GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University)

VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A++ Grade

GITAM School of Technology

CURRICULUM AND SYLLABUS

4 Year Undergraduate Programme
UCSEN05: B. Tech. Computer Science and Engineering (Data Science)

w.e.f. 2023-24 admitted batch

(Updated on 31st July 2023)

Academic Regulations

Applicable for the Undergraduate Programmes in the Schools of Business, Humanities & Social Sciences, Science, Technology

https://www.gitam.edu/academic-regulations

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

Quality Policy

To achieve global standards and excellence in teaching, research, and consultancy by creating an environment in which the faculty and students share a passion for creating, sharing and applying knowledge to continuously improve the quality of education.

UCSEN05: B.Tech. Computer Science and Engineering (Data Science)

VISION AND MISSION OF THE SCHOOL

VISION

To become a global leader in holistic engineering education and research

MISSION

1. To impart a strong academic foundation and practical education through a flexible curriculum, state-of-the-art infrastructure, and best learning resources
2. To actively pursue academic and collaborative research with industries and research institutions, both in India and abroad
3. To build a congenial and innovative eco system by enabling the latest technologies, thus helping the students, to solve the challenges of societal importance
4. To provide our students with the appropriate leadership, management, communication skills and professional ethics for career success and to continuously impact the global lives

UCSEN05: B.Tech. Computer Science and Engineering

(Data Science)

(w.e.f. academic year 2023-24 admitted batch)

Programme Educational Objectives (PEOs)

PEO 1 The graduates will demonstrate proficiency in Data Science leading to successful careers as Data Scientists

PEO 2 The graduates will exhibit commitment to developing sustainable solutions that satisfy the current societal needs.

PEO 3 The graduates will adapt to and aid in technological advances by life-long learning and innovation.

Mapping of the Mission of the School with the PEOs

	PEO1	PEO2	PEO3
M1	H	M	L
M2	H	M	H
M3	M	L	M
M4	H	M	M

H – High, M – Medium, L – Low

Programme Outcomes (POs) and Programme Specific Outcomes (PSOs):

At the end of the Programme the students would be able to:

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1	Identify, formulate and solve engineering problems to provide efficient solutions.
PSO2	Design and develop computer-based applications of varying complexities in emerging areas of Computer Science and Engineering.
PSO3	Apply the principles and techniques of mathematical and statistical models for data analysis to extract the insights in supporting business and scientific processes.

Curriculum Structure

(Flexible Credit System)

UNIVERSITY CORE (UC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Soft Skills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Soft Skills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Soft Skills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)	0	0	2	0	0	1
CLAD20XX	2	Soft skills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Soft skills 6A/6B/6C	0	0	2	0	0	1
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*
LANG1012	1	Communication Skills in English – Intermediate	0	0	4	0	0	2
LANG1022	1	Communication Skills in English – Advanced	0	0	4	0	0	2
MFST1001	1	Health and Wellbeing#	0	0	2	0	0	1*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
VEDC1001	1	Venture Development	0	0	0	2	0	2

* Pass/Fail courses
# Opt any two courses among the five
^ Online/Swayam/NPTEL Courses

Soft skills courses 5 and 6								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CLAD2001	2	Preparation for Campus Placement-1 (Soft skills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation for Higher Education (GRE/ GMAT)-1 (Soft skills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT – 1 (Soft skills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation for Campus Placement-2 (Soft skills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation for Higher Education (GRE/ GMAT)-2 (Soft skills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT – 2 (Soft skills 6C)	0	0	2	0	0	1

Sports Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

Club Activity Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1001	1	Club Activity (Participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of the Club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of the Club)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2

Community Service courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1041	1	Community Services – Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services – Mobilizer	0	0	0	0	2	2

FACULTY CORE (FC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CHEM1001	1	Chemistry	2	1	2	0	0	4
CSEN1011	1	Problem Solving and Programming with C	0	0	6	0	0	3
CSEN1021	1	Programming with Python	0	0	6	0	0	3
CSEN1031	1	Artificial Intelligence Applications	0	0	2	0	0	1
EECE1001	1	Basic Electrical and Electronics Engineering	2	1	2	0	0	4
HSMCH102	1	Universal Human Values	3	0	0	0	0	3
INTN2333	2	Internship 1	0	0	0	0	1	1
INTN3444	3	Internship 2	0	0	0	0	1	3
MATHXXXX	X	Mathematics Basket 1	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 2	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 3	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 4	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 5	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 6	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
MECH1011	1	Engineering Visualization and Product Realization	0	0	4	0	0	2
MECH1021	1	Workshop	0	0	2	0	0	2
MECH1001	1	Design Thinking	0	0	2	0	0	1
PHYS1001	1	Physics	2	1	2	0	0	4
PHYSXXXX	1	Physics Basket	3	1	0	0	0	4
PROJ2999	2	Capstone Project – Introduction	0	0	0	0	2	2
PROJ3999	3	Capstone Project – Final	0	0	0	0	6	6
PROJ2888	2	Project Exhibition 1	0	0	0	0	1	1
PROJ3888	3	Project Exhibition 2	0	0	0	0	1	1
VIVA3555	3	Comprehensive Examination	1	0	0	0	0	1
XXXXXXXX	X	Management Basket	3	0	0	0	0	3
BTEN1001	1	Introduction to Biotechnology-I	2	0	0	0	0	2
BTEN1021	1	Introduction to Biotechnology-II	2	0	0	0	0	2

Mathematics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH1001	1	Single Variable Calculus	2	0	0	0	0	2
MATH1011	1	Several Variable Calculus	2	0	0	0	0	2
MATH2371	2	Difference Equations	2	0	0	0	0	2
MATH1031	1	Differential Equations	2	0	0	0	0	2
MATH2281	2	Numerical techniques	2	0	0	0	0	2
MATH1021	1	Transform Techniques	2	0	0	0	0	2
MATH2381	2	Operations Research	2	0	0	0	0	2
MATH2301	2	Complex Variables	2	0	0	0	0	2
MATH1041	1	Discrete Mathematics	2	0	0	0	0	2
MATH1051	1	Graph Theory	2	0	0	0	0	2
MATH2311	2	Number Theory	2	0	0	0	0	2
MATH2291	2	Linear Algebra	2	0	0	0	0	2
MATH2341	2	Probability Theory and Random Variables	2	0	0	0	0	2
MATH2321	2	Random Processes	2	0	0	0	0	2
MATH2351	2	Optimization Methods	2	0	0	0	0	2
MATH2331	2	Computational Methods	2	0	0	0	0	2
MATH1061	1	Introduction to Mathematics – I	2	0	0	0	0	2
MATH1071	1	Introduction to Mathematics – II	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
Physics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
PHYS1001	1	Physics	2	1	2	0	0	4
PHYS1011	1	Mechanics and Properties of Matter	3	1	0	0	0	4
PHYS1021	1	Principles of Quantum Mechanics	3	1	0	0	0	4
PHYS1031	1	Physics of Semi Conducting devices	3	1	0	0	0	4
PHYS1041	1	Mechanics and Modern Physics	3	1	0	0	0	4
Management Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
FINA1031	1	Principles and Practice of Banking	3	0	0	0	0	3
HRMG1021	1	Human Resource Management	3	0	0	0	0	3
MKTG3011	3	Sales and Distribution Management	3	0	0	0	0	3

Programme Core (PC)								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
CSEN1041	1	Computer Engineering Workshop	0	0	2	0	0	1
CSEN1051	1	Digital Logic Circuits	2	1	0	0	0	3
CSEN1071	1	Data Communications	2	0	0	0	0	2
CSEN1101	1	Operating Systems	3	0	2	0	0	4
CSEN1111	1	Object Oriented Programming with Java	0	0	4	0	0	2
CSEN2001	2	Data Structures	3	0	2	0	0	4
CSEN2011	2	Computer Organization and Architecture	2	1	0	0	0	3
CSEN2021	2	Computer Networks	3	0	2	0	0	4
CSEN2031	2	Artificial Intelligence	3	0	2	0	0	4
CSEN2061	2	Database Management Systems	3	0	2	0	0	4
CSEN2081	2	Data Visualization and exploration with R	3	0	2	0	0	4
CSEN2091	2	OOSE based Application Development	3	0	2	0	0	4
CSEN3001	3	Design and Analysis of Algorithms	3	0	0	0	0	3
CSEN3011	3	Artificial Neural Networks	3	0	2	0	0	4
CSEN3061	3	Automata Theory and Compiler Design	3	0	0	0	0	3
CSEN3082	3	Deep Learning	2	1	0	0	0	3

Programme Elective (PE)								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
CSEN1131	1	Software Engineering	3	0	2	0	0	4
CSEN1151	1	Fundamentals of E-Commerce	3	0	0	0	0	3
CSEN2051	2	Sensor Technology and Instrumentation	3	0	0	0	0	3
CSEN2071	2	Cryptography and Network Security	3	0	0	0	0	3
CSEN2101	2	Internet of Things	2	0	2	0	0	3
CSEN2111	2	Agile Software Development	3	0	0	0	0	3
CSEN2121	2	Cloud Computing	3	0	0	0	0	3
CSEN2131	2	Computer Graphics	3	0	0	0	0	3
CSEN2141	2	Data Analytics: Descriptive, Predictive, Prescriptive	3	0	0	0	0	3
CSEN2151	2	E-Commerce	3	0	0	0	0	3
CSEN2161	2	Introduction to Data Science	2	1	0	0	0	3
CSEN2171	2	loT Hardware	3	0	0	0	0	3
CSEN2181	2	Programming Mobile Applications	3	0	0	0	0	3
CSEN3021	3	Microcontrollers and Applications	3	0	2	0	0	4
CSEN3041	3	Ethical Hacking	3	0	2	0	0	4

CSEN3051	3	Wireless Sensor Networks	3	0	0	0	0	3
CSEN3071	3	Web Application Development and Software Frameworks	3	0	2	0	0	4
CSEN3091	3	Digital Forensics	3	0	2	0	0	4
CSEN3101	3	Big Data Analytics	2	1	0	0	0	3
CSEN3121	3	Adhoc and Sensor Networks	3	0	0	0	0	3
CSEN3131	3	Advanced Computer Architecture	3	0	0	0	0	3
CSEN3141	3	Advanced Computer Networks	3	0	0	0	0	3
CSEN3151	3	Advanced Data Structures	2	1	0	0	0	3
CSEN3161	3	Advanced Operating Systems	3	0	0	0	0	3
CSEN3171	3	Advances in Internet of Things	3	0	0	0	0	3
CSEN3181	3	Android Security Internals	3	0	0	0	0	3
CSEN3191	3	Cyber Security	3	0	0	0	0	3
CSEN3201	3	Data Warehousing and Mining	2	1	0	0	0	3
CSEN3211	3	Design Patterns	3	0	0	0	0	3
CSEN3221	3	Distributed Systems	3	0	0	0	0	3
CSEN3231	3	Image Processing	2	1	0	0	0	3
CSEN3241	3	Information Retrieval Systems	2	1	0	0	0	3
CSEN3251	3	Introduction to Pattern Recognition and Machine Learning	2	1	0	0	0	3
CSEN3261	3	Machine Learning and its Applications	3	0	2	0	0	4
CSEN3271	3	Parallel Computing	3	0	0	0	0	3
CSEN3281	3	Secure Software Engineering	3	0	0	0	0	3
CSEN3291	3	Software Metrics	3	0	0	0	0	3
CSEN3301	3	Software Requirements Management	3	0	0	0	0	3
CSEN3311	3	Software Testing Methodologies	3	0	0	0	0	3
CSEN3321	3	Threat Intelligence	3	0	0	0	0	3
CSEN3331	3	Machine Learning Techniques and Applications	3	0	0	0	0	3
CSEN3341	3	Programming Languages	3	0	0	0	0	3
CSEN3351	3	Building a Modern Computer from First Principles	3	0	0	0	0	3
CSEN4001	4	IoT Architectures and Protocols	3	0	2	0	0	4
CSEN4011	4	Cloud Based IoT	3	0	2	0	0	4
CSEN4021	4	Augmented Reality -Virtual Reality- Basic	3	0	0	0	0	3
CSEN4031	4	Block Chain Technology	3	0	0	0	0	3
CSEN4041	4	Cloud Security	3	0	0	0	0	3
CSEN4051	4	Edge Computing	3	0	0	0	0	3
CSEN4061	4	Energy Management for IoT devices	3	0	0	0	0	3

CSEN4071	4	Fundamentals of IOS security	3	0	0	0	0	3
CSEN4081	4	Game Programming	3	0	0	0	0	3
CSEN4091	4	Human Computer Interaction	3	0	0	0	0	3
CSEN4101	4	Information Security	3	0	0	0	0	3
CSEN4111	4	Intrusion Detection and Prevention Systems	3	0	0	0	0	3
CSEN4121	4	IoT for Industries	3	0	0	0	0	3
CSEN4131	4	IoT Security	3	0	0	0	0	3
CSEN4141	4	Natural Language Processing	3	0	0	0	0	3
CSEN4151	4	Operating System Security	3	0	0	0	0	3
CSEN4161	4	Security for Cyber Physical systems	3	0	0	0	0	3
CSEN4171	4	Social Network Analysis	2	1	0	0	0	3
CSEN4181	4	Software Defined Networks	3	0	0	0	0	3
CSEN4191	4	Web Application Security	3	0	0	0	0	3
CSEN4201	4	Augmented Reality – Virtual Reality – Intermediate	3	0	0	0	0	3
24CSEN4061	4	Graph Data Analytics	3	0	0	0	0	3
24CSEN4111	4	Security Operations Management	3	0	0	0	1	4
19ECF446	4	Cyber Law and IT Protection	2	1	0	0	0	3
# Opt eligible PC/PE courses from other programmes as an open elective course and earn 24 credits								

PROGRAMME STRUCTURE

BTech Programme consists of courses which could be grouped under University Core (UC), Faculty Core (FC), Major/Programme Core (PC), Major/Programme Electives (PE) and Open Electives (OE) as the below breakup.

Category	Credits	% of Program (in credits)
University Core (UC)	12	8%
Faculty Core (FC)	57	35%
Programme Core (PC)	52	33%
Programme Electives (PE)	15	9%
Open Electives (OE)	24	15%
Total	**160**	

Courses offered under University Core are common to all undergraduate level programmes offered by GITAM. Courses offered under Faculty core are common to all BTech programmes offered by GITAM and are meant to acquaint the student with general engineering principles in all disciplines of engineering. Based on the chosen BTech Programme, the student shall complete courses under Programme Core (specific to be chosen branch of engineering).

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. In general,

- **Theory:** A student attending classroom lecture/ tutorial/ skill development activity of 50 minutes' duration per week, spread over the entire semester is awarded one credit.
- **Practical:** A student attending a minimum of 100 minutes per week of laboratory session/ practical is awarded - one credit.
- **Project Work:** A student working for 50 minutes of project work per week with 3 hours of work performed independent of the instructor during the entire semester is awarded - one credit
- **Internship:** 8 hours in a day for four weeks is required for earning internship credits

Syllabus

University Core

CSEN1001	IT Productivity Tools	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Description:

This course introduces all software tools that improve the productivity of a student in enhancing his learning experience with all the activities taken up as part of his coursework.

Course Educational Objectives:

- To enable the learner, the skill in preparing technical documents of professional quality using docs, sheets and forms.
- To involve the student in designing and creating of websites and acquaint the student with the skill of processing audio, images, documents etc.
- To create awareness in analyzing data using pivot tables, query manager etc.
- To create awareness in composing emails, mail merge, e-mail merge etc.
- To provide the exposure to work with collaborative tools.

List of Experiments:

1. Create a typical document consisting of text, tables, pictures, multiple columns, with different page orientations.
2. Create a technical paper / technical report consisting of table of contents, table of figures,table of tables, bibliography, index, etc.
3. Compose and send customized mail / e-mail using mail-merge.
4. Create / modify a power point presentation with text, multimedia using templates withanimation.
5. Create spreadsheet with basic calculations with relative reference, absolute reference, andmixed reference methods.
6. Simple report preparation using filtering tool / advanced filtering commands / pivot tables in spreadsheet application.
7. Analyse the results of a examination student wise, teacher wise, course wise, institute-wise.
8. Collecting and consolidating data using collaborative tools like google docs, sheets, forms.
9. Create charts / pictures using online tools like: www.draw.io or smart draw
10. Create a website of his interest.

Textbooks:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More
3. https://drawio-app.com/tutorials/video-tutorials/
4. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and WebGraphics Fourth Edition ISBN-13: 978-1449319274

References/Online Resources:

1. https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software
2. https://www.coursera.org/projects/analyze-data-pivot-tables-crosstabs-google-sheets
3. https://www.coursera.org/learn/excel-advanced#syllabus
4. https://www.coursera.org/learn/how-to-create-a-website
5. https://support.microsoft.com/en-us/office
6. https://www.diagrams.net/
7. https://edu.google.com/

Course Outcomes:

1. Create / alter documents / Technical Paper / Project report with text, pictures, graphs ofdifferent styles.
2. Create / modify power point presentations with text, multimedia and to add animationusing / creating templates.
3. Perform basic calculations / retrieve data / createpivot tables / chart using a spreadsheetapplication.
4. Create simple diagrams / charts using online tools like: www.draw.io .
5. Manage documents, presentations, spreadsheets and websites in collaborative mode.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1					2				1	1					
CO2					2				1	1					
CO3	2	1	1		2				1	1					
CO4					2				1	1					
CO5					2				3	3					

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The students can perform simple document preparation to complex calculations in isolated mode and collaborative mode that are useful throughout their career.

<table>
<tr><td rowspan="2">CLAD1001</td><td rowspan="2">EMOTIONAL INTELLIGENCE & REASONING SKILLS (SOFT SKILLS 1)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Emotional intelligence is a set of skills that are thought to contribute to the appraisal of emotions in oneself and others. It can also help contribute to the effective regulation of emotions as well as feelings (Salovey & Mayer, 1990). In terms of emotional intelligence, self-awareness and self- management have to do with our ability to relate to ourselves. Social awareness and relationship management have to do with our ability to relate to others. Similarly, the ability to solve questions on Analytical Reasoning and Data Sufficiency is a critical area tested in almost all competitive examinations and admission tests. Upon completion, students should be able (1) to deal with theirown emotions as well as the emotions of others and relate better with both. Using better knowledgeof EI, students will also be able to set more meaningful goals for themselves, choose suitable time management techniques that work best for them and work in teams more effectively. (2) to apply different concepts, ideas, and methods to solve questions in reasoning and data sufficiency

Course Educational Objectives:

- Use EI to relate more effectively to themselves, their colleagues and to others. Apply self-awareness and self-assessment (SWOT) to better understand and manage their own emotions. Apply social awareness to empathize with others and build stronger relationships with others.
- Set meaningful goals based on their strengths and weaknesses and apply time management techniques, such as Q4 organizing to put first things first.
- Manage conflicts and work in teams in an emotionally intelligent manner.
- Solve questions on non-verbal and analytical reasoning, data sufficiency and puzzles

List of Activities & Tasks for Assessment:

Unit	Topics	Hours
1	Self-Awareness & Self-Regulation: Introduction to Emotional Intelligence, *Self-Awareness:* Self-Motivation, Accurate Self-Assessment (SWOT Analysis),Self-Regulation: *Self Control, Trustworthiness & Adaptability*	3
2	Importance, Practising Social Awareness, Building Relationships, Healthy andUnhealthy Relationships, Relationship Management Competencies-Influence, Empathy, Communication, Types of Conflicts, Causes, Conflict Management	3

3	Social Media: Creating a blog, use of messaging applications, creating awebsite to showcase individual talent, creation of a LinkedIn Profile	2
4	Goal Setting & Time Management: Setting SMART Goals, Time Wasters, Prioritization, Urgent Vs Important, Q2 Organization	3
5	Teamwork: Team Spirit, Difference Between Effective and Ineffective Teams, Characteristics of High Performance Teams, Team Bonding, Persuasion, Team Culture, Building Trust, Emotional Bank Account	4
6	Verbal Reasoning: Introduction, Coding-decoding, Blood relations, Ranking Directions, Group Reasoning	6
7	Analytical Reasoning: Cubes and Dices, Counting of Geometrical figures	3
8	Logical Deduction: Venn diagrams, Syllogisms, Data Sufficiency, Binary logic	4
9	Spatial Reasoning: Shapes, Paper Cutting/Folding, Mirror images, Water images and Rotation of figures	2

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to relate more effectively to themselves, their colleagues and to others
2. Students will be able to set their short term and long term goals and better manage their time
3. Students will be able to manage conflicts in an emotionally intelligent manner and work inteams effectively
4. Students will be able to solve questions based on non-verbal and analytical reasoning, datasufficiency and puzzle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	3		2			
CO2	2	2	2	3	2	1	2		3	3		3			
CO3	2		2	3					3	2	2	2			
CO4	2	2	2	3		1					2	3			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-201**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Emotional Intelligence and reasoning skills are essential for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD1011	LEADERSHIP SKILLS & QUANTITATIVE APTITUDE (SOFT SKILLS 2)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Communication Skills is having the ability to convey information to others so that messages are understood, and outcomes delivered. Some essential qualities of Communication Skills include understanding the needs of others, clearly communicating messages, adapting the communication style, and using a range of communication methods. Presentation Skills is having the ability to confidently deliver an engaging messageto a group of people which achieves the objectives. Some essential qualities of Presentation Skills include a thorough preparation of content, structuring content logically, managing nerves, engaging your audience, delivering presentation objectives, positively influencing the audience, and responding to audience needs.Tackling questions based on numbers, arithmetic, data interpretation and puzzles requires the application of different rules and concepts of numerical computation, numerical estimation, and data estimation.

Course Educational Objectives:

- Learn and apply, through different individual and group activities, different ideas, and skills tocommunicate in a positive and impressive manner.
- Apply the goal setting process (based on SWOT) and Q2 organizing for effective time management.
- Apply different concepts in numbers, numerical computation, and numerical estimation to solvequestions that often appear in various competitive examinations and admission tests.
- Apply different concepts for tackling questions based on data interpretation, progression and series thatare frequently given in various competitive examinations and admission tests.

List of Activities & Tasks for Assessment:

Unit	Topics	Hours
1	Communication Skills: The Communication Process, Elements of Interpersonal Communication, Non-Verbal Communication: Body Language, Posture, Eye Contact, Smile, Tone of Voice, Barriers to Communication. Effective Listening Skills: Active Listening, Passive	5

	Listening, Asking Questions, Empathizing, Being Non-Judgmental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations	
2	Focus on Audience Needs, focus on the Core Message, Use Body Language andVoice, Start Strongly, Organizing Ideas & Using Visual Aids: SPAM Model, EffectiveOpening and Closing Techniques, Guy Kawasaki's Rule (10-20-30 Rule), Overcoming Stage Fear, Story Telling	3
3	Problem Solving & Decision Making: Difference Between the Two, Steps in RationalApproach to Problem Solving: Defining the Problem, Identifying the Root Causes, Generating Alternative Solutions, Evaluating and Selecting Solutions, Implementingand Following-Up, Case Studies	3
4	Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, structuring a Response, Methods of Generating Fresh Ideas	4
5	Number Theory: Number System, Divisibility rules, Remainders and LCM & HCF	3
6	Numerical Computation and Estimation - I: Chain Rule, Ratio Proportions, Partnerships & Averages, Percentages, Profit-Loss & Discounts, Mixtures, Problem on Numbers & ages	6
7	Data Interpretation: Interpretation and analysis of data in Tables, Caselets, Line- graphs, Pie-graphs, Boxplots, Scatterplots and Data Sufficiency	3
8	Mental Ability: Series (Number, Letter and Alphanumeric), Analogy (Number, Letter and Alphanumeric) and Classifications	3

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
2. Students will be able to apply the rational model of problem solving and decision makingin their problem solving and decision-making efforts.

3. Students will be able to solve questions based on numbers and arithmetic given in various competitive examinations
4. Students will be able to solve questions based on data interpretation, progressions, and series.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2			2	3		2			
CO2	2	2	3	2		3	3		3	3		2			
CO3	2	2	2	2		2						3			
CO4	2	2	2	2		2									
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Leadership and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD1021	VERBAL ABILITY & QUANTITATIVE ABILITY (SOFT SKILLS 3)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Vocabulary is an important part of verbal ability. An understanding of word formation, prefixes, suffixes, and roots is necessary to remember and use a vast repository of words. Approaching words through word families and other ways of groupings is an effective way of gaining mastery over vocabulary. Understanding and getting acquainted with the different rules and exceptions in the use of grammar and structure, especially from the relevant examination point of view, is crucial to cracking questions given in many competitive tests. Similarly, improving reading comprehension skills and test taking abilities in this area takes time and effort, especially given the fact that most students do not possess strong reading habits. In so far as quantitative aptitude is concerned, students need to develop a strong foundation on the basic mathematical concepts of numerical estimation, geometry, mensuration, data sufficiency, etc. to be able to crack different round 1 tests of major recruiters and admission tests of top Indian and foreign universities.

Course Educational Objectives:

- List and discuss the different word formation methods, word denotation, connotation, collocation, etc. and introduce selected high frequency words, their antonyms, synonyms, etc.
- Apply different advanced reading skills to solve questions based on author's tone, main ideas and sub-ideas, inferences, Para jumbles, etc. that are frequently asked in various competitive exams and admission tests.
- Solve different types of questions based on vocabulary, such as word analogy; structure, grammar, and verbal reasoning; introduce common errors and their detection and correction.
- Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude. This includes questions on time and work, time and distance, pipes and cisterns, lines and angles, triangles, quadrilaterals, polygons and circles, 2- & 3-dimensional mensuration.

List of Activities & Tasks for Assessment:

1. **Vocabulary Builder:** Understanding Word Formation, Prefixes, Suffixes and Roots, Etymology, Word Denotation, Connotation and Collocation, Synonyms and Antonyms

2. **Reading Comprehension:** Advanced Reading Comprehension: Types of RC passages, Types of Text Structures, Types of RC Questions: Distinguishing Between Major Ideas and Sub Ideas, Identifying the Tone and Purpose of the Author, Reading Between the Lines and Beyond the Lines, Techniques for Answering Different Types of Questions
3. **Para Jumbles:** Coherence and Cohesion, Idea Organization Styles, Concept of Mandatory Pairs and Its Application: Transitional Words, Antecedent-Pronoun Reference, Article Reference, Cause and Effect, Chronological Order, General to Specify, Specify to General, Idea-Example, Idea-Explanation, Etc.
4. **Grammar Usage:** Rules Governing the Usage of Nouns, Pronouns, Adjectives, Adverbs, Conjunctions, Prepositions and Articles
5. **Numerical Computation and Estimation - II:** Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Races and Games of Skill, Simple Interest& Compound Interest
6. **Geometry:** Lines and Angles, Triangles, Quadrilaterals & Polygons, and Circles
7. **Mensuration:** 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), 3-Dimensional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. List and discuss word formation methods, selected high frequency words, their antonyms, synonyms, etc.
2. Analyze reading passages and quickly find out the correct responses to questions asked, including para jumbles, by using reading skills like skimming, scanning, reading between the lines, etc.
3. Solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		2			
CO2				2		2				2		3			
CO3									1	2		3			
CO4	2	2	3			2						1			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD1031	PRACTICING VERBAL ABILITY & QUANTITATIVE APTITUDE (SOFT SKILLS 4)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

A sound knowledge of the rules of English grammar, structure and style and its application in detecting errors in writing are important areas of Verbal Ability frequently tested as a part of the written test in many competitive examinations and admission tests of major recruiters and universities respectively. This module focuses on all important areas of grammar and structure commonly asked in major tests, such as GMAT, CAT, XLRI, CRT, etc. Similarly, in the area of Quantitative Aptitude, different kinds of questions are asked from Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7), and Mental Ability (Number series, Letter series & Alpha numeric series, Analogies (Numbers, letters), Classifications, Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, and Statistics) . This module focuses on all these areas by building on what the students already learnt in their earlier studies.

Course Educational Objectives:

- Apply the rules of grammar to solve questions in Error Detection, Sentence Correction and Sentence Improvement.
- Apply the rules of structure to solve questions in Error Detection, Sentence Correction and Sentence Improvement, Fill-in-blanks and Cloze Passages.
- Explain methods of solving problems in Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of basesystem (7, 24), Clocks (Base 24), Calendars (Base 7)]
- Explain how to solve questions in Mental Ability (Number series, Letter series & Alpha numeric series, Analogies, Numbers, letters, Classifications] and Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, Statistics)

List of Activities & Tasks for Assessment:

1. Error Detection: Pronouns, Conjunctions, Prepositions and Articles
2. Error Detection: Tenses and their Uses
3. Sentence Correction: Subject-Verb Agreement, Antecedent-Pronoun Agreement, Conditional Clauses
4. Sentence Correction: Modifiers (Misplaced and Dangling) & Determiners, Parallelism & WordOrder, and Degrees of Comparison
5. Combinatorics: Permutations & Combinations, Probability

6. Crypt arithmetic & Modular Arithmetic: Crypt arithmetic, Application of Base System (7, 24),Clocks (Base 24), Calendars (Base 7)
7. Algebra: Exponents, Logarithms, Word-problems related to equations, Special Equations,Progressions, Statistics

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Identify and correct errors in English grammar and sentence construction
2. Identify and correct errors in Structure, Style and Composition
3. Solve problems in Combinatorics, Cryptarithmetic, and Modular Arithmetic
4. Solve problems in Mental Ability and Algebra

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		1			
CO2									1	3		1			
CO3		2	3	2		2						2			
CO4		3	2	2		2						2			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2001	PREPARATION FOR CAMPUS PLACMENT -1 (SOFT SKILLS 5A)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course addresses all relevant areas related to campus placements and readies them to ace their upcoming/ ongoing recruitment drives. Specifically, it focuses on students' career preparedness, interview skills, test preparedness, etc.

Course Educational Objectives:

Prepare the students for their upcoming/ ongoing campus recruitment drives.

List of Activities & Tasks for Assessment:

1. Career Preparedness: Resume & Cover Letter Writing, Interview Skills: Elevator Pitch, Making the First Impression, Being Other-Oriented, Being Positive and Curious, communicating with Confidence and Poise, Frequently Asked Questions & How to Answer Them, Pitfalls to Avoid, Etc. Etiquette: Hygiene, Courtesy, Culture differences, Workplace, use of cell phone, Profanity, Slang, Protocol.
2. Verbal Ability: Practicing Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning.
3. Quantitative Aptitude: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems
4. Reasoning: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Write a power resume and covering letter
2. Answer interview questions with confidence and poise
3. Exhibit appropriate social mannerisms in interviews
4. Solve placement test questions on verbal ability, quantitative aptitude and reasoning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		1			
CO2						3			2			1			
CO3						2			1	3		3			
CO4		3		2		2			1			3			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2011	PREPARATION FOR HIGHER EDUCATION (GRE/ GMAT)-1 (SOFT SKILLS 5B)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning: Reading Comprehension, Sentence Equivalence, TextCompletion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment: Issue/ Argument
4. Integrated Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	2					3			3			
CO2		2	2	2					3			3			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2021</td><td rowspan="2">PREPARATION FOR CAT/ MAT – 1
(SOFT SKILLS 5C)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests and includes fully solved mock testsas well.

Course Educational Objectives:

- Prepare the students to solve questions from all four relevant areas of CAT/ XAT/MAT, etc.
- Orient the students for CAT/ XAT, etc. through mock tests

List of Activities & Tasks for Assessment:

1. Quantitative Ability: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation: Data Interpretation and Data Sufficiency
3. Logical Reasoning: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher andIMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2		2			3	3	3	3			
CO2	2	2	2	2		1			2		2	3			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2031	PREPARATION FOR CAMPUS PLACEMENT-2 (SOFT SKILLS 6A)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course builds on the previous course and focuses on all four major areas of campus placements, including career preparedness, mock interviews, verbal ability, quantitative aptitude, and logical reasoning.

Course Educational Objectives:

- To comprehensively prepare all eligible and aspiring students for landing their dream jobs.
- To sharpen the test-taking skills in all four major areas of all campus drives

List of Activities & Tasks for Assessment:

1. Career Preparedness II: Mock Interviews, Feedback and Placement Readiness
2. Verbal Ability II: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning
3. Quantitative Aptitude II: Number Systems, Algebra, Geometry, Data Handling,Data Sufficiency, Word Problems
4. Reasoning II: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Demonstrate career preparedness and confidence in tackling campus interviews
2. Solve placement test questions of a higher difficulty level in verbal ability, quantitative aptitude and logical reasoning.
3. Practice test-taking skills by solving relevant questions accurately and within time.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									2	3		2			
CO2	2	2	2	3		3			2	2	3	2			
CO3	2	2	2	3		2			1		2	3			
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2041	PREPARATION FOR HIGHER EDUCATION (GRE/GMAT)-2 (SOFT SKILLS 6B)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of theirhigher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests at a higher difficulty-level and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve higher level questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning II: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning II: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment II: Issue/ Argument
4. Integrated Reasoning II

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher level questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3		2			2	2	2	2			
CO2		2		2		2			2	2	2	2			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2051	PREPARATION FOR CAT/ MAT – 2 (SOFT SKILLS 6C)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests at a higher level of difficulty and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve all types of questions from all four relevant areas of CAT/ XAT/ MAT, etc.

List of Activities & Tasks for Assessment:

1. Quantitative Ability II: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation II: Data Interpretation and Data Sufficiency
3. Logical Reasoning II: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability II: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher difficulty level questions from all four relevant areas of CAT/ MAT aslisted above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		3					3	3	3	2			
CO2	1	2		2					2	3	2	2			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

DOSL1001	CLUB ACTIVITY – PARTICIPANT	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course recognizes student participation in multiple activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to engage in and identify and pursue their personal interests and hobbies.

Course Educational Objectives:

- Create opportunities for students to participate in a variety of non-academic experiences
- Interact with and learn from peers in a setting without an external performance pressure
- Allow exploration of interesting activities and reflection about these experiences
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Participation in various club-based activities
2. Weekly reflection paper
3. Portfolio (on social media using an Instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. YouTube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Identify personal interest areas
2. Learn from diverse perspectives and experiences
3. Gain exposure to various activities and opportunities for extra-curicular activities
4. Learn to manage time effectively
5. gain confidence

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	2	3	2			
CO2									3	3		2			
CO3									3	3	2	3			
CO4									3	3		3			
CO5								3	3	3		2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

This course recognizes student participation in non-academic events and activities which focus on inclusive partnerships and collaborations with all stakeholders by using all sustainable means to promote lifelong learning.

<table>
<tr><td rowspan="2">DOSL1011</td><td rowspan="2">CLUB ACTIVITY – MEMBER OF THE CLUB</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course encourages and acknowledges student members' work in organizing events and activities organized by various student organizations that pursue specific co-curricular and extra- curricular interests. These activities allow students to actively learn from the process of conceptualizing and organizing such activities as part of a team.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be a member of a club and organize activities in that particular interest area
2. Learn from diverse perspectives and experiences
3. Learn to design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be a member of a club and organize activities in that particular interest area
- Learn from diverse perspectives and experiences
- Learn to design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1021	CLUB ACTIVITY – LEADER OF THE CLUB	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students(Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1031	CLUB ACTIVITY – COMPETITOR	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1041	COMMUNITY SERVICES - VOLUNTEER	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course recognizes student participation in Community service activities organized by various student organizations and other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students develop empathy and citizenship behavior
- Enable students to develop an altruistic attitude and community development sensibility
- Allow exploration of community service activities and reflect about these experiences
- Learn to work in small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Participation in various community service activities
2. Weekly reflection paper

3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)

Course Outcomes:

1. Experience of volunteering in a variety of Community service activities
2. Gaining empathy for lesser privileged sections of society by experience
3. Understanding the process of generating community awareness
4. Understanding Disaster management and relief through training and experience
5. Developing environmental and sustainability awareness

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

<table>
<tr><td rowspan="2">DOSL1051</td><td rowspan="2">COMMUNITY SERVICES - MOBILIZER</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course recognizes student leadership in mobilizing community service activities as members of various student organizations or other Government and non-government organizations that existfor providing service to communities. These activities allow students to develop leadership, management skills, empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students understand leadership in a community environment
- Enable students to develop an altruistic attitude and community development sensibility
- Allow deep understanding of community service through practical experience
- Learn to lead small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper

3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and other Government and non- government community service organizations

Course Outcomes:

1. Experience of mobilizing and executing Community service activities
2. Providing opportunities for community service volunteering for other fellowstudents
3. Understanding the process of mobilizing cash, kind and volunteer support
4. Building leadership and management skills
5. Building empathy and citizenship behavior

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSP1001	BADMINTON	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Badminton - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Badminton: Grips - Racket, shuttle
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Badminton Gameplay: Service, Forehand, Backhand
7. Preparatory Drills and Fun Games
8. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the Badminton World Federation (BWF)

Course Outcomes:

1. Learn to play Badminton
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1011	CHESS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Chess - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Chess: Pieces & functions, basic play
4. Chess board moves & terminology
5. Chess Gameplay: Openings, castling, strategies & tactics
6. Preparatory Drills and Fun Games
7. Game Variations & Officiating

References:

1. International Chess Federation (FIDE) Handbook

Course Outcomes:

1. Learn to play Chess
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1021	CARROM	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Carrom - History and development
2. Rules of the Game, Board components & dimensions
3. Fundamental Skills - Carrom: - Striking
4. Gameplay – General
5. Preparatory Drills and Fun Games
6. Game Variations: Singles/ Doubles/ Mixed
7. Preparatory Drills and Fun Games

References:

1. Indian Carrom Federation Handbook - Laws

Course Outcomes:

1. Learn to play Carrom
2. Understanding of the fundamental concepts such as rules of play, game variations

3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1031	FOOTBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Football - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Kicking, heading, ball control, Keeping
4. Movement, throwins, tackling, defense, scoring, defense
5. Gameplay- Formations, passing, FKs, CKs, PK, tactics
6. Preparatory Drills and Fun Games
7. Game Variations: Small sided games, 7v7, 11v11

References:

1. FIFA Laws of the Game

Course Outcomes:

1. Learn to play Football
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1041	VOLLEYBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Volley - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Striking, Ball control, Lifting
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Jumps, strikes, layoffs, attack, defense

References:

1. FIVB - Official Volleyball Rules

Course Outcomes:

1. Learn to play Volleyball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1051	KABADDI	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kabaddi - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Raiding, catching
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Chain system movement

References:

1. Amateur Kabaddi Federation of India (AKFI) - Official Rules
2. Rules of Kabaddi - International Kabaddi Federation

Course Outcomes:

1. Learn to play Kabaddi
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1061	KHO KHO	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kho Kho - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills: Sitting, giving Kho, Pole dive
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Running, sitting
6. Gameplay: Running strategies, ring method, chain method
7. Preparatory Drills and Fun Games

References:

1. Khelo India Official Rulebook of Kho Kho

Course Outcomes:

1. Learn to play Kho Kho
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1071	TABLE TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Table Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - TT: Grips - Racket, ball
4. Stances and footwork
5. TT Gameplay- Forehand, Backhand, Side Spin, High Toss. Strokes-Push, Chop, Drive, Half Volley, Smash, Drop-shot, Balloon, Flick, Loop Drive.
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Table Tennis Federation (ITTF)

Course Outcomes:

1. Learn to play Table Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

<table>
<tr><td rowspan="2">DOSP1081</td><td rowspan="2">HANDBALL</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Handball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Handball: Throwing, Ball control, Movement
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Gameplay: Shots, throws, movements, attack, defense
7. Preparatory Drills and Fun Games

References:

1. International Handball Federation - Rules of the Game & Regulations

Course Outcomes:

1. Learn to play Handball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1091	BASKETBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Basketball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Passing, Receiving, Dribbling
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, attack, defense

References:

1. FIBA Basketball Official Rules

Course Outcomes:

1. Learn to play Basketball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1101	TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Tennis: Grips - Racket, ball
4. Stances and footwork
5. Gameplay- Forehand, Backhand, Service, volley, smash
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Tennis Federation (ITF)

Course Outcomes:

1. Learn to play Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1111	THROWBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Throwball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Throwing, Receiving
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, control

References:

1. World Throwball Federation - Rules of the Game

Course Outcomes:

1. Learn to play Throwball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

ENVS1001	ENVIRONMENTAL STUDIES	L	T	P	S	J	C
		3	0	0	0	0	3*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation led to pollution. This course helps in finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Educational Objectives:

- To impart knowledge on natural resources and its associated problems.
- To familiarize learners about ecosystem, biodiversity, and their conservation.
- To introduce learners about environment pollution.
- To acquaint learners on different social issues such as conservation of water, green buildingconcept.
- To make learners understand about the present population scenario, its impacts and role ofinformational technology on environment and human health.
- To make learners understand about the importance of field visit.

UNIT 1 Multidisciplinary nature of environmental studies & Natural Resources 10 hours

Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness. Natural resources and associated problems. Uses and over exploitation of Forest resources, Water resources, Mineral resources, Food resources, Energy resources. Role of an individual in conservation of natural resources.

Activity:

1. Planting tree saplings
2. Identification of water leakage in house and institute-Rectify or report
3. Observing any one day of a week as Car/bike/vehicle free day.

UNIT 2 Ecosystem and biodiversity 10 hours

Ecosystem: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession.

Biodiversity: Definition, Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching, man wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ

Activity:

1. Visit to Zoological Park-Noting different ecosystem
2. Biodiversity register- Flora and fauna in the campus

UNIT 3 Environmental Pollution 10 hours

Definition Causes, effects, and control measures of: -Air pollution. Water pollution. Soil pollution. Marine pollution. Noise pollution. Nuclear hazards. Solid waste Management: Causes, effects, and control measures. Role of an individual in prevention of pollution. Pollution case studies.

Activity:

1. Visit to treatment plant and documentation.
2. Documentation of segregation of solid waste-Dry and Wet

UNIT 4 Social Issues and the Environment 10 hours

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Green building concept.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.

Activity:

1. Observing zero hour at individual level-documentation.
2. Eco friendly idols.
3. Rainwater harvesting-creating storage pits in nearby area.

UNIT 5 Human Population and the Environment and Environment Protection Act and Field work 10 hours

Population growth, variation among nations. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Environmental Protection Act, Issues involved in enforcement of environmental legislation.

Activity:

1. Visit to a local polluted site-industry/agriculture
2. Identifying diseases due to inappropriate environmental conditions

Text Book(s):

1. Erach Bharucha. Textbook of environmental studies for undergraduates courses-Universities Press,India Private Limited. 2019.
2. Kaushik A and Kaushik C.P. Perspectives in Environmental Studies. New Age InternationalPublishers Edition-VI. 2018.
3. Dave D Katewa S.S. Textbook of Environmental Studies, 2nd Edition. Cengage Learning India. 2012.

Additional Reading:

1. Benny Joseph. Textbook of Environmental Studies 3rd edition, McGraw Hill Publishing company limited. 2017.

Reference Book(s):

1. McKinney M.L., Schoch R.M., Yonavjak L. Mincy G. Environmental Science: Systems andSolutions. Jones and Bartlett Publishers. 6th Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5th edition. 2005.

Journal(s):

1. https://www.tandfonline.com/loi/genv20
2. https://library.lclark.edu/envs/corejournals

Website(s):

https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf From Climate Science to Action | Coursera

Course Outcomes:

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).

4. Function of green building concept.
5. Adapt value education

CO-PO Mapping:

	Programme Objectives (POs)												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2		2				1							2		
CO3			1						1					1	
CO4				2							2				1
CO5	1													1	
CO6					2							1			1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN: BOS

BOS: 04-07-22 **ACADEMIC COUNCIL:14-07-22**

SDG No. & Statement:

1. SDG-6-Clean water and Sanitation
2. SDG-7-Affordable and clean energy
3. SDG-13 - Climate change
4. SDG-14 - Life below water
5. SDG-15 - Life on Land

SDG Justification:

1. The learner will understand the importance of clean water and sanitation through this course and apply in their daily activities – SDG-6

2. The learner will make use of renewable resources to reduce pollution achieves SDG-7

3. The learner will understand present situation in climate change and takes appropriate steps to combat climate change – SDG-13

4. The learner will understand the existence of life below water – SDG-14

5. The learner will understand to promote sustainable terrestrial ecosystem – SDG15

FINA3001	PERSONAL FINANCIAL PLANNING	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Risk Management in Personal financing Fundamentals of Investing Saving Money for the future Personal and Family Financial Planning Introduction to Personal Finance						

Course Description:

Personal Financial Planning is one of the most significant factors in our lives. It is essential that funds are available as and when required at various stages of life. Unavailability of funds at critical stages of our life leads to financial distress and leads to many medical and non- medical problems. There are certain planned and unplanned events in our life. On the one hand,education of our children, their marriage, our retirement etc. are some of the planned events ofour life, but at the same time, some medical urgency, accident or death of an earning member might be some unplanned events. Many of these events are beyond our control, but the availability of funds can be planned to avoid any financial distress. In other words, we cannot stop the rain but can plan for an umbrella.
This course looks at the many challenges an individual faces in a complex financial environment and the rising uncertainties of one's life. It focuses on achieving long-term financial comfort of individual and family through goal setting, developing financial and life strategies, acquiring personal financial planning knowledge and managing risk throughout one's life.

Course Educational Objectives:

- To build students' ability to plan for long-term financial comfort of individual andfamily through goal setting, developing financial and life strategies.
- To provide students with knowledge on terms, techniques to evaluate investment avenues.
- To build the skill set of the student to enable them to file their tax returns.

UNIT 1 Basics of Financial Planning

Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

UNIT 2 Risk and Insurance Management

Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

UNIT 3 Investment Products and Measuring Investment Returns

Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate Investments, Direct Equity
Measuring Investment Returns: Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

UNIT 4 Retirement Planning

Introduction to the retirement planning process, estimating retirement corpus, Determining the retirement corpus, Retirement Products (NP)

UNIT 5 Tax Planning

Income Tax: Income tax principles: Heads of Incomes, Exemptions and Deductions, Types of Assesses, Rates of Taxation, Obligations for Filing and Reporting, Tax aspects of Investment Products, Wealth Tax

Textbooks:

1. National Institute of Securities Management (NISM) Module 1 & XA
2. Madhu Sinha, Financial Planning, 2 Edition, McGraw Hill India
3. Simplified Financial Management by Vinay Bhagwat, The Times Group

References:

1. Personal Financial Planning (Wealth Management) by S Murali and K R Subbakrishna, Himalaya Publishing House.
2. Mishra K.C., Doss S, (2009). Basics of Personal Financial Planning 1e. NationalInsurance Academy, New Delhi: Cengage Learning.
3. Risk Analysis, Insurance and Retirement Planning by Indian Institute of Banking andFinance.

Course Outcomes:

1. Describe the financial planning process and application of time value of money
2. Application of life and non-life insurance products in financial planning
3. Understand the investment avenues and analysis of investment returns
4. Understand the retirement planning and its application
5. Describe and analysis the Tax Planning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	0	0	1	0	0	1	1	1	0	3	1	1	3
CO2	2	2	0	0	1	1	1	1	0	1	1	3	1	1	2
CO3	3	2	1	0	1	0	0	1	0	1	1	3	2	2	3
CO4	3	2	0	1	1	0	1	1	0	1	1	2	2	3	2
CO5	3	3	0	1	1	1	2	1	0	1	1	1	2	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**
SDG No. & Statement:
Goal 4: Quality education
Goal 12: Responsible consumption and Production
SDG Justification:
Goal 4: This course enables the students to attain their financial literacy that builds in the discipline of saving and improves their lifelong learnings.
Goal 12: This course ensures sustainable consumption and helps in providing them their life long financial requirements .

LANG1012	COMMUNICATION SKILLS IN ENGLISH – INTERMEDIATE	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description

Communication Skills in English (Intermediate) is the second of the three-level graded courses for the developmental enhancement of communication skills in English. Based on the learning outcomes set in the beginner-level syllabus, this course focuses on giving learners more exposure to the use of language for communicative purposes and equipping them with next level skills (ref. Bloom's taxonomy) and practice in complexity and cognitive engagement. This course also includes the inferential level of comprehension (listening and reading) that involves analysis and application of language skills and decision-making skills while speaking/writing with an awareness of social and personality-based communication variations. This course emphasizesguided writing through adequate pre- and post-context building tasks. The focus is on the stimulation and application of critical thinking in addition to schematic review for communication in real-life situations.

Course Educational Objectives

- Train learners to listen to short audio texts with familiar content actively; guided activity like question-making and responding to others' questions based on the audio text would help learners engage in transactional dialogue; extended activities like extrapolating/critiquing the responses would help learners enhance their schematic thinking. (Bloom's Taxonomy Level/s: 2 & 4)
- Equip learners with strategies to read actively and critically and understand the writers' viewpoints and attitude by providing reading comprehension tasks using authentic texts such as op-ed articles from newspapers, and reports on contemporary problems. (Bloom'sTaxonomy Level/s: 4 & 5)
- Help learners understand various aspects and techniques of effective presentations (group/individual) through demonstration and modelling, enabling them to develop their presentation skills by providing training in using the tips and strategies. Learners would be encouraged to observe and express opinion on teacher-modelling. Reflection on issues like anxiety, stage-fear, confidence, and levels of familiarity with topic and audience would be addressed. Practice would be given on tone, pitch, clarity and other speech aspects. Detailed peer feedback and instructor's feedback would cover all the significant aspects. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of the structure and conventions of academic writing through reading, demonstration, scaffolding activities, and

discussion. Corrective individual feedback would be given to the learners on their writing. (Bloom's Taxonomy Level/s: 2 & 3)

List of Tasks and Activities

S. No.	Tasks	Activities
1	Listening to subject related short discussions/explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection /Presentation
2	Asking for information: asking questions related tothe content, context maintaining modalities	Group role-play in a context (i.e. Identifying the situation and different roles and enacting theirroles)
3	Information transfer: Visual to verbal (unfamiliarcontext); demonstration by teacher, learners' task(guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in smallgroups, individual writing, and feedback
4	Introducing officials to peers and vice versa - Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
5	Vocabulary in context: Find clues in a text and usethem to guess the meaning of words/phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts andlistening to discussions/talks
6	Follow the essentials of lectures, talks, discussions, reports and other forms of academicpresentations and mark individual and group presentations aided with images, audio, video, tabular data, etc.	Making power point presentation aided with images, audio, video, etc. with a small group bylistening to academic lectures/talks/ discussions,etc.
7	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/discipline-specific topic: creating outline,assigning specific roles to members of the group;and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
8	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual),oral questioning, discussion

9	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context,coordinating with situational clues and fellow speakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
10	Writing a short reflective report of an event - incident/meeting/celebration	Writing a report on meetings/celebrations/events etc. by actively involved in such events and giving a short oral presentation.
11	Formal Group Discussion on topics of current interest and relevance; focus on effective participation, reflection on control over argument/counter argument, and adherence tothe conventions of formal GD	Noticing strategies from AV modelling, teacher scaffolding thoughopen-house discussion, Note-making(Group work), Group Discussion (free), post-performance discussion,Feedback
12	Speaking spontaneously on topics of interest and writing short structured essays on the same topicsadopting appropriate academic conventions and grammatical accuracy. Make sure to write accurate paragraph and essay by following: cohesion and coherence, topic sentence, introduction and conclusion	Reading for task preparation, note-making, reflection and corrective peer andteacher feedback. Practice paragraph and essay writing in groups; maintain rubrics of writing

Reference Books

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. FoundationBooks. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.
4. Cambridge IGCSE: English as a Second Language Teacher’s Book Fourth Edition.By Peter Lucantoni. CUP (2014).
5. Cambrdige Academic English: An Integrated Skills Course for EAP (Upper Intermediate)By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 bySarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxfor: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

Online Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary

9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

- Understand the speaker's point of view in fairly extended talks on general or discipline-specifictopics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)

- "Read and demonstrate understanding of articles and reports on limited range of contemporaryissues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"

- Make short presentations on a limited range of general topics using slides, and engage in small group discussions sharing experiences/views on familiar contemporary issues and give reasons for choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)

- Write clear, fairly detailed text (a short essay) on a limited range of general topics, and subjects of interest, and communicate clearly through email/letter to seek/pass on information or givereasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)

- Reflect on others' performance, give peer feedback on fellow learners' presentations, responsesto writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

CO-PO Mapping:

	PO 1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PO 16	PSO 1	PSO 2	PSO3	PSO4
CO1	3	3	3	3	2	1	1	1	2	1	2	1	1	1	1	2	3	1	1	1
CO2	2	2	2	3	3	2	1	1	2	2	1	1	2	1	1	1	3	2	2	1
CO3	2	3	2	3	3	1	3	2	2	2	2	1	2	1	1	2	3	2	2	1
CO4	2	3	3	3	3	1	2	1	2	2	1	1	2	1	1	1	3	2	1	1
CO5	3	3	2	3	3	1	3	2	1	2	1	2	2	1	1	2	3	1	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:	
BOS :	**ACADEMIC COUNCIL:**
SDG No. & Statement:	

SDG 16 Peace and Justice Strong Institutions. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
SDG Justification: By relating to people with empathy, employing creative problem-solving strategies and engaging meaningfully in a diverse world will create inclusive societies for sustainable development.

<table>
<tr><td rowspan="2">LANG1022</td><td rowspan="2">COMMUNICATION SKILLS IN ENGLISH – ADVANCED</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description

Communication Skills in English (Advanced) is the third of the three-level graded courses for the developmental enhancement of communication skills in English. Based on the learning outcomes set in the upper-intermediate syllabus, this course focuses on giving learners exposure to higher levels of skills/input processing (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course includes an advanced level of comprehension i.e. anaytical, evaluative, and extrapolative processing (listening and reading). It involves problem-solving, logical reasoning, and decision-making skills in terms of the application of the learning (speaking/writing) with an awareness of social and personality-based variations in communication. This course provides opportunities for activity-based practice of advanced oraland written communicative skills besides building awareness of the finer nuances of language usefor various purposes. This course emhasizes free writing through meaningfully engaging pre- and post-context-building tasks. There is ample scope for applying critical thinking through simulated activities for effective communication in real-life situations.

Course Objectives

1. Enable learners to listen actively, become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)

2. Enable learners to become aware of tone and attitude in written texts, and demonstrate theircomprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skillsand strategies.

3. Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument.

4. Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their communication skills in real life situations.

List of Activities & Tasks for Assessment

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a longtext/short text on a current topic related to technology and society, identifying and questioning the author's intention, post- reading discussion in small groups, maintaining group dynamics, arriving at aconsensus. Understanging and inferring the meaning.	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflectionand brief presentation of thoughts/ideas/opinions on the themeof the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well-known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening,student checklist for noticing keywords/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer (among students), modification, editing, proofreading,and feedback before the final version is done	Pre-reading game/modelling, discussion in small groups, independent writing and feedback	4
4	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions offormal and polite speech, and managing bias	Listening to group discussions/debates,reading news-paper articles on current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentative essays).	3
5	Collaborative writing in groups of 3 -4 on topics that would require data collection andreading followed by recorded peer-reflectionand peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work(collaboration), presentation, peer feedback, Open-class discussion	5
6	Writing a statement of purpose Discuss all details about the student academic and professional background, highlighting the student accomplishments,	Reading & discussion of sample statement of purposes. Discuss the content in groups and know whether all mentioned details are present. Do practice writing after lecture and discussion.	2

	goals, and how a student fit to the education applied to.	Make sure to adopt a proper writing style.	

7	Mind-mapping for advanced reading, making correlations across texts, extending the author'spoint of view	Reading texts on abstract topics and comprehending the author's perspectiveby inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
8	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disagreeingwith rationale	Listening to some lectures, talks, and presentations in the academic seminarsand adapting some strategies to handlethe Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
9	Learn resume and cover letter format & introduce different interview modes. Modelling an interview: with a panel of fourjudges (peers)	Pre-task activity for orientation/strategies (controlled/guided), Model interview (AV support), Group work (role play), Interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/teacher)	2
10	Speaking on abstract and complex topics beyond his/her own area of interest/field ofstudy, using the language flexibly and effectively.	Reading texts on abstract topics and comprehending the author's perspectives. Similarly, listening to talks and discussions on an abstract topic of other discipline and making short oral presentation by sharingviews and opinions.	3
11	Self-reflection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas toothers	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some generaltopic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance ofthe content, etc.	1

12	Collaborative and individual tasks: planning, preparing (preparing an outline, structure, setting objectives, and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, groupwork (collaboration), oral correction, task distribution, presentation, feedback	5

Reference Books

1. Latham-Koenig, C. & Oxenden, C. (2014). American English File-5. Oxford: OUPRichards,
2. J.C. and Bohlke, D. (2012). Four Corners-4. Cambridge: CUP.
3. Cambrdige Academic English: An Integrated Skills Course for EAP (Advanced) By Martin Hewings and Craig Thaine, CUP (2012)
4. Berlin, A. (2016). 50 Conversation Classes: 50 Sets of Conversation Cards With an Accompanying Activity Sheet Containing Vocabulary, Idioms and Grammar. Poland: CreateSpace Independent Publishing Platform
5. Zemach, D. E., Islam, C. (2011). Writing Paragraphs: From Sentence to Paragraph. Germany: Macmillan Education.
6. Stewart, J. P., Fulop, D. (2019). Mastering the Art of Oral Presentations: Winning Orals, Speeches, and Stand-Up Presentations. United Kingdom: Wiley.
7. Kroehnert, Gary. (2010). Basic Presentation Skills. Sidney: McGraw Hill.
8. Cunninghum, S. & Moor, P. (nd). Cutting Edge (Advanced) With Phrase Builder. Longman Publishers. CUP
9. McCarthy, M & O'Dell, F. (2017). English Idioms in Use (Advanced). Cambridge: CUP. Online

Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/

12. https://librivox.org/

Course Outcomes

- Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
- Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widely accepted conventions. (Bloom's Taxonomy Level/s: 3)
- Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
- Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)

- Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PO16	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	1	2	2	2	3	2	2	1	1	1	2	3	3	1	1
CO2	2	3	2	3	3	1	3	3	3	3	2	2	2	1	1	2	3	3	1	1
CO3	2	3	1	3	3	2	1	1	2	1	2	2	1	1	1	2	3	3	2	1
CO4	3	3	3	3	3	2	1	1	3	2	2	2	1	1	1	1	3	3	2	1
CO5	3	3	3	3	3	3	2	2	3	3	2	2	3	1	1	1	3	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:	
BOS :	**ACADEMIC COUNCIL:**
SDG No. & Statement:	
SDG 16 Peace and Justice Strong Institutions. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.	
SDG Justification: By relating to people with empathy, employing creative problem-solving strategies and engaging meaningfully in a diverse world will create inclusive societies for sustainable development.	

MFST1001	HEALTH & WELLBEING	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how toexercise, the role of sports and physical fitness in development of a good health. The course also focuses on the importance of emotional well-being and mindfulness. This course helps in teaching the role of yoga in maintenance of physical balance.

Course Educational Objectives:

- To provide an understanding of the relationship between food and nutrition
- To emphasize the role of exercise, sports and physical fitness in obtaining a good health
- To explain about the mindfulness and emotional well being
- To teach the role of yoga and meditation in maintaining the body balance

UNIT 1

Understand the relationship between Food and Nutrition and how food composition affects nutritional characteristics. Knowledge about regulatory principles in determining diets and recommended daily allowances. Understand how to create personalised diet/nutrition plans.

UNIT 2

Understand how exercise, activity and sports helps in developing good health. Experiential exposure to the role of proper, specific nutritional interventions along with structured activities on developing proper physical health. Practical exercises and assignments in sports and exercise regimes.

UNIT 3

Introduction to emotional wellbeing and mindfulness. Teaching of mindfulness practices to reduce stress, increase relaxation and improve mental wellbeing.

UNIT 4

Introduction to Yoga theory and how Yoga helps in maintaining balance in the body. Practice of Yoga and meditation to improve overall emotional and physical balance. Practical yoga exercises and meditation techniques

Course Outcomes:

By the end of the course, student will

1. Learn the role of nutrition and diet in maintaining a good health
2. understand how the exercise, sports and physical activities will improve health
3. learn mindfulness practices for reducing stress
4. know the importance of yoga and meditation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

PHPY1001	GANDHI FOR THE 21ST CENTURY	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides the students with basic knowledge on Gandhi's early life, transformations in South Africa and his entry into India's national movement. While going through the social-political, economic, and educational philosophies of Gandhi, the course analyses how his ideologies are relevant even in the 21st century.

Course Educational Objectives:

The objectives of the course are;

- To provide the students with the basic knowledge on Gandhi’s life and his philosophies
- To understand the early influences and transformations in Gandhi
- To analyse the role of Gandhi in India’s national movement
- To apply Gandhian Ethics while analysing the contemporary social/political issues
- To appreciate the conflict resolution techniques put forward by Gandhi and its significance in thecurrent scenario.

UNIT 1 MK Gandhi: Childhood and Education

M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

UNIT 2 From Mohan to Mahatma-South African Experiences

Gandhi in South Africa (1893-1914): South African Experiences - civil right movements in South Africa - invention of Satyagraha - Phoenix settlement- Tolstoy Farm - experiments in Sarvodaya, education, and sustainable livelihood.

UNIT 3 Gandhi and Indian National Movement

Gandhi and Indian National Movement (1915-1947): Introduction of Satyagraha in Indian soil -non- cooperation movement - call for women’s participation - social boycott - Quit-India movement - fighting against un-touchability - Partition of India- independence.

UNIT 4 Gandhi and Sustainable Development

Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

UNIT 5 Gandhi and Contemporary Issues

Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

References:

1. Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House
2. Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan PublishingHouse
3. Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.
4. Khoshoo, T N (1995). *Mahatma Gandhi: An Apostle of Applied Human Ecology*. New Delhi:TERI
5. Kripalani, J.B. (1970). *Gandhi: His Life and Thought*. New Delhi: Publications Division.
6. Narayan, Rajdeva (2011). *Ecological Perceptions in Gandhism and Marxism*. Muzaffarpur:NISLS
7. Pandey, J. (1998). *Gandhi and 21st Century*. New Delhi: Concept.
8. Weber, Thomas (2007).Gandhi as Disciple and Mentor. New Delhi: CUP

Course Outcomes:

After the successful completion of the course the students will be able to;

1. Understand the life of Gandhi
2. Appreciate the role of Gandhian non-violence and Satyagraha in India's freedom struggle.
3. Critically examine the philosophy of Gandhi on Education, Sarvodaya, and Satyagraha
4. Analyse the contemporary significance of Gandhian constructive programmes and eleven vows
5. Examine the possible solutions for some of the contemporary challenges like environmentalissues, moral degradation and ethical dilemmas.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2	3	3	3	3
CO2	3	3	2	3	2	3	3	3	3	2	3	2	3	2	3
CO3	3	3	3	2	3	2	2	3	3	2	2	3	2	3	2
CO4	3	2	2	3	3	2	2	3	3	2	3	2	3	3	2
CO5	3	3	2	2	3	3	3	3	3	3	2	2	2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-4: Ensure Inclusive And Equitable Quality Education And Promote Lifelong Learning Opportunities For All.

Sdg-8: Promote Sustained, Inclusive And Sustainable Economic Growth, Full And Productive Employment And Decent Work For All

SDG Justification:

Statement: This course promotes the education for all the people without considering their religion, caste, gender and regional differences.

Statement: This course deals with the basic concepts of national income and employment to understand the national level scenario of how an economy is growing and providing employment.

POLS1001	Indian Constitution and History	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course analyzes the basic structure and operative dimensions of the Indian Constitution. It explores various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The course also deals with various challenges faced by the constitution and its coping mechanisms. Broadly, the students would understand and explain the working of different institutions and political debates ensuing from the operation of the Indian constitution in action.

Course Educational Objectives:

- To introduce constitutional history of India.
- To explain the process of making Indian constitution
- To analyze Fundamental of Rights, Duties and other principles in constitution
- To create familiarity with political developments which shaped the constitution.

UNIT 1 India as a Nation 6 hours

Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.

Rowat, D. (1950). 'India: The Making of a Nation', International Journal, 5(2), 95-108. doi:10.2307/40194264

Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1.

The Politics of Idea since independence, New Delhi: Cambridge University Press. pp. 1-30.

UNIT 2 Understanding the Constitution 6 hours

Mehta, U.S. (2011). 'Constitutionalism' in *The Oxford Companion to Politics in India*, (ed) by Nirja Gopal Jayal, and Pratap Bhanu Mehta, New Delhi: Oxford University Press. pp. 15-27.

Austin, G. (2016), 'The Constituent Assembly: Microcosm in Action' *in The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp. 1-25.

Beteille, Andre (2008): "Constitutional Morality," *Economic and Political Weekly*, Vol 43, Issue No 40

Prahladan, Vivek (2012): “Emergence of the Indian Constitution,” *Economic and Political Weekly*, Vol 47, Issue No 07.

UNIT 3 **The Preamble, Fundamental Rights and Directive Principles of State Policy** **6 hours**

Bhakshi, P.M. (2011). ‘Preamble’ in *The Constitution of India*, New Delhi: Universal Law. Pp. 1-5. Laxmikanth, M. (2017). ‘Chapter IV: Preamble of the Constitution’ in *Indian Polity*, Chennai: McGraw Hills.

Kumar, Virendra (2007): “Basic Structure of The Indian Constitution: Doctrine of Constitutionally Controlled Governance [From Kesavananda Bharati to I.R. Coelho]” *Journal of the Indian Law Institute*, Vol 49, No 3, pp 365-398.

Austin, G (2016), ‘ ’ in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp.63-105.

Reddy, S (1980). Fundamental Ness of Fundamental Rights and Directive Principles in the Indian Constitution. *Journal of the Indian Law Institute*, 22(3), pp. 399-407.

Bhatia, Gautam (2017): “The Supreme Court’s Right to Privacy Judgement,” *Economic and Political Weekly*, Vol 52, Issue No 44

UNIT 4 **Citizenship** **6 hours**

Jayal, N.G. (2019). ‘Reconfiguring citizenship in contemporary India’ in *South Asia Journal of SouthAsian Studies*, pp.33-58.

Roy, Anupama. (2010). ‘Chapter I: Enframing the citizen in contemporary times’ in *Mapping Citizenship in India*, New Delhi: Oxford University Press.

Das, Veena (2010): “State, Citizenship and the Urban Poor,” *Citizenship Studies,* Vol 15, pp 319-333.Valerian Rodrigue

UNIT 5 **Separation and Distribution of Powers** **6 hours**

Pal, Ruma. (2016). ‘Separation of Powers’ in *The Oxford Handbook of the Indian Constitution*, (ed) by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, Delhi: Oxford University Press.

Bakshi, P. (1956). ‘Comparative Law: Separation of Powers in India’. *American Bar Association Journal, 42*(6), 553-595.

Rao, P. (2005). 'Separation of Powers in a Democracy: The Indian Experience'. *Peace Research, 37*(1),113-122.

Kumar, Ashwani (2019): "Constitutional Rights, Judicial Review and Parliamentary Democracy,"

Economic and Political Weekly, Vol 51, Issue 15

Tillin, Louise. (2015). 'Introduction' in *Indian Federalism*. New Delhi: Oxford University Press. pp.1-30.

Chakrabarty, Bidyut and Rajendra Kumar Pandey. (2008). *Federalism' in Indian Government andPolitics*, New Delhi: Sage Publications. pp. 35-53.

Arora, B. and Kailash, K. K. (2018). 'Beyond Quasi Federalism: Change and Continuity in IndianFederalism', in *Studies in Indian Politics*, pp. 1-7.

Agrawal, Pankhuri (2020): "COVID-19 and dwindling Indian Federalism," *Economic and PoliticalWeekly,* Vol 55, Issue No 26

Recommended Readings:

De, Rohit. (2018). *A People's Constitution – The Everyday Life of Law in the Indian Republic*, USA:Princeton University Press.

Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, Oxford, 1966.

Lahoti, R.C. (2004). *Preamble: The Spirit and Backbone of the Constitution of India*. Delhi: EasternBook Company.

Rajeev Bhargava (ed), *Ethics and Politics of the Indian Constitution*, Oxford University Press, NewDelhi, 2008.

Subhash C. Kashyap, *Our Constitution*, National Book Trust, New Delhi, 2011.Tillin, Louise. (2015). *Indian Federalism*. New Delhi: Oxford University Press.

Zoya Hassan, E. Sridharan and R. Sudarshan (eds), *India's Living Constitution: Ideas, Practices,Controversies*, Permanent Black, New Delhi, 2002.

Course Outcomes:

On the successful completion of the course students would be able to:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance iscarried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as theObligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the

Constitution andamended it from time to time.
4. Equip themselves to take up other courses in law after having done a foundation course on IndianConstitution

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	3	3	2	3	1	2	1	2	1	2
CO2	1	1	2	1	2	2	3	2	3	1	2	1	1	2	1
CO3	1	2	1	2	2	2	3	1	3	1	1	1	2	1	2
CO4	1	1	1	2	2	2	3	1	3	1	1	1	1	1	2
CO5	1	1	1	2	2	2	3	2	3	1	2	1	1	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG Justification:

The course primarily talks about evolution of the constitutional institutions. Since the SDG-16 talks about the quality of the institutions, it is applicable here.

<table>
<tr><td rowspan="2">VEDC1001</td><td rowspan="2">VENTURE DEVELOPMENT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

India as part of its "Make in India" initiative has been focusing on creating incubation centers within educational institutions, with an aim to generate successful start-ups. These start-ups will become employment creators than employment seekers, which is the need of the hour for our country. This common course (university core) for all the disciplines is a foundation on venture development. It is an experiential course that starts with students discovering their deeper self in terms of how they might contribute to society by creating exciting new products and services that can become the basis of real businesses. The students learn about the emerging areas of knowledge that are the foundations of any successful company. They will learn how to develop insight into the problems and desires of different types of target customers, and from this, to identify the design drivers for a specific innovation. Students will learn specific design methods for new products and services. The students will learn that as important as the product or service itself, is a strategy for monetizing the innovation – for generating revenue, structuring the operating costs, and creating the operating profit needed to support the business, hire new employees, and expand forward. This course is aimed to be the beginning of what might be the most important journey of personal and career discovery so far in a student's life, one with lasting impact. This is not just a course, but potentially, an important milestone in life that a student remembers warmly in the years to come.

Course Educational Objectives:

Students have the opportunity to:

- Discover who they are – Values, Skills, and Contribution to Society
- Understand how creativity works and permeates the innovation process
- Learn the basic processes and frameworks for successful innovation.
- Gain experience in going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.

UNIT 1 PERSONAL DISCOVERY 4 hours

Personal Values, Excite & Excel, Build a Team, Define Purpose, Mission Statement

UNIT 2 IDEATION 10 hours

Ideation & Impact, User Insights - Frameworks, Customer Interviews, Interpreting Results

UNIT 3 SOLUTION DISCOVERY 8 hours

Concept Design, Competitive Analysis, Product Line Strategy, Prototyping Solutions, Reality Check

UNIT 4 BUSINESS MODEL DISCOVERY 4 hours

Understand the Industry, Types of Business Model, Define Revenue Models, Define Operating Models, Define Customer Journey, Validate Business Model

UNIT 5 DISCOVERY INTEGRATION

Define Company Impact, Create Value, Tell Your Story

L – 15; Total Hours – 30

Textbooks:

1. Meyer and Lee, “Personal Discovery through Entrepreneurship”, The Institute for Enterprise Growth, LLC. Boston, MA., USA.

References:

1. Adi Ignatius (Editor-in-Chief), “Harvard Business Review”, Harvard Business Publishing, Brighton, Massachusetts,2021

Course Outcomes:

1. Identify one’s values, strengths and weaknesses and their will to contribute to the society
2. Formulate an idea and validate it with customers
3. Demonstrate prototyping and analyse the competition for the product
4. Create business models for revenue generation and sustainability of their business
5. Come up with a pitch that can used as the basis for actually starting a company based on an impactful innovation and societal impact

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						3	1	3	3	3		3			
CO2		3		3	1	3	2	1	3	3	1	3			
CO3	1	3	3		3		3		3	1	3	3			
CO4					1	1	3	3	3	1	3	1			
CO5					3	3			3	3	3	3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

SDG Justification:

4. The course involves identifying one’s personal values and working on real-life problems, thus forming the base to work on their passions even past the collegiate life.

17. The course is developed in collaboration with North-eastern University, USA and the training for the champions is being by North-eastern University.

Faculty Core

<table>
<tr><td rowspan="2">CHEM1001</td><td rowspan="2">CHEMISTRY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course enables the students to gain knowledge on various aspects of Water and its treatment, electrochemical energy systems, Construction of batteries, renewable energy sources, Semiconductors, Steel, Cement and Polymers, Corrosion and its control, nanomaterials, Analytical instruments, and applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

1. To impart knowledge on various aspects of water and its treatment.
2. To study about electrochemical energy systems, renewable energy sources, solar cells, and their applications.
3. To gain knowledge on materials such as steel, cement, and polymers
4. To create awareness on corrosion and its control.
5. To introduce different types of nanomaterials.
6. To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

UNIT 1 Water and its treatment 9 Hours

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization-industrial water treatment- Boiler feed water and its treatment -internal conditioning– Calgon and Phosphate conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis.

UNIT 2 Electrochemical Energy Systems 9 Hours

Battery Technology: Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, Lead-acid storage battery, lithium cells- Lithium-ion cell, Li MnO2 cell. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane, and oxygen fuel cell- Merits of fuel cell. **Renewable energy sources – Types of renewable energy sources. Semiconductors:** Definition, types of semiconductors: doping- n type and p – type semiconductors and applications. - **Solar cells:** Introduction, harnessing solar energy, Photovoltaic cell, solar water heaters.

UNIT 3 Engineering materials and Polymer Chemistry 8 Hours

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymer Chemistry: Concept of polymerization – Types of Polymerization, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Thermoplastic resins and Thermosetting resins: examples- Polyethylene, Styrene, Nylon 6,6 and Bakelite. and applications, Conducting polymers:– Examples – and applications.

UNIT 4 Corrosion and its control 8 Hours

Corrosion and Its Prevention: Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, temperature and dissolved oxygen on corrosion rate. Corrosion prevention and control by cathodic protection- protective coatings- paints.

UNIT 5 Nanomaterials and Analytical Instrumental Techniques 8 Hours

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM)

Analytical Instrumental Techniques

Review of electromagnetic spectrum, Quantization of energy. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, IR and UV-spectroscopy with examples.

Text Books:

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill Education Private Limited, (2009).

References:

1. Sashi chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

Course Outcomes:

After the completion of the course, the student will be able to

1. List the important purification methods of water.
2. Illustrate the principles and applications of batteries, solar energy.
3. Explain the importance of materials such as steel, cement, and polymers

4. Identify different protective coatings.
5. Analyze the importance of nano materials and the principles of SEM and TEM.

CHEMISTRY LABORATORY

List of Experiments:

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate
8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resin
12. Preparation of Urea-Formaldehyde resin
13. Thin layer chromatography
14. Preparation of TiO2/ZnO nano particles
15. SEM analysis of nano materials

Textbooks:

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

Course Outcomes:

After the completion of the laboratory course, the student will be able to

1. explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods.
2. identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods).
3. experiment with the physical parameter of organic compounds.
4. compare the viscosities of oils.
5. list the preparation of polymers and nano materials.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	2	3	1	1	2	2	3	1	3	2
CO2	3	2	1	1	3	3	3	2	1	1	3	3	1	3	3
CO3	3	2	1	1	2	3	2	2	1	1	2	3	3	1	2
CO4	3	2	2	1	2	3	3	2	2	1	2	3	3	2	2
CO5	2	2	1	2	3	3	2	2	1	2	3	2	3	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

CSEN1011	PROBLEM SOLVING AND PROGRAMMING WITH C	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Familiarity with Computer system and its operation.						

***Course Description**:*
The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course objectives:
1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

Module I: **Introduction to Computer Problem-Solving** 12Hours
Introduction, the Problem-Solving Aspect, Top-Down Design, Introduction to the idea of an algorithm, Introduction to Flowchart using Raptor tool.
Introduction to C Language – Structure of a C Program, Keywords, Identifiers, Data Types (int, float, char, unsigned int) and Variable declaration, Constants, Input / Output function. Operators, Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.
Exercises: Construct a flowchart and write a program to
- Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
- Calculate simple and compound interest for various parameters specified by the user
- To enter marks of five subjects and calculate total, average and percentage.
- Calculate net salary of employee given basic,da,hra,pf and lic
- retrieve remainder after division of two numbers without using mod operator
- Convert an upper-case character to a lower-case character.
- Swap two numbers
- Enter two angles of a triangle and find the third angle.
- Check Least Significant Bit (LSB) of a number
- Input any number from user and check whether nth bit of the given number is set (1) or not (0)(hint: Use bitwise operators)

Module II: Control Structures 15 Hours

- **Control Structures:** Selection Statements (making decisions) – if, if-else, nested if, else if ladder and switch statements. Repetition statements (loops)-while, for, do-while statements, Nested Loops.
- Unconditional statements-break, continue, goto.
- Pointers – Pointer variable, pointer declaration, Initialization of pointer, accessing variables through pointers, pointers to pointers, pointers to void.

Exercises: Construct a Flowchart and Write a Program to

- Check whether the triangle is equilateral, isosceles, or scalene triangle.
- Check whether entered year is a leap year or not
- Find minimum among three numbers.
- Check whether a number is divisible by 5 and 11 or not.
- Check whether a number is positive, negative or zero using switch case.
- Design a calculator that performs arithmetic operations on two numbers using switch case
- Find Roots of a Quadratic Equation
- Find factorial of a number
- Check whether number is a palindrome or not
- Check whether number is perfect or not
- Convert a decimal number to binary number
- To find the sum of the series [1-X^2/2!+X^4/4! ....].
- Print following patterns

```
*
*
* *
* * *
* * * *
A
B B
C CC
D D D D
E E E EE
1
2 3
4 5 6
7 8 9 10
```

- Calculate the greatest common divisor of two numbers
- Generate first n numbers in the Fibonacci series
- Generate n prime numbers
- Swap two numbers using pointers.
- Performs all the five arithmetic operations using Pointers.

Module III: Functions 15 Hours

Functions-Designing Structured Programs, user defined function- function definition, function prototype, function call, Types of functions. Parameter Passing by value, parameter passing by address, Recursive functions. Dynamic Memory allocation Functions, pointers to functions.

Storage classes-auto, register, static, extern.

Exercises: Write a program using functions to

- Print even and odd numbers in a given range
- Find power of a number
- Return maximum of given two numbers
- To print all strong numbers between given interval using functions.
- Check whether a number is prime, Armstrong or perfect number using functions.
- Demonstrate call by value and call by reference mechanisms.
- Find power of any number using recursion.
- Generate Fibonacci series using recursion
- Find product of two numbers using recursion
- Find the sum of digits of a number. Number must be passed to a function using pointers.
- Find GCD (HCF) of two numbers using recursion.
- Find LCM of two numbers using recursion.

Module IV: Arrays and Strings 15 Hours

Arrays – Declaration and Definition of Array, accessing elements in array, Storing values in array, linear search, binary search, bubble sort, Two – dimensional arrays, multidimensional arrays. Arrays and Pointers, Pointer Arithmetic and arrays, array of pointers, Passing array to function.

Strings – Declaration and Definition of String, String Initialization, unformatted I/O functions, arrays of strings, string manipulation functions, string and pointers.

Exercises: Write a program to

- Find minimum and maximum element in an array
- Implement linear search.
- Sort an array in descending order.
- Given a two-dimensional array of integers and a row index, return the largest element in that row.
- Find transpose of a matrix.
- Perform multiplication of two matrices
- Count total number of vowels and consonants in a string.
- Reverse the given string without using String handling functions.
- Sort strings in dictionary order
- To perform addition of two matrices.
- Read an array of elements of size ‘n’ and find the largest and smallest number using functions
- find total number of alphabets, digits or special character in a string using function

Module V: Structures and Files 15Hours

Structures–Declaration, initialization, accessing structures, operations on structures, structures containing arrays, structures containing pointers, nested structures, self-referential structures, arrays of structures, structures and functions, structures and pointers, unions.

Files – Concept of a file, Opening and Closing files, file input / output functions (standard library input / output functions for text files)

Exercises: Write a program to

- Store information of a student using structure

- Add two complex numbers by passing structures to a function
- Store information of 10 students using structures
- Store Employee information using nested structure
- Read file contents and display on console.
- Read numbers from a file and write even and odd numbers to separate file.
- Count characters, words and lines in a text file.

Textbooks(s)

- B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning

Reference Book(s)

1. Jeri R Hanly, Elliot B Koffman, Problem Solving and Program Design in C, 7/e, Pearson Education, 2012.
2. B.W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2/E, Pearson education, 2015.
3. B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017.
4. P. Dey and M Ghosh, Programming in C, 2/e, Oxford University Press, 2011.

Additional Exercises:

1. Given numbers x, y, and target, return whichever of x and y is closer to the target. If they have the same distance, return the smaller of the two
2. There are three friends Ram, Raheem and Robert. Ram's age is 20, Raheem is aged three times more than his friend Ram. After 8 years, he would be two and a half times of Ram's age. After further 8 years, how many times would he be of Rams age? Robert's age is 25 now. Now program your computer to determine the final ages of all the three people after 16 years and also show who is elder.
3. Given an actual time and an alarm clock time, both in "military" format (such as 0730 for 7:30am), print how many more minutes before the alarm rings. But if the time is after the alarm, print "Alarm already went off".
4. Let there be a scenario where you and your friend are going to a restaurant. You have lunch there every fourth day, and he has his lunch there every sixth day. How many days before you meet again for lunch at the same restaurant?
5. Two friends Suresh and Ramesh have **m** red candies and **n** green candies respectively. They want to arrange the candies in such a way that each row contains equal number of candies and also each row should have only red candies or green candies. Help them to arrange the candies in such a way that there are maximum number of candies in each row.
6. On a chessboard, positions are marked with a letter between a and h for the column and a number between 1 and 8 for the row. Given two position strings, return true if they have the same colour.
7. Given two strings s0 and s1, return whether they are anagrams of each other.
8. Write a program to encrypt and decrypt a password which is alphanumeric
9. Given a string, return the string with the first and second half swapped. If the string has odd length, leave the middle character in place.
10. Given an array of integers, return the second-largest element.
11. Given lists of integers people, jobs, profits. Each person i in people have people[i] amount of strength, and performing job j requires jobs[j] amount of strength and nets profits[j] amount of

profit. Given that each person can perform at most one job, although a job can be assigned to more than one person, return the maximum amount of profit that can be attained.

12. Mr. Roxy has arranged a party at his house on the New Year's Eve. He has invited all his friends - both men and women (men in more number). Your task is to generate the number of ways in which the invitees stand in a line so that no two women stand next to each other. Note that the number of men is more than the number of women and Roxy doesn't invite more than 20 guests. If there are more than 20 guests or an arrangement as per the given constraints is not possible, print 'invalid'.
13. Two friends have entered their date of birth and they want to know who is elder among them. Make a structure named Date to store the elements day, month and year to store the dates.

Case Study:

1. Create a structure containing book information like accession number, name of author, book title and flag to know whether book is issued or not. Create a menu in which the following functions can be done: Display book information, Add a new book, Display all the books in the library of a particular author, Display the number of books of a particular title, Display the total number of books in the library, Issue a book (If we issue a book, then its number gets decreased by 1 and if we add a book, its number gets increased by 1)

2. Ranjan is maintaining a store. Whenever a customer purchases from the store, a bill is generated. Record the customer name, amount due, the amount paid, mobile number with purchased items in file. At the end of day print the total income generated by store.

3. Contact Management System- Create structure to store Contact information like name, gender,mail,phone number and address. Users can add new contact and can also edit and delete existing contact. (Hint: Use Files to store data)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education, Decent Work and Economic Growth

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG Justification:

Learning various problem-solving techniques will lead to become a good problem solver.

CSEN1021	PROGRAMMING WITH PYTHON	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Educational objectives:

1. To elucidate problem solving through python programming language
2. To introduce function-oriented programming paradigm through python
3. To train in development of solutions using modular concept s
4. To teach p actical Python solution patterns

Unit I: **Introduction to Python** 18 **Hours**

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/output statements, Conditional If, while and for loops.

Exercises:

1. Accept input from user and store it in variable and print the value.
2. Use of print statements and use of (.format)for printing different data types.
3. Take 2 numbers as user input and add, multiply, divide, subtract, remainder and print the output (Same operations on floating point input as well)
4. Conversion of one unit to another (such as hours to minutes, miles to km and etc)
5. Usage of mathematical functions in python like math.ceil, floor, fabs, fmod, trunc, pow, sqrt etc.
6. Building a mathematical calculator that can perform operations according to user input. Use decision making statement.
7. Accepting 5 different subject marks from user and displaying the grade of the student.
8. Printing all even numbers, odd numbers, count of even numbers, count of odd numbers within a given range.
9. a) Compute the factorial of a given number. b) Compute GCD of two given numbers. c) Generate Fibonacci series up to N numbers.
10. Check whether the given input is a) palindrome b) strong c) perfect
11. Compute compound interest using loop for a certain principal and interest amount

Unit II: Functions 18 Hours

User defined Functions, parameters to functions, recursive functions. Lists, Tuples, Dictionaries, Strings.

Exercises:

- Create a function which accepts two inputs from the user and compute $^{n}C_{r}$
- Recursive function to compute GCD of 2 numbers
- Recursive function to find product of two numbers
- Recursive function to generate Fibonacci series
- Program to print a specified list after removing the 0th, 4th and 5th elements.
  Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow']
  Expected Output : ['Green', 'White', 'Black']
- Program to get the difference between the two lists.
- Program to find the second smallest number and second largest number in a list.
- Given a list of numbers of list, write a Python program to create a list of tuples having first element as the number and second element as the square of the number.
- Given list of tuples, remove all the tuples with length K.
  Input : test_list = [(4, 5), (4,), (8, 6, 7), (1,), (3, 4, 6, 7)], K = 2
  Output : [(4,), (8, 6, 7), (1,), (3, 4, 6, 7)]
  Explanation : (4, 5) of len = 2 is removed.
- Program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
  Sample Input: (n=5) :
  Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- Program to remove a key from a dictionary
- Program to get the maximum and minimum value in a dictionary.
- Program to perform operations on string using unicodes ,splitting of string,accessing elements of string using locations
- Program for Counting occurrence of a certain element in a string, getting indexes that have matching elements.For ex -.In Rabbit count how many times b has occurred . Example-I have to go to a doctor and get myself checked. Count the number of occurrences of ‘to’.
- Program for replacing one substring by another For example - Rabbit - Replace ‘bb’ by ‘cc’
- Program to Acronym generator for any user input (ex-input is Random memory access then output should be RMA).Example - Random number (RN)
- Python function that accepts a string and calculates the number of uppercase letters and lowercase letters.
- Program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings

  Sample List : ['abc', 'xyz', 'aba', '1221'] Expected Result : 2

Unit III: Files and Packages 18 Hours

Files—Python Read Files, Python Write/create Files, Python Delete Files.

Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions.

Exercises

- read an entire text file.
- read the first n lines of a file.
- append text to a file and display the text.
- Read numbers from a file and write even and odd numbers to separate files.
- Count characters, words and lines in a text file.
- To write a list to a file.
- Given a CSV file or excel file to read it into a data frame and display it.
- Given a data frame, select rows based on a condition.
- Given is a data frame showing the name, occupation, salary of people. Find the average salary per occupation.
- To convert Python objects into JSON strings. Print all the values.
- Write a Pandas program to read specific columns from a given excel file.

Unit IV: Operations in database with suitable libraries **18 Hours**

SQLite3: CRUD operations (Create, Read, Update, and Delete) to manage data stored in a database.

Matplotlib -- Visualizing data with different plots, use of subplots. User defined packages, define test cases.

Exercises

- Special commands to sqlite3 (dot-commands)
- Rules for "dot-commands"
- Changing Output Formats
- Querying the database schema
- Redirecting I/O
    - Writing results to a file
    - Reading SQL from a file
    - File I/O Functions
    - The edit() SQL function
    - Importing CSV files
    - Export to CSV
- Export to Excel

Reference - https://www.sqlite.org/cli.html

Matplotlib can be practiced by considering a dataset and visualizing it.
It is left to the instructor to choose appropriate dataset.

Unit V: Regular Expressions **18 Hours**

Regular expression: meta character, regEx functions, special sequences, Web scrapping, Extracting data.

Exercises

Write a Python program to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).
Write a Python program that matches a string that has an a followed by zero or more b's
Write a Python program that matches a string that has an a followed by one or more b's
Write a Python program that matches a string that has an a followed by zero or one 'b'
Write a Python program that matches a string that has an a followed by three 'b'
Write a Python program to find sequences of lowercase letters joined with an underscore

Write a Python program to test if a given page is found or not on the server.
Write a Python program to download and display the content of robot.txt for en.wikipedia.org.
Write a Python program to get the number of datasets currently listed on data.gov
Write a Python program to extract and display all the header tags from en.wikipedia.org/wiki/Main_Page
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Textbooks(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press

Reference Book(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Python for Data Analysis, Wes McKinney, O.Reeilly

Course Outcomes:

After completion of this course the student will be able to

- Define variables and construct expressions.
- Utilize arrays, storing and manipulating data.
- Develop efficient, modular programs using functions.
- Write programs to store and retrieve data using files.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Learning a programming language like Python students can get decent jobs in different fields.

CSEN1031	ARTIFICIAL INTELLIGENCE APPLICATIONS	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	CSEN1011: Problem Solving and Programming with C CSEN1021: Programming with Python						
Co- requisite	None						
Preferable exposure	Programming						

Course Description:

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Educational Objectives:

1. Provide introduction to basic concepts of artificial intelligence.
2. Explore applications of AI
3. Explore the scope, advantages of intelligent systems
4. Experiment with different machine learning concept
5. Exposure to AI-intensive computing and information system framework

UNIT 1 **2 Hours**

Introduction to Artificial intelligence: Basics of AL Agents and Environment, The Nature of Environment.

List of Experiment(s):

Implementation of toy Problems (8-Puzzle, Wumpus World, Vacuum-clean Example, etc)

UNIT 2 **2 Hours**

Applications of AI: Game Playing, [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo]

List of Experiment(s):

1. Implementation of (Sudoku, Crossword Puzzle, or Wumpus World, etc)

UNIT 3 **2 Hours**

Conceptual introduction to Machine Learning: Supervised, Unsupervised, and Semi-Supervised Learning.

List of Experiment(s):

1. Supervise - Perform Data Labelling for various images using object recognition

UNIT 4 **2 Hours**

Reinforcement Learning, Introduction to Neural Networks, Deep Learning

List of Experiment(s):

1. Explore the effect of different hyperparameters while implementing a Simple Fully Connected Neural Network. (https://playground.tensorflow.org)

UNIT 5 **2 Hours**

Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection.

List of Experiment(s):

1. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons

UNIT 6 **2 Hours**

Segmentation. Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.

List of Experiment(s):

1. Teachable Machine Brain.JS In Browser Object Recognition through
2. Haar Cascade Object detection for Eye and Face in Python using Open CV

UNIT 7 **2 Hours**

Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling.

List of Experiment(s):

1. Sentiment Analysis and Polarity detection

UNIT 8 **2 Hours**

Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.

List of Experiment(s):

1. Text to Speech recognition and Synthesis through APIs

UNIT 9 **2 Hours**

Introduction to o Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, Designing Elements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.

List of Experiment(s):

1. Building a Chatbot using IBM Watson visual studio
2. Building a Chatbot using Pandora bots
3. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

UNIT 10 2 Hours

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation and Autonomous Vehicles, Smart Homes, Smart Cities

List of Experiment(s):

1. Build a smart application specific to the domain of the student.

Textbooks:

1. Tom Markiewicz& Josh Zheng, Getting started with Artificial intelligence, Published by O'Reilly Media,20l7
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

References:

1. Aurtlien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts,Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Mcdia,20l 7
2. Build an AI Assistant with wolfram alpha and Wikipedia in python.https://medium .com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe.
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv Computer Vision Projects withPython-Publishing (201 6).
4. Curated datasets on kaggle https://www.kaggle.com/datasets.

Course Outcomes:

1. Able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing
2. Recognize various domains in which Al can be applied
3. Implement the methods in processing an image:
4. Implement simple of chatbots
5. identify smart applications:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021)

SDG No. & Statement:

SDG Justification:

EECE1001	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	None						

Course Description:

This course introduces the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems, and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Educational Objectives:

1. To impart the analysis and design aspects of DC networks in electrical and electronic circuits
2. To explain the basic concepts of AC networks used in electrical and electronic circuits.
3. To demonstrate the importance and operating principles of electrical machines (transformers, motors and generators)
4. To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
5. To expose basic concepts and applications of Operational Amplifier and configurations.

UNIT 1 **7 Hours**

DC Circuits: Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Superposition, Thevenin's and maximum power transfer theorem.

UNIT 2 **8 Hours**

AC Circuits: Alternating voltages and currents, AC values, single phase RL, RC, RLC series circuits, power in AC circuits, Power Factor, three phase systems-Star and Delta Connection-Three phase power measurement.

UNIT 3 **9 Hours**

Electrical Machines: Construction, working principle and application of DC machines, Transformers, single phase and three phase Induction motors, special machines-Stepper motor, Servo motor and BLDC motor.

UNIT 4 **8 Hours**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

UNIT 5 **8 Hours**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Difference amplifiers, A Single Op-amp difference amplifier. Adders, subtractors, integrators, differentiators, filter circuits using Opamps,

Basic Electrical and Electronics Engineering Laboratory

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum power transfer Theorem.
5. Load test on DC generator.
6. Load test on single phase transformer.
7. Measurement of voltage, current and power factor of single phase RL, RC series circuits.
8. Measurement of voltage, current and power factor of single phase RLC series circuit.
9. Measurement of power in a three phase circuit.
10. Current Voltage Characteristics of a p-n Junction Diode/LED.
11. Diode Rectifier Circuits.
12. Voltage Regulation with Zener Diodes.
13. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
14. Inverting and Non-inverting Amplifier Design with Op-amps.
15. Simulation experiments using PSPICE
    a) Diode and Transistor Circuit Analysis.
    b) MOSFET Amplifier design.
    c) Inverting and Noninverting Amplifier Design with Op-amps.

Textbooks:

1. D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education,

2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R. K. Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

After completion of this course, the student will be able to

1. predict and analyse the behaviour of an electrical circuit (L3).
2. analyse the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
3. explain the use of transformers in transmission and distribution of electric power and other applications (L2).
4. demonstrate the operation and applications of various electronic devices (L2).
5. construct Inverting and Noninverting configurations of Op-amp (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2	1	2		1		2			1	1	2	
CO2	1	2		2	2		1		1			1	2	1	
CO3	1	2		1		2		1	1	2	2				
CO4			2		3						1			3	2
CO5	3	2	3										3	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG3: Good Health and Well Being: Understanding the fundamentals of electrical and electronics systems can help in designing systems, to promote good health and well being

SDG5: Gender Equality: Acquiring the interdisciplinary knowledge help overcome the gender barriers in workplace

SDG8: Descent Work and Economic: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas

SDG12: Responsible Consumption and Production: Use of right and energy efficient electric and electronic components and devices results in reasonable consumption and production
SDG Justification:

HSMCH102	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	None						

Course Description:

During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Educational Objectives:

The objective of the course is fourfold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

UNIT 1 Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT 2 Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.
Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT 3 Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT 4 Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT 5 Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
    a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

References:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination: 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Course Outcomes:
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a. faculty-student or mentor-mentee programs throughout their time with the institution
b. Higher level courses on human values in every aspect of living. E.g. as a professional

INTN2333	INTERNSHIP 1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite	Completion of minimum of four semesters						
Co- requisite	None						
Preferable exposure	None						

Course Educational Objectives:

1. The course is designed to expose the students to expected industry skills and industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

One week of work at industry site. Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. identify skill set required to participate activity in real-time projects relevant to the industry
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. formulate technical background required to participate in Internship 2

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

INTN3444	INTERNSHIP 2	L	T	P	S	J	C
		0	0	0	0	1	3
Pre-requisite	Completion of minimum of six semesters						
Co- requisite	None						
Preferable exposure	None						

Course Educational Objectives:

1. The course is designed to expose the students to industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

Four weeks of work at industry site. Supervised by an expert at the industry

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

MATH1001	SINGLE VARIABLE CALCULUS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	None						

Course Description:

This course is designed to impart knowledge on differentiation and integration of function, emphasizing their inter-relationship and applications to engineering.

Course Educational Objectives:

1. To familiarize the students in the concepts the derivatives and its underlying concepts like limits and continuity.
2. To explain the concept of derivative and calculation of extreme values of extreme values of various functions.
3. To impart knowledge on integration for the computation of areas, arc lengths.
4. To demonstrate various techniques of integrations.

UNIT 1 Limits and continuity of single and several variables 6 Hours

Limit of a Function and Limit Laws, The Precise Definition of a Limit, One-Sided Limits, Continuity (Without proofs). Functions of Several Variables, Limits and Continuity in Higher Dimensions (Without proofs)

UNIT 2 Derivatives and applications 7 Hours

The Derivative as a Function, Differentiation Rules, The Chain Rule, Extreme Values of Functions on Closed Intervals, Monotonic Functions (Without proofs)

UNIT 3 Integrals and applications 7 Hours

The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Definite Integral Substitutions and the Area between Curves, Arc Length (Without proofs)

UNIT 4 Techniques of integration 6 Hours

Using basic Integration Formulas, Integration by Parts, Trigonometric Integrals, Trigonometric Substitutions, Integration of Rational Functions by Partial Fractions (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
4. Hyghes-Hallett, Gleason, McCallum et al. Single Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.

Course Outcomes:

At the end of the course, the student will be able to

- determine limit, one sided limit, continuity of single and several variable functions.
- solve problems in a range of mathematical applications using differentiation
- solve problems in a range of mathematical applications using integration
- apply the fundamental theorem of calculus.
- evaluate integrals using various techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1011</td><td rowspan="2">SEVERAL VARIABLE CALCULUS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">MATH1001</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to impart knowledge on calculus of functions of more variables which are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Course Educational Objectives:

1. To teach basic concepts of partial derivatives.
2. To explain the evaluation of double integrals and its applications.
3. To demonstrate the evaluation and applications of triple integrals.
4. To acquaint the knowledge of line and surface integrals and applications.

UNIT 1 Partial derivatives and applications 7 Hours

Partial Derivatives of a Function of Two Variables and More Than Two Variables, Second-order Partial derivatives, The Chain Rule for Functions of Two and Three variables, Extreme Values and Saddle Points, Lagrange Multipliers, Taylor's Formula for Two Variables (Without proofs)

UNIT 2 Double integrals 6 Hours

Double and iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration: Area of bounded region in a plane, Double Integrals in Polar Form. (Without proofs)

UNIT 3 Triple integrals 5 Hours

Triple Integrals in Rectangular Coordinates: Triple Integrals, Volume of a Region in Space, Finding limits of integration, Triple Integrals in Cylindrical and Spherical Coordinates. (Without proofs)

UNIT 4 Integrals and Vector fields 8 Hours

Vector Fields and Line Integrals: Line Integrals of Vector Fields, Line Integrals with Respect to dx, dy, or dz, Work Done by a Force over a Curve in Space, Green's Theorem in the Plane: Tangential form, Using Green's Theorem to Evaluate the Line Integral and Verification, Surface Integrals: Surface Integrals of Vector Fields, Stokes' Theorem (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. Hyghes-Hallett, Gleason, McCallum et al. Multivariable Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.
4. James Stewart. Multivariate Calculus, Concepts and Contexts. (3rd Edn) Thomson/Brooks/Cole, Canada, 2005.

Course Outcomes:

At the end of the course, the student will be able to

- utilize functions of several variables in optimization.
- employ the tools of calculus for calculating the areas.
- calculate volumes using multiple integrals.
- determine the work done using vector calculus
- determine the rate of flow of a fluid using vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2371</td><td rowspan="2" colspan="6">DIFFERENCE EQUATIONS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="12">None</td></tr>
<tr><td>Co- requisite</td><td colspan="12">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="12">Engineering and Science</td></tr>
</table>

Course Description:

Difference equations is the study of equation which involves the difference of a discrete function. In this course, the student can form a difference equation, solving linear higher order difference equations using analytical techniques, simultaneous linear difference equations and also find the solution of linear higher order difference equations and simultaneous difference equations using Z-transforms.

Course Educational Objectives:

1. Student is able to know how to find the order of a difference equation and complementary function of a difference equation.
2. Student is able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Student is able to know how to find Z-transforms a discrete function using properties and using to basic theorems.
4. Student is able to know how to find the inverse Z-transforms a function and also using convolution theorem.
5. Student is able to know how to find the solution of a difference equation using Z-transforms

UNIT 1 **Difference equations - I** **5 Hours**

Introduction, definition of order, and solution of difference equation, formation of difference equations, linear difference equations, complementary function, rule for finding complementary function.

UNIT 2 **Difference equations-II** **5 Hours**

Particular integrals, Rule for finding particular integrals, simultaneous linear difference equations.

UNIT 3 **Z-transforms** **5 Hours**

Introduction, Definition, some standard Z-transforms, linear property, damping rule, Shifting U_n to the right and to the left, Multiplication by n, two basic theorems.

UNIT 4 **Inverse Z-transforms** **5 Hours**

Convergence of Z-transforms, evaluation of inverse Z-transforms, properties, convolution theorem.

UNIT 5 Applications of Z-transforms 5 Hours

Solving difference equations and simultaneous linear difference equations with constant coefficients by Z-transforms.

Textbooks:

1. “Higher Engineering Mathematics” by B.S. Grewal published by Khanna Publishers

References:

1. Advanced Engineering mathematics by Irvin Kreyszig

Course Outcomes:

1. Able to find the order of a difference equation and complementary function of a difference equation.
2. Able to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Able to find Z-transforms a discrete function using properties and using to basic theorems.
4. Able to find the inverse Z-transforms a function and also using convolution theorem.
5. Able to find the solution of a difference equation using Z-transforms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 ACADEMIC COUNCIL: 17-09-2021

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1031</td><td rowspan="2">DIFFERENTIAL EQUATIONS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to impact the knowledge on ordinary, partial differential equations and their applications.

Course Educational Objectives:

6. To familiarize the students with the basic concepts of ordinary differential equations.
7. To demonstrate the evaluation and applications of first order differential equations.
8. To explain the evaluations of linear homogeneous and non-homogeneous differential equations.
9. To familiarize the students with the basic concepts of partial differential equations.
10. To explain the concepts of first order partial differential equations.
11. To demonstrate the evaluation of differential equations using math software’s

UNIT 1 First Order Ordinary Differential Equations 5 Hours

Order and Degree of an Ordinary Differential Equation (ODE), ODE’s of first order and first degree, Variable separable method, Linear Equations, Bernoulli’s Equations.

UNIT 2 Linear Ordinary Differential Equations of High Order 6 Hours

Definitions, Complete Solution, Operator D, Complimentary function, Inverse operator, Rules for finding particular integral (e^{ax}, sinbx/cosbx, x^m& $e^{ax}v(x)$)

UNIT 3 Applications of Linear Ordinary Differential Equations of Higher Order 5 Hours

Method of Variation of Parameters, Simple Harmonic Motion, Oscillations of a Spring

UNIT 4 Introduction to Partial Differential Equations 5 Hours

Introduction, Formation of Partial Differential Equation(PDE), Solutions of a PDE, Equations solvable by direct integration, Linear equations of the first order.

UNIT 5 Partial Differential Equations of Second Order 5 Hours

Homogeneous linear equations with constant coefficients, Rules for finding the complementary function and particular integral, Working procedure to solve the equations.

Textbooks:

1. Simmons, G.F., Differential Equations with Applications and Historical Notes, Second Edition, McGraw-Hill, Inc., 1991.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984
2. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
3. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.

Course Outcomes:

1. Form and find the solution of an ordinary differential equation.
2. Apply the concept of differential equations to solve real world problems.
3. Evaluate linear homogeneous and non homogeneous differential equations
4. Form and find the solution of a partial differential equations of first order.
5. Evaluate second order partial differential equations and solution of differential equations using computational tool.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2281	NUMERICAL TECHNIQUES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to enhance problem solving skills of engineering students using a powerful problem-solving tool namely numerical Techniques. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

Course Educational Objectives:

1. To familiarize the students with numerical solutions of nonlinear and systems of linear equations.
2. To get exposed to finite differences and interpolation.
3. To demonstrate the numerical differentiation and integration.
4. To explain the numerical solutions of ordinary differential equations

UNIT 1 Solution of algebraic and transcendental equations 6 Hours

Regula-falsi method and Newton- Raphson method. **Solution of linear system of equations**-Iterative methods: Gauss Jacobi method, Gauss Seidel method, and finding the eigenvalues of a matrix by Power method.

UNIT 2 Interpolation 5 Hours

Difference operators (shifting, delta, del) and difference tables, Newton's forward and backward interpolation formulae, Divided difference formula, and Lagrange's interpolation formula.

UNIT 3 Numerical Differentiation and Numerical Integration 5 Hours

Numerical Differentiation: Derivatives using forward, and backward difference formulae.
Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rules.

UNIT 4 Numerical solutions of ordinary differential equations - 1 5 Hours

Picard's method, Taylor's series method, Euler's method, and Modified Euler's method

UNIT 5 Numerical solutions of ordinary differential equations - 2 5 Hours

Runge-Kutta method (second and fourth order), Predictor-Corrector methods-Adams-Bashforth and Milne's methods.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

References:

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5/e, New Age International(P) Limited, 2007.
2. S.S. Sastry, Introductory methods of Numerical Analysis,4/e,PHI Learning Publications,2009.
3. H.C Saxena, Finite Differences and Numerical Analysis, Chand and Company Pvt. Ltd., New Delhi.

Course Outcomes:

At the end of the course, the student will be able to

1. analyze how root finding techniques can be used to solve practical engineering problems.
2. apply various interpolation techniques to solve practical problems .
3. apply numerical differentiation and integration whenever and wherever routine methods are not applicable .
4. solve differential equations using various numerical methods .
5. know the strengths and weaknesses of the various methods and be able to decide which ones are appropriate for a particular problem

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1021</td><td rowspan="2">TRANSFORM TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">MATH1031</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to impact the knowledge on (Laplace, Fourier) transforms and applications of these transforms on differential equations.

Course Educational Objectives:

1. To introduce and explain the concepts of Laplace transforms and properties.
2. To demonstrate the evaluation of Laplace transforms of special functions and additional properties.
3. To impart knowledge on obtaining Fourier series
4. To introduce and explain the concepts of Fourier transforms and properties.
5. To explain the evaluation of Fourier transforms of various function and then applications to boundary value problem.
6. To demonstrate and understand the transform techniques using available software

UNIT 1 Laplace transforms 5 Hours

Introduction, transforms of elementary functions, properties of Laplace transforms, transforms of derivatives, transforms of Integrals, Multiplication by t^n, Division by t.

UNIT 2 Applications of Laplace transforms 5 Hours

Evaluation of integrals by Laplace transforms, Inverse transforms, Solution of Differential equations.

UNIT 3 Fourier Series 6 Hours

Introduction, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval.

UNIT 4 Half-Range Fourier Series 3 Hours

Even and odd functions, Half range sine series, and Half range cosine series.

UNIT 5 Fourier transforms 7 Hours

Introduction, Fourier sine & cosine integrals, Fourier transforms, Properties of Fourier transforms-linear, change of scale & shifting property.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson Publishers, 2011.

Course Outcomes:

At the end of the course students will be able to

1. find Laplace transform of a function along with properties.
2. evaluate the Laplace transform of special functions.
3. apply the Laplace transform for solving differential equations (continuous systems)
4. evaluate the Fourier transform of a function along with properties and solve boundary value problems by Fourier transforms.
5. evaluate the engineering problems using transform techniques with the help of advanced math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2381	OPERATIONS RESEARCH	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

Operations Research (OR), also known as management science, has become an indispensable tool in scientific management. Operations Research focuses on developing and analyzing strategic and tactical levels to aid in decision-making and decision-making on the operational level. The essential tools of OR are algorithms, procedures that create and improve solutions to a point at which optimal or, at least, satisfactory solutions have been found.

Course Educational Objectives:

This course is designed to:

1. introduce the fundamentals of Operations Research to the students at the undergraduate level
2. solve different types of optimization problems of various categories and applying modern methodologies in the area of optimization
3. help students to develop a deep understanding of the classical and numerical optimization techniques and problem-solving capabilities

UNIT 1 **Linear Programming** **4 Hours**

Formulation of LPP, convex sets and their properties, slack and surplus variables, Basic solution, Basic feasible solution, non-degenerate and degenerate basic feasible solutions, optimal solution, General, Standard, and Canonical form of LPP.

UNIT 2 **Simplex Method** **8 Hours**

Simplex method, Degeneracy in LPP, Artificial variables techniques-Two Phase method, Big M-method.

UNIT 3 **Duality** **5 Hours**

Duality in linear programming, primal-dual relationships, weak duality theorem, strong duality theorem, and dual simplex method.

UNIT 4 **Integer Programming** **4 Hours**

Gomory's cutting plane method, Branch and Bound method for solving integer linear programming problems

UNIT 5 Sensitivity Analysis 5 Hours

Introduction to sensitivity analysis, variations in the price vector, variations in the requirement vector, addition of a new decision variable to the existing problem.

Textbooks:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

On successful completion of this course, students will be able to:

1. understand the linear programming problem, its formation, and basic definitions of solutions
2. understand the simplex method, which is a very efficient algorithm to solve a linear programming problem
3. understand the dual primal relationship, properties of duality, and the dual simplex algorithm
4. find integer solutions to LPP by cutting plane methods
5. find variations in price and requirement vectors and retaining optimality

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 ACADEMIC COUNCIL: 17-09-2021

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2301	COMPLEX VARIABLES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to familiarize the students with complex analysis, nature of a series, evaluation of integrals using Cauchy's theorem.

Course Educational Objectives:

- To explain the concept of complex functions and analytic functions.
- To explain the concept of conformal mapping.
- To explain the concept of Cauchy's theorem and residue theorem.
- To explain the convergence of series such as Taylor's and Laurent.
- To explain the concept of Cauchy's theorem and residue theorem.

UNIT 1 Functions of a Complex variable 6 Hours

Limit and continuity, Differentiation, Analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugates- applications to flow problems.

UNIT 2 5 Hours

Geometrical representation of f(z) – Some standard transformations – Bilinear transformation - Conformal mappings. Special conformal transformations ($w = z^2$, $w= z+1/z$, $w = e^z$, $w= \cosh z$)

UNIT 3 Complex Integration 5 Hours

Integration of complex functions - Cauchy's theorem - Cauchy's integral formula.

UNIT 4 Series representation of analytic functions 5 Hours

convergent series of analytic functions, Laurent 's and Taylor series, zeros and singularities of an analytic function

UNIT 5 Calculus of residues 5 Hours

Residue -Cauchy Residue theorem – Calculation of residues (All theorems without proof).

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, New Delhi, 2012.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics Narosa Publishing House, New Delhi, 2014.
2. N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, 8th Edition, Lakshmi Publications, New Delhi, 2012.

Course Outcomes:

1. Make use of differentiation and integration of complex functions in engineering problems.
2. Concept of conformal mappings .
3. Use Cauchy's theorem and Cauchy's integral formula to evaluate the line integrals
4. Apply Taylor's and Laurent's series to expand complex functions and know about the convergence region .
5. Evaluation of integrals using Residue theorem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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SDG No. & Statement: 4
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SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1041	DISCRETE MATHEMATICS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

Discrete Mathematics introduces students to the mathematics of networks, social choice, and decision making. This course provides students with a hands-on exploration of the relevancy of mathematics in the real world. This course reflects the rigor taught in many entry-level mathematics courses.

Course Educational Objectives:

1. To introduce basics of mathematical logical operators and connectives
2. To impart knowledge on normal forms and rules of inference.
3. To impart knowledge on partially ordered and total ordered sets.
4. To familiarize closed form solution of linear recurrence relations by various methods.
5. To impart knowledge on basic concepts of algebraic structures.
6. To write program structures, and understand when programming is most applicable

UNIT 1 Logic Operators and Connectives 5 Hours

Negation, conjunction, disjunction, conditional and bi-conditional, well formed formulae, tautologies, equivalence of formulae, duality, tautological implications.

UNIT 2 Mathematical logic 5 Hours

Conjunctive and disjunctive normal forms- principal disjunctive and conjunctive normal forms, Rules of inference for propositional calculus (Rule P, Rule T and CP rule).

UNIT 3 Sets and Relations 5 Hours

Basic concepts of set theory, Power set, relations, properties of binary relations in a set, Equivalence relations, composition of binary relations, Partial ordering, Partially ordered set.Hasse diagram.

UNIT 4 Recurrence relations 5 Hours

Recurrence relations, solving linear recurrence relations by characteristic roots method, system of recurrence relations.

UNIT 5 Algebraic Structures 6 Hours

Algebraic Structures-Semi group, Monoid, Groups, subgroups, cosets (definition and examples) Lagrange's theorem on finite groups

Text Books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Discrete Mathematical Structures,Sixth edition-Kolman,Busby,Ross

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Check the validity of a statement formula
2. analyze the concepts in set theory and relations
3. find a general solution of recurrence equation
4. build the algebraic structures and apply Lagrange's theorem on finite groups
5. Convert problem solving strategies to procedural algorithms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
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SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1051	Graph Theory	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

This course introduces basic concepts in Graph Theory, including properties and characterization of graph/trees and graph theoretic algorithms, which are widely used in Mathematical modelling and has got applications across Computer Science and other branches in Engineering.

Course Educational Objectives:

1. To introduce basics of group theory and its applications
2. To impart knowledge on basic concepts of paths and circuits
3. To impart knowledge on Trees, spanning trees, shortest spanning trees
4. To familiarize in the matrix representation of graphs
5. To transform scientific problems into generic computational models

UNIT 1 Basics of graphs 5 Hours

Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, complete graph, Bi-partite and complete Bi-partite graphs.

UNIT 2 Matrix representation of graphs 5 Hours

Adjacency Matrix, Incidence Matrix, Path Matrix (Definition and examples)

UNIT 3 Paths and circuits 6 Hours

Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Hamiltonian graphs (Definition, examples and without proofs)

UNIT 4 Trees 5 Hours

Trees and their properties, spanning trees, minimal spanning trees, Kruskal’s algorithm for finding a minimal spanning tree.

UNIT 5 Applications of Trees and Fundamental circuits 5 Hours

Preorder, in order and post order traversals, Prefix and Postfix notations of an arithmetic expression, parsing trees.

Textbooks:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.

2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2006.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Course Outcomes:

Upon successful completion of this course the student should be able to

1. analyse the concepts in graph theory
2. apply graph theory concepts in core subjects such as data structures and network theory effectively
3. Identify different types of paths
4. Construct minimum spanning tree using some algorithms and identify tree traversals
5. Solve the graphical problems which are accessed in available software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2311	NUMBER THEORY	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to explain the basics and applications of number theory for the students of Computer Science. The core courses of these branches encounter with concepts like prime factorization, modular arithmetic, and quadratic reciprocities in number theory. The first unit of the course provide a strong platform for such encounters and the other units focuses on applications of number theory.

Course Educational Objectives:

1. To teach basic concepts of number theory focusing on Computational aspects.
2. To teach the concepts of factorization of integers.
3. To teach Format’s theorem and quadratic residues.
4. To explain Chines remainder theorem and Euclidean algorithm.
5. To explain polynomial arithmetic.

UNIT 1 **Basic Concepts in Number Theory** **5 Hours**

Topics in elementary number theory, Divisibility, Greatest Common Divisor, Euclidean Algorithm

UNIT 2 **5 Hours**

Fundamental theorem of Arithmetic, Congruences, Properties of congruences, Linear congruences

UNIT 3 **5 Hours**

Fermat's theorem, Fermat's little theorem, Wilson’s theorem

UNIT 4 **5 Hours**

Chinese remainder theorem, The functions τ *and* σ, Euler Phi-function, Euler’s theorem, Some properties of phi function

UNIT 5 **5 Hours**

The order of integer modulo n, Primitive roots for prime, Composite number having primitive roots

Textbooks:

1. Elementary Number Theory | 7th Edition by David Burton, Mc Graw Hill Education

References:

1. Basic Number Theory by S.B. Malik,S. Chand publishers

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Apply concepts of number theory focusing on Computational aspects.
2. Analyze concepts of factorization of integers.
3. Explain Fermat's theorem and quadratic residues.
4. Analyse Chines remainder theorem and Euclidean algorithm.
5. Analyse the concept of polynomial arithmetic.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

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SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2291	LINEAR ALGEBRA	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to gain knowledge in the concepts of Linear Algebra focusing on basics of matrices, vector spaces and singular value decomposition to understand the basic concepts of Linear Algebra in the applications of image processing and machine learning.

Course Educational Objectives:

1. To familiarize with theory of matrices and tools for solving system of linear equations
2. To impart knowledge on Eigen values and Eigen vectors.
3. To teach basic concepts of vector spaces and their properties.
4. To explain the concepts of inner product spaces.
5. To familiarize with concept of singular value decomposition and its applications

UNIT 1 Fundamentals of Matrices 5 Hours

Introduction to Matrices and Rank of a matrix, Echelon form, solving system of linear equations.

UNIT 2 Eigen values and Eigen vectors 5 Hours

Eigen values and Eigen vectors, positive definite matrices, Linear dependence, and Linear independence.

UNIT 3 Vector Spaces 6 Hours

Vector space, linear combination of vectors, linear span, basis and dimension, linear Transformation.

UNIT 4 Inner Product Spaces 5 Hours

Inner Product Spaces, examples of inner product spaces, norm and length of a vector cauchy-schwarz's inequality.

UNIT 5 Singular value decomposition 5 Hours

Singular values, computing singular value decomposition and Introduction to principal component analysis.

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal.
2. Linear Algebra, Schaum's Outline,4th edition, Seymour Lipchutz,Marc Lipson

References:

1. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
3. Introduction to linear algebra, 5th Edition, Gilbert Strang.
4. Applied Mathematics (Vol. I & II), by P. N. Wartikar& J. N. Wartikar.
5. Digital Image Processing, R C Gonzalez and R E Woods.

Course Outcomes:

At the end of the course the student will be able to

- solve the system of linear equations
- calculate Eigen values and Eigen vectors
- find the basis
- learn Singular value decomposition
- learn principal Component analysis

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems.

MATH2341	PROBABILITY THEORY AND RANDOM VARIABLES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

To expose the students to the basics of probability theory and random processes essential for modelling and quantifying uncertainties and noise in systems

Course Educational Objectives:

- To know about various random life length models and their uses in finding the reliability of different electronic devices.
- To learn about basic properties and characteristics of various random processes with reference to signal and trunk processes.

UNIT 1 Probability 5 Hours

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem- Independent events.

UNIT 2 Random Variable 5 Hours

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

UNIT 3 Multiple Random Variables 6 Hours

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.

UNIT 4 Expected Value of a Function of Random Variables 6 Hours

Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

UNIT 5 Random Process 6 Hours

Temporal characteristics - the random process concept, stationarity and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References:

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. Analyze the outcomes of random experiments and develop the concept of random variables and obtain probabilities through them
2. define single random variables in terms of their PDF and CDF, and calculate moments such as the mean and variance
3. explore the random experiments specified by multiple random variables and study the Distribution of them
4. apply the fundamentals of probability theory and random processes to practical engineering problems
5. identify and interpret the key parameters that underlie the random nature of the problems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

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SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2321	RANDOM PROCESSES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to impart knowledge on random processes needed in applications such as signal processing, digital communications, speech processing, data modelling, etc.

Course Educational Objectives:

1. To familiarize the students in the concepts of probability and random variables.
2. To study Random Processes, its types, distribution, and density functions.
3. To study Gaussian and Poisson processes.
4. To apply random process to signal processing in communication systems.
5. To apply skills in analysing random phenomena which occur in Electrical and Electronics Engineering applications.

UNIT 1 Random Processes 6 Hours

Temporal characteristics - the random processes concept, Classification of random processes, stationarity and statistical independence. Time averages and Ergodicity.

UNIT 2 Correlation and Covariance functions 5 Hours

Auto correlation, Cross correlation, Properties. Covariance functions. Gaussian random processes, Poisson random processes

UNIT 3 Density functions 5 Hours

Probability density and joint probability density functions, Properties.

UNIT 4 Spectral densities functions - I 5 Hours

Spectral characteristics, the power density spectrum: Properties, relationship between power density spectrum and autocorrelation function.

UNIT 5 Spectral densities functions-II 5 Hours

Cross-power density spectrum, Properties, relationship between cross power spectrum and cross-correlation function.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.

References:

1. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
2. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

At the end of the course, the student will be able to:

- solve the problems on multiple random variables, joint distribution and independence
- solve the problems Gaussian and Poisson processes
- understand the concept of random processes
- determine covariance and spectral density of stationary random processes
- characterize the random signals in communication systems with their autocorrelation and power spectral density functions

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
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SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2351	OPTIMIZATION METHODS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

Optimization is the art of finding the best result under given conditions. In this fast-expanding world, an engineer has to use many Optimization methods, as it is the most significant in decision-making, design, manufacturing, maintenance, planning, and scheduling.

Course Educational Objectives:

This course is designed to:

- introduce various optimization methods for solving real-world problems
- find optimal solutions to transportation, assignment, and sequencing problems
- know project planning and scheduling
- study the network analysis techniques through CPM and PERT

UNIT 1 Transportation Problem 6 Hours

Introduction and LP formulation of Transportation Problem, feasible solution, basic feasible solution, finding Initial basic feasible solutions by North West corner rule, Least-cost entry method, Vogel's approximation method, Transportation Algorithm (MODI Method) to find an optimal solution.

UNIT 2 Assignment Problems 5 Hours

Introduction to Assignment Problem, Mathematical formulation, Hungarian Method for finding optimal solution, unbalanced assignment problem, Travelling Salesman Problem.

UNIT 3 Sequencing Problem 4 Hours

Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines.

UNIT 4 Network Analysis in Project planning 4 Hours

Project, Project Planning, Project Scheduling, Project Controlling, Work breakdown structure, Network Techniques, terms used in network-activity, event, path, network, dummy activity, looping, Fulkerson's rule, network diagram, and activity on node diagram.

UNIT 5 PERT and CPM 7 Hours

Critical path method (CPM), Measure of activity, Critical path analysis, the four floats, subcritical and supercritical activities, slack, Programme evaluation and review technique (PERT), time estimates, frequency distribution curve for PERT

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

On successful completion of this course, students will be able to:
1. apply MODI method for finding optimal transportation cost
2. apply Hungarian Method for solving assignment problems and finding an optimal route to the salesman
3. understand the process of finding optimal sequencing for processing jobs on machines
4. understand the network terminology and construction
5. apply CPM and PERT techniques for project management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2331</td><td rowspan="2">COMPUTATIONAL METHODS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve aerospace engineering application problems.

Course Educational Objectives:

1. Develop the mathematical skills in the areas of numerical methods.
2. Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, Interpolation, and applications, solving ODEs, PDEs.
3. Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
4. Train in developing the codes for implementing the numerical methods using any programming languages.
5. Formulate a mathematical model for a given engineering problem

UNIT 1 Mathematical Modeling of Engineering Problems 5 Hours

Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems. **Roots of Equations:** Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems. **Algebraic Equations**: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosky) matrices.

UNIT 2 Eigenvalues and Eigenvectors Problems 5 Hours

Formulation of equations to column, truss, spring-mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors. **Interpolation Methods:** Polynomial interpolation, Lagrange interpolation polynomials with equi- spaced data. **Regression or Curve Fitting:** Linear regression by least squares method.

UNIT 3 **Initial Value Problems** **6 Hours**

Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems. **Boundary Value Problems:** Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

UNIT 4 **6 Hours**

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations. **Parabolic Transient Diffusion Equations:** Explicit and implicit formulation, Crank Nicolson Method.

UNIT 5 **Numerical Integration** **6 Hours**

Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

List of Computational Exercises:

1. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton-Raphson until the approximate error falls below 0.5%.
2. Solve the system of simultaneous linear equations by
   i. Naïve -Gauss elimination
   ii. Gaussian elimination with partial pivoting
   iii. Gauss -Seidel method.
   iv. LU decomposition
3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.
6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2nd and 4th order methods.
8. Find the integral by numerical methods such as Trapezoidal and Simpson's rule.

Textbooks:

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

References:

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005

Course Outcomes:

At the end of the course, the student will be able to:

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. Analyse and evaluate the accuracy of common numerical methods.
4. Implement numerical methods using any programming language (matlab, scilab, python…)
5. Write efficient, well-documented code and present numerical results in an informative way.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1061	Introduction to Mathematics - I	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

- To explain the concepts of Trigonometry.
- To explain the basic concepts of differentiation and differential equations
- To teach the evaluation of definite and indefinite integrals.
- To explain the basic concepts of differential equations, multivariable and vector calculus

UNIT 1 : Representations , Co-ordinate systems and Trigonometry 3 Hours

Representations for Scalars, Vectors, Matrices and Tensors. Coordinate systems: cartesian and polar coordinate systems.

Trigonometry: Trigonometric functions, Periodicity, Trigonometric Ratio of Compound angles, multiple and sub multiple angles, transformations, brief introduction of inverse trigonometric, hyperbolic and inverse hyperbolic functions.

UNIT 2 Differential Calculus 3 Hours

Limits and Continuity: Definition of right hand limit, left hand limit, standard limits

(without proofs)**,** definition of continuity and simple illustrations.

Differentiation: Introduction, definition, differentiation of a function at a point and on an interval, derivative of a function, differentiation of sum, difference, product and quotient of functions, differentiation of algebraic, exponential, logarithmic functions, composite, implicit, parametric, hyperbolic, inverse hyperbolic functions, derivatives of first and second order.

UNIT 3 Integration 8 Hours

Indefinite Integrals: Integration as the inverse process of differentiation, standard forms, properties of integrals, integration by the method of substitution covering algebraic, trigonometric, exponential functions, integration by parts, logarithmic functions, inverse trigonometric functions.

Definite Integrals: Definition of a definite integral and its properties (without proof)

UNIT 4 Introduction to differential equations , Multivariable calculus, and Vector Calculus 8 Hours

Differential Equations : Order and degree of a ordinary differential equations, Formation of ordinary differential equations

Multivariable Calculus : Limits and continuity of functions of two or more variables, Partial derivates, Total derivates(without problems)

Vector Calculus : Gradient, Divergence and Curl (with simple problems), Introduction to line, surface and volume integrals (without problems) illustrated with Stokes, Gauss, and Green's theorems (Only statements).

Textbooks:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IA, IB & IIA, 2018.
2. NCERT class XI and XII (part 1) Mathematics text books.
3. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S.Sharma, Intermediate Mathematics, S.Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

- solve problems involving trigonometric functions
- understand the principles of differential calculus
- evaluate integration using various techniques
- understand the basic concepts of ordinary differential equations,
- understand the basic concepts of multivariable and vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1071	INTRODUCTION TO MATHEMATICS - II	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

1. To describe the basic concepts of matrices
2. To introduce complex numbers and their properties.
3. To teach the techniques based on partial fractions
4. To explain the concepts of straight lines and circles
5. To impart knowledge on solid geometry.
6. To demonstrate the solution of a problem using computationa

UNIT 1 Matrices 6Hours

Matrices, determinants, definition, types of matrices, algebra of matrices, properties of determinants of 2 X 2, 3 X 3 matrices, inverse of a matrix, solving simultaneous linear equations in two and three variables using matrix inverse method, Cramer's rule and Gauss Jordan method. Eigenvalues and Eigenvector of matrices.

UNIT 2 Complex Numbers 6 Hours

Complex number as an ordered pair of real numbers, representation of z⍰ (a, b) in the form (a + ib) conjugate complex numbers, modulus and amplitude of a complex number, geometrical representation of a complex number, Argand diagram.

UNIT 3 Partial Fractions 6 Hours

Introduction, resolving g(x) into partial fractions when g(x) contains non repeated linear factors, repeated linear factors, repeated and non-repeated irreducible quadratic factors.

UNIT 4 Co-ordinate Geometry 6 Hours

Straight lines: General equation of a straight line,line passing through the point of intersection of two given lines, angle between two intersecting lines, condition for perpendicularity and parallelism, length of the perpendicular from a point to a straight line, distance between two parallel lines (without proofs).

Circles: Equation of a circle, centre and radius, equation of a circle through three non collinear points, parametric equations of a circle.

Unit V Solid Geometry 6 hours

Solid Geometry: Equation of a plane, Intersection of two planes, Equation of a sphere in spherical and cartesian coordinates, Intersection of a plane and a sphere.

Textbooks:

1. Textbook for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IB, IIA & IIB, 2018.
2. NCERT class XI and XII (part 1 & 2) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S. Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

1. describe the properties of matrices
2. describe the properties of complex numbers
3. find a fractional function and resolve it into partial fractions
4. illustrate straightline and circle properties and describe different regions in different co-ordinate systems
5. illustrate the procedure to solve a problem using math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2361	PROBABILITY AND STATISTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	Engineering and Science						

Course Description:

Probability theory is important when it comes to evaluating statistics. This course treats the most common discrete and continuous distributions, showing how they use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions.

Course Educational Objectives:

1. To familiarize the students with the foundations of probability and statistical methods
2. To impart concepts in probability and statistical methods in engineering applications.

UNIT 1 Data Science and Probability 10 Hours

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variables: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

UNIT 2 Random Variable and Probability Distributions 8 Hours

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

UNIT 3 Correlation, Regression and Estimation 8 Hours

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

UNIT 4 Testing of Hypothesis and Large Sample Tests 8 Hours

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

UNIT 5 Small Sample Tests 6 Hours

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), χ2 - test for goodness of fit, χ2 - test for independence of attributes.

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. classify the concepts of data science and its importance
2. apply discrete and continuous probability distributions
3. explain the association of characteristics through correlation and regression tools
4. identify the components of a classical hypothesis test
5. infer the statistical inferential methods based on small and large sampling tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MECH1011	ENGINEERING VISUALIZATION AND PRODUCT REALIZATION	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	**None**						
Co- requisite	**3D Printing**						
Preferable exposure	**Fusion 360 Additional Modules**						

Course Description:

This course introduces basic engineering drawing concepts such as projections, sectional views, and utility of drafting and modelling packages. The course imparts the knowledge of modelling and assembling of components using CAD software. The course also includes preparation of 3D models using 3D printing. The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

Course Educational Objectives:

1. To create awareness of engineering drawing as relevant to industry standards.
2. To improve visualization abilities essential for successful engineering design.
3. To impart 2D sketching and 3D modeling using the relevant software.
4. To teach assembly drawing and simulation of motion between mating components.
5. To introduce basic 3D printing software for preparing the products for printing.

List of experiments:

1. Manual Drawing: Introduction to Engineering graphics: Principles of Engineering Graphics and their significance, conventions in drawing lettering, BIS Conventions, Dimensioning, Sectional Views
2. Free hand sketching, Free hand sketching of isometric & orthographic views and interpretation of drawings.
3. Computer Aided Drafting, Introduction to CAD software: Basic draw and Modify commands in 2d
4. Introduction to 2D and 3D modelling using CAD packages
5. Assembly drawings, Assembly of individual 3D components, animation of motion
6. Coordinating multiple moving parts under joint constraints.
7. 3D printing, Introduction to 3D printing software, slicing.
8. Grading and rendering of simple geometries using software.

List of Projects:
Any one project among the following can be opted by the student and submitted:IC Engine Model (3D printed mini model)

- Belt Drive for a bike
- Four Wheel Drivable
- ATV Robot
- Toy making
- Carrom board
- Chess board and pieces model toy train,
- Avengers
- Building Bridges dams etc.,
- Wind Turbine Model etc
- Design of Radar and 3D Printing of Radar
- Models' Programmable logic Controllers –PLC
- Arduino Board Design and 3D Printing of Enclosures for Arduino Boards
- Design of mini mother boards

Text Books:

1. N D Bhatt, 'Engineering Drawing',53,Charotar Publishers, Gujarat India,2019,9789380358963
2. Lydia Sloan Cline,'Fusion 360 for Makers: Design Your Own Digital Models for 3D Printing and CNC Fabrication – Import, 5 June 2018 ',1,Make Comm**UNIT** y LLC,USA,2018,9781680456509

References:

1. Randy Shih,'Parametric Modeling with Autodesk Fusion 360 ',(Spring 2021 Edition),SDC Publications,Squibb Road Mission, KS,2021,1630574376, 9781630574376

Online Resources:

1. Introduction-to-parametric-modeling. 14, 2021, 1:27 p.m., https://www.ascented.com/courseware/product/autodesk-fusion-360--introduction-to-parametric-modeling
2. PP Song et al.,,'https://www.researchgate.net/publication/325189986_Research_and_Application_of_Autodesk_Fusion360_in_Industrial_Design', 2018,8

Course Outcomes:

1. Prepare drawings as per international standards.
2. Utilize Engineering visualization as Language of Engineers.
3. Sketch 2D models using CAD software
4. Sketch 3D models using CAD package.
5. Develop model for printing simple objects using 3D printer

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	1	2							3	1	1
CO2	3	3		2	1	3	1		2	1	1		2	2	1
CO3	2	3		3	1	2			2	1	2		3	2	1
CO4	2	3		3	1	3							3	2	2
CO5	3	3	3	3	3	3		2		3	3	1	3	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG 4 - ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG-9 engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation***.***
SDG Justification:
SDG 4-The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG 9-The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

MECH1021	WORKSHOP	L	T	P	S	J	C
		0	0	2	0	0	2
Pre-requisite	**None**						
Co- requisite	**Isometric Views, Development of surfaces**						
Preferable exposure	**2D Drawings, Power tools**						

Course Description:

This course enables the students to familiarize with the basic fabrication practices and to explore the various devices, tools and equipment used. Hands-on exercise is provided in various trade sections. Essentially student should understand the labor involved, machinery or equipment necessary, time required to fabricate and should be able to estimate the cost of the product or job work which are fundamental tasks for engineering plans.

Course Educational Objectives:

1. Explain tools used in carpentry, fitting and sheet metal and practice procedure of doing experiments.
2. Make the students to learn types of basic electric circuit connections and PCBs.
3. Provide training to prepare FRP composites.
4. Train the students on preparing 3D plastics using injection molding.
5. Demonstrate on utilizing 3D printer for printing 3D objects

List of Jobs:

1. Wood Working - Cross halving Joint/Dove Tail Joint/End Bridle Joint (Any two)
2. Sheet Metal working - Taper tray/conical funnel/Elbow pipe (Any Two) (including soldering).
3. Fitting- V fit/Dove Tail fit/ Semicircular fit (Any Two)
4. Electrical Wiring -Parallel and series connection
5. Electrical Wiring -Two-way switch connection
6. Electrical Wiring- Wiring of lighting systems
7. Injection molding-Make any two plastic components using injection molding machine.
8. 3D printing Demonstration

Text Books:

1. P. Kannaiah, K. L. Narayana, 'Workshop Manual', 2/e, Scitech Publications, India, 2007.
2. B. L Juneja , 'Workshop Practice ', 1/e, Cengage Learning ,Delhi, 2015

References:

1. K Mallick, 'Fiber-Reinforced Composites: Materials, Manufacturing, and Design', 3/e, CBC Press, New York, 2007.

Course Outcomes:

After completion of this lab the student will be able to

1. Summarize application of different power tools
2. Develop different parts with metal sheet/wood working/fits in real time applications.
3. Demonstrate electrical circuits in various applications.
4. Prepare models using injection molding m/c .
5. Familiarize with 3D printer operations

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			3				2			3	2		
CO2	2	2	3	1	3	2	2		3	3			3	2	
CO3	3	2											2		
CO4	2	2	3		2								2		
CO5	3	1			2		1						2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :29-4-2021 **ACADEMIC COUNCIL: 17-9-2021**

SDG No. & Statement:

SDG 4 - ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

MECH1001	DESIGN THINKING	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**None**						

Course Pre-requisite(s): Engineering Visualization and Product Realization

Course Description:

Design is a realization of a concept or idea into a configuration, drawing or product. Design Thinking is the cognitive and practical process by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end-user. This course introduces design thinking in product innovation.

Course Educational Objectives:

1. To familiarize the product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

Topic	Type
Each member of the group has to ask (vocally) the group members different questions about a product that they would like to design. Write down the questions and answers and submit as a word or pdf document.	Exercise
Each member of the group must ask (vocally) the group members questions about the product chosen in the previous experiment. This helps to gain indepth insights as well as new findings and information in order to grasp the problem or situation holistically or simply to find relevant questions for an interview. Write down the questions and answers and submit as a word or pdf document	Exercise
• Identify relevant factors of influence that constitute the basis for a new or improved product or offer; then analyze it in a targeted manner. • Make sure that you are sufficiently creative in the analysis process, because the focus is on technical "details". • Boost the efficiency of the analysis process by avoiding empty runs. • Make use of a standardized procedure in order to examine the problem and solution space again with the help of data.	Exercise
• Do research, talk with people, and have empathy to formulate profound stories. • Summarize the results from the "understand" and "observe" phases and discuss with the team.	Exercise

- Highlight unexpected results and generate new perspectives.
- In general, share insights, ideas, and results (solutions) with others.
- Explore untapped market opportunities. Exercise
- Provide differentiated and new offers based on the user needs.
- Adapt a strategy to new market needs by understanding the competitive edge.
- Establish the right vision for the design challenge or a road map for stepby-step implementation and control mechanisms.
- Find out at an early stage whether the basic need is satisfied and the product attracts interest on the market. Exercise
- Find out through iterative testing whether the user need is met with a minimally functional product and how the product should be enhanced.
- Find out through user feedback how much demand there is for the product before developing further details and features.
- Minimize the risk of investing in a solution for which there is little demand on the market, thus saving time, money, and energy.
- Perform a true A/B test or several variants of a prototype in the form of a multi-variants test or as split testing. Exercise
- Do a quantitative evaluation.
- Carry out a qualitative survey and evaluate the number and content of feedbacks.
- Compare individual variants of a function or a prototype (e.g. buttons, visuals, arrangement).
- Collect and appraise experiences made in the project in a structured manner. Exercise
- Learn from experience and make use of it in the next project.
- Facilitate a positive attitude toward mistakes and appreciate progress.
- Identify and document the findings; make them applicable and usable.
- Case Studies: Example : Software Prototyping, Additive Manufacturing; Design of Arduino Boards for various applications etc Exercise

Text Books:

1. Pahl, Beitz, Feldhusen, Grote,'Engineering Design: a systematic approach',3rd,Springer Science & Business Media,London,2007,978-1846283185
2. Christoph Meinel,Larry Leifer,Hasso Plattner,'Design Thinking Understand – Improve – Apply',1st,Springer,Berlin, Heidelberg,2011,978-3-642-13756-3

References:

1. Marc Stickdorn, Jakob Schneider,'This is Service Design Thinking: Basics, Tools, Cases',1st,WILEY,United States,2012,978-1-118-15630-8

Course Outcomes:

1. Innovate new methods in product development

2. 2 Apply Design Thinking in developing the new designs
3. Select ideas from ideation methods in new product development
4. Use Design Thinking in developing software products
5. Apply principles of Design Thinking in service design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	1	2							3	1	1
CO2	3	3		2	1	3	1		2	1	1		2	2	1
CO3	2	3		3	1	2			2	1	2		3	2	1
CO4	2	3		3	1	3							3	2	2
CO5	3	3	3	3	3	3		2		3	3	1	3	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS: 29-4-2021 **ACADEMIC COUNCIL: 17-9-2021**

SDG No. & Statement:
SDG 9
The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.
SDG Justification:
The course involves design aspects

PHYS1001	PHYSICS	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	None						

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce mathematical principles to estimate forces, fields and waves.
2. To familiarize students with electromagnetics in modern communication systems.
3. To impart knowledge concerning the electrical behaviour of dielectric materials.
4. To demonstrate the properties of magnets.
5. To introduce semiconductor physics and devices.

UNIT 1 Basics of Electromagnetics 9 Hours

Electrostatic field: Coulomb's law and Gauss 'law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations. Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

UNIT 2 Fiber Optics 7 Hours

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

UNIT 3 Dielectric, Magnetic and superconducting Materials 10 Hours

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only). Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Superconductivity: definition –Meissner effect –type I & II superconductors –BCS theory (qualitative) –high temperature superconductors –Josephson effects applications.

UNIT 4 **Semiconductor Physics** **8 Hours**

Introduction, origin of energy band, intrinsic and extrinsic semiconductors, mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p- type semiconductors, Drift and diffusion currents in semiconductors.

UNIT 5 **Semiconductor Devices** **8 Hours**

Zener Diode, Tunnel diode, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

PHYSICS LABORATORY

List of Experiments

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
3. To determine magnetic susceptibility by Quincke's tube method
4. To determine the Hall coefficient using Hall effect experiment
5. To determine the resistivity of semiconductor by Four probe method
6. To determine the energy gap of a semiconductor.
7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode
12. To study the characteristics of Solar Cell
13. To study the characteristics of Zener diode
14. To study the resonance of LCR circuit

Text Books:

1. David J.Griffiths, "Introduction to Electrodynamics", 4/e, Pearson Education, 2014.
2. Charles Kittel, "Introduction to Solid State Physics", Wiley Publications, 2011.
3. M. N. Avadhanulu, P.G. Kshirsagar, "A Text book of Engineering Physics", 11/e, S. Chand Publications, 2019.

References:

1. Principles of Physics, 10ed, ISV, Jearl Walker, David Halliday, Robert Resnick, Wiley India.
2. Gerd Keiser, "Optical Fiber Communications", 4/e, Tata Mc Graw Hill, 2008.
3. S.O.Pillai, "Solid StatePhysics", 8/e, New Age International, 2018.
4. S.M. Sze, "Semiconductor Devices-Physics and Technology" , Wiley, 2008.

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.5144798
3. https://aapt.scitation.org/doi/abs/10.1119/1.1511591

Course Outcomes:

1. Apply mathematical principles to estimate magnetic and electric forces, fields and waves
2. Use the principles of EM waves and Maxwell equations to understand communication systems
3. Apply basic properties of dielectric, magnetic and superconducting materials in electromagnetics
4. Understand physics of semiconducting materials
5. Use working principles of semiconducting devices in electronic circuits

Text Book:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers,2017

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	1	1							1			1	1		
CO3	1	1							1			1	1		
CO4	1	1							1			1	1		
CO5	1	1							1			1	1		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1011	MECHANICS AND PROPERTIES OF MATTER	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for students of Aerospace, Civil and Mechanical Engineering. It introduces fundamentals of elasticity and thermal properties – the essentials for understanding the behaviour of materials. Mechanics of solids is taught to acquaint them with the behaviour of rigid objects. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To acquaint the basic concepts of sound waves and principles in acoustic design.
2. To introduce the concepts of elasticity, strain hardening and failure in materials and impart the relation between stress and strain.
3. To impart the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems.
4. To demonstrate the use of Newton's laws of motion for understanding the mechanics of a particle.
5. To explain the working principle and construction of different types of sensors.

UNIT 1 **Mechanics** **10 Hours**

Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = - grad V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.

UNIT 2 **Elasticity** **8 Hours**

Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli.

UNIT 3 **Thermal Properties** **10 Hours**

Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints - bimetallic strips; Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.

UNIT 4 Acoustics 8 Hours

Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of buildings, Acoustic requirements of a good auditorium.

UNIT 5 Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors- Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.

Text Books:

1. D.Kleppner and Robert Kolenkow"An Introduction to Mechanics- II" Cambridge University Press,2015.
2. M.N. Avadhanulu & T.V.S. Arun Murthy, S Chand A Textbook of Engineering Physics, Volume-I 2018.
3. Ian R Sinclair, Sensor and Transducers 3/e,Elsevier (Newnes), 2001.

References:

1. M K Varma, "Introduction to Mechanics"-Universities Press, 2015
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., McGraw Hill Education (India) Private Limited, 2013.

Course Outcomes:

After completion of this course, the student will be able to

1. describe the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships
2. apply the concepts of strain, internal force, stress and equilibrium to deformation of solids
3. explain the fundamental theory for the analysis of heat transfer processess in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters
4. estimate forces and moments in mechanical systems using scalar and vector techniques
5. outline the basic principle and operation of different types of sensors

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1							1			1		1	1	
CO2	1	1						1			1		1	1	
CO3	1	1						1			1		1	1	
CO4	1	1						1			1		1	1	
CO5	1					1		1			1		1	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1021	PRINCIPLES OF QUANTUM MECHANICS	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	None						

Course Description:

This course is designed with principles of Quantum mechanics for advanced courses in their respective engineering branches. It introduces Quantum mechanics with relevant mathematical tools and provides a basis for further study of quantum mechanics. It also introduces basics of Qubits for Quantum computing applications.

Course Educational Objectives:

1. To introduce the basic principles of quantum mechanics.
2. To introduce wave equation and significance of wave function.
3. To teach solving the Schrödinger's equation for spinless particles moving in one-dimensional potential.
4. To develop an understanding of concepts of angular momentum.
5. To introduce Dirac bra-ket formalism and the concept of QUBITs.

UNIT 1 Introduction to Quantum Physics 10 Hours

Introduction, Classical Mechanics vs Quantum Mechanics, Planck's quantum theory (qualitative), Photo-electric effect. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them, Wave-particle duality, Heisenberg uncertainty principle: ground state energy of hydrogen atom.

UNIT 2 Properties of Matter Waves 8 Hours

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities, and normalization.

UNIT 3 Quantum Tunneling 8 Hours

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimensional rectangular potential barrier, 1D linear harmonic oscillator (no derivation required, only eigen function, eigen values and zero-point energy).

UNIT 4 Quantum Properties of Electrons 9 Hours

Electron angular momentum, angular momentum operator, Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect, Stark Effect, Gyromagnetic Ratio and Bohr Magneton (qualitative)

UNIT 5 Qubits for Quantum Computing 10 Hours

Introduction to Dirac Bra-Ket notation, Introduction to Pauli spin matrices, Quantum Superposition, Interference, Quantum Measurement, Decoherence, Entanglement, Bloch sphere, Qubits, and multiple qubits, Qubits Vs classical bits, representation of a qubit probability.

Textbooks:

1. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
2. Quantum Mechanics, Satya Prakash, 2016, Pragati Prakashan.
3. Quantum Computing for Everyone, Chris Bernhardt, 2019, The MIT Press,

References:

1. Introduction to Quantum Mechanics, D.J. Griffith, 2ndEd. 2005, Pearson Education.
2. Quantum Computing: An Applied Approach, Jack D. Hidary, 2019,

Journal(s):

1. https://aapt.scitation.org/doi/full/10.1119/1.4897588
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Websites

1. https://www.intechopen.com/online-first/73811
2. https://www.quantum-inspire.com/kbase/what-is-a-qubit/

Course Outcomes:

At the end of this course, the students will be able to:

1. Explain the basic principles of quantum mechanics.
2. Interpret wave equation and significance of wave function.
3. Solve the Schrödinger's equation for spinless particles moving in one-dimensional potential.
4. Understand of concepts of angular momentum and spin.
5. Apply Dirac bra-ket formalism to the concept of QUBITs.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			2	1		
CO2	1	1							1			2	1		
CO3	1	1							1			2	1		
CO4	1	1							1			2	1		
CO5	2	2							2			2	2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1241</td><td rowspan="2">PHYSICS OF OPTOELECTRONIC DEVICES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors, and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce nature light and its properties.
2. To familiarize students with different semiconductors and its energy band gaps.
3. To introduce semiconductor physics and devices.
4. To impart knowledge about the semiconducting optical devices.
5. To demonstrate the properties of different semiconducting optical devices.

UNIT 1 Elements of light 8 Hours

Nature of light, Light sources, Black body, Colour temperature, Units of light, Radio metric and photometric units, Light propagation in media and waveguides, Electro-optic effects. Overview of luminescence: Photoluminescence, Cathodoluminescence, Electroluminescence, Injection-luminescence.

UNIT 2 Semiconductor Materials 10 Hours

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT 3 Principles of Lasers 10 Hours

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, Transition rates (Fermi's golden rule), Optical loss and gain; semiconducting diode laser, applications of semiconductor Lasers.

UNIT 4 Solar cells and Photovoltaic devices 9 Hours

Charge carrier generation and recombination, p-n junction model and depletion capacitance, Photovoltaic effect, Physics of Solar Cells, Principle of solar energy conversion,

Conversion efficiency, Type of solar cells in use: Dye Sensitized Solar Cells, Thin film solar cells, Perovskite Solar cell.

UNIT 5 Semiconductor devices 8 Hours

Radiative recombination devices: Light-emitting diodes (LED), Organic Light Emitting Diodes (OLED) and its types, Photoelectric devices: Photodiodes. Photo conducting devices: Photodetectors and photoconductors, Photoresistors, Photo transistors.

Textbooks:

1. Jasprit Singh, Optoelectronics – An Introduction to materials and devices; McGraw Hill,1996.
2. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition 2019
3. Maurice Quillec, Materials for Optoelectronics; Springer Science, 1996.
4. S. C. Gupta, Optoelectronic Devices and Systems; Prentice Hall India, 2005.
5. P. Bhattacharya, Semiconductor optoelectronic devices; Prentice Hall India, 2006.

References:

1. Pyshkin, Ballato, Optoelectronics - Advanced Materials and Devices; InTech, 2013.
2. Manijeh Razeghi, Optoelectronic materials and device concepts; SPIE, 1991
3. Sun and Dalton, Introduction to Organic Electronic and Optoelectronic Materials and Devices; CRC Press, 2008.
4. J. Palais, Introduction to optical electronics; Prentice Hall, 1988.
5. Jasprit Singh, Semiconductor optoelectronics; McGraw-Hill, 1995.

Course Outcomes:

After completion of this unit, the student will be able to

1. Outline the properties of semiconductors
2. explain the occupation probability and Fermi level variation in different electronic materials
3. Know about the interaction of light with materials and its optical properties
4. Explain the conduction mechanism in semiconducting and optical devices.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	2	1							1			2	1		
CO3	1	1							1			2	1		
CO4	2	1					1		1			2	1		1
CO5	2	1					1		1			2	1		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1041	MECHANICS AND MODERN PHYSICS	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course designed for students of Biotechnology to impart principles of Newtonian mechanics will help the students in understanding the oscillatory behavior of materials. It also introduces fundamentals of quantum mechanics – the essentials for understanding the behavior of properties of materials. Fundamentals of optics and electromagnetism in understanding the use in spectroscopy. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To impart knowledge on damped and forced oscillations.
2. To familiarize students with the concepts of quantum mechanics
3. To impart knowledge concerning the wave properties of electromagnetic waves
4. To familiarize the students about the Maxwell's equations and its propagation
5. To outline the principles and working of few common sensing devices

UNIT 1 Fundamentals of Dynamics and Oscillations 10 Hours

Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations.
Galilean invariance. Review of Newton's Laws of Motion.
Oscillations: SHM, Simple Harmonic Oscillations. Differential equation of SHM and its solution. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor

UNIT 2 Modern Physics (Quantum Physics) 8 Hours

Introduction, matter waves and its properties, Davisson-Germer experiment, GP Thomson experiment, Heisenberg's uncertainty principle, Schrodinger's time independent wave equation, physical significance of wave function, particle in a one-dimensional infinite well, rectangular potential barrier (transmission coefficient), band theory of solids (qualitative), distinction between metals, insulators and semiconductors, introduction to Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstien statistics.

UNIT 3 Optics 10 Hours

Interference: Introduction, interference in thin films due to reflected light: interference in parallel-sided film and wedge-shaped film, Newton's rings. Diffraction: Introduction; Fraunhofer diffraction at single slit (qualitative only), diffraction due to N-slits (diffraction

grating) (qualitative only), determination of wavelength of light with a plane transmission grating.
Polarisation: Introduction; Double refraction –double refraction in calcite crystal, negative and positive crystals, Nicol's prism, Retarders (quarter and half¬wave plates).

UNIT 4 Maxwell`s equations and Electromagnetic wave propagation 8 Hours

Maxwell's equations (both differential and integral forms) and its physical significance, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization of EM waves.

UNIT 5 Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors -Piezoelectric, magnetostrictive sensors, ultrasonic sensors; Fibre optic methods of pressure sensing; Temperature sensor -bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors

Textbooks:

1. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000.
2. A Text Book of Optics, 25/e, Brij Lal, M N Avadhanulu & N Subrahmanyam, 2012, S. Chand Publishing.
3. Ian R Sinclair, Sensor and Transducers 3rd eds, 2001, Elsevier (Newnes)
4. David J. Griffiths, "Introduction to Electrodynamics"-4/e, Pearson Education,2014
5. M.N. Avadhanulu, P.G. Kshirsagar, A Textbook of Engineering Physics, S.Chand, 2014.

References:

1. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1st eds., 2013 McGraw Hill Education (India) Private Limited.
3. Elements of Properties of Matter, D. S. Mathur, S. Chand Publishing

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Course Outcomes:

At the end of this course, the students will be able to:

1. Understand the concept of damped and forced oscillations.
2. Understand concepts of quantum mechanics
3. Understand interference, diffraction and polarization of light waves
4. Know about the maxwell's equations and its propagation
5. Use principles and working of few common sensing devices

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1				1	1				
CO2						1				1	1				
CO3						1				1	1				
CO4						1				1	1				
CO5						1				1	1				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PROJ2999</td><td rowspan="2">CAPSTONE PROJECT – INTRODUCTION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

At the end of the course the student will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PROJ3999</td><td rowspan="2">CAPSTONE PROJECT – FINAL</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>6</td><td>6</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">PROJ2999</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics:

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

At the end of the course the student will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ2888	PROJECT EXHIBITION 1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**None**						

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

1. Excite interested students in continuing/initiating in the work of interest
2. Attract startups/industry to commercialize the project work
3. acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PROJ3888</td><td rowspan="2">PROJECT EXHIBITION 2</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">PROJ2888</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

- Excite interested students in continuing/initiating in the work of interest
- Attract startups/industry to commercialize the project work
- acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

VIVA3555	COMPREHENSIVE EXAMINATION	L	T	P	S	J	C
		1	0	0	0	0	1
Pre-requisite	**Completion of minimum of six semesters**						
Co- requisite	**None**						
Preferable exposure	**None**						

Course Educational Objectives:

1. Designed to test the students on the computer science and Engineering concepts, and tools, and the process of identifying and solving engineering problems.

Course Outcomes:

The students will be able to

1. Apply knowledge of mathematics, science, and engineering
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care and safety, manufacturability, and sustainability

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

BTEN1001	INTRODUCTION TO BIOTECHNOLOGY-I	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	None						

Course Description:

This course introduces the student to the basics of biology such as classification, cell structure, biomolecular structure, metabolism, function

Course Educational Objectives:

- Introduce the cellular basis of life.
- Provide the basis for classification of living organisms.
- Describe the important biomolecules
- Describe the applications of biomaterials
- Describe the different metabolic pathways

UNIT 1 **6 hours**

Introduction to Biology, Cellular basis of life, differences between prokaryotes and eukaryotes. Classification based on carbon and energy sources, Tools of molecular taxonomy

UNIT 2 **8 hours**

Biomolecules, structure and functions of proteins, nucleic acids, lipids and sugars. Structure and function of hemoglobin, antibodies and enzymes. Industrial applications of enzymes

UNIT 3 **10 hours**

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation. Anaerobic respiration and Fermentation and its industrial applications Mechanism of photosynthesis, Light and dark reactions

UNIT 4 **12 hours**

Genetics: Mendel's laws of inheritance. Gene interactions- Epistasis, Incomplete & Codominance, Multiple alleles, Additive, complementation, Pleiotropism. Linkage, Crossing over. Gene mapping. Cell cycle and regulation. Mitosis and Meiosis

UNIT 5 **14 hours**

Human physiology – Membrane transport- Active and passive. Cell signaling and communication. Neurons – structure, function and types. Synapse-types, neurotransmitters, transmission of nerve impulse. Neuromuscular junctions. Muscle- structure, function and types.

Textbooks:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011

References

1. Alberts et. al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.
3. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain classification of living organisms.
2. Explain cell as the basis of life
3. Explain the importance of various biomolecules
4. Summarize application of enzymes and fermentation in industry.
5. Analyze metabolic pathways

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1										2			3			
CO2											2		3			
CO3		2	2							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

BTEN1021	INTRODUCTION TO BIOTECHNOLOGY-II	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co- requisite	None						
Preferable exposure	None						

Course Description:

This course introduces the student to the Applications of Biotechnology in plant , animal and industrial development

Course Educational Objectives:

1. Describe the concept of Central Dogma of Molecular Biology
2. Describe the transfer of genetic information.
3. Introduce recombinant DNA technology
4. Introduce the techniques used for modification of living organisms

UNIT 1 10 hours

Biotechnology: Concept, scope and importance. Origin of life-theories. Structure of bacterial, plant and animal cells-functions of cell organelles. Significance of biomolecules in biological systems

UNIT 2 12 hours

The central dogma of molecular biology. Concepts of genetic engineering, Restriction endonucleases, cloning vectors, methods of gene transfer. Polymerase Chain Reaction. Introduction to bioinformatics and biological databases

UNIT 3 12 hours

Biotechnology for Plant improvement: Strategies for engineering stress tolerance, transgenic plants. Micropropagation of novel varieties. Production of secondary metabolites and their importance. Molecular pharming.

UNIT 4 12 hours

Biotechnology for improvement of animals: Applications in animal husbandry, medicine and animal husbandry. Transgenic animals. Gene therapy and genetic counseling. Bioethics.

UNIT 5 14 hours

Industrial and Microbial Biotechnology: Overview of industrial fermentation process and products. Fermentation technology for production of Penicillin. Introduction to patents. Biotech industry in India and abroad.

Textbooks:

1. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal society of chemistry, 2009.
2. W. Godbey, An Introduction to Biotechnology, The Science, Technology nd Medical Applications, 1/e, Woodhead Publishing, 2014.

References

1. P.K. Gupta, Elements of Biotechnology, 2/e, Rastogi Publications, 2014.
2. B. Albert’s, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts and P.Walter, Molecular Biology of the Cell, 6/e, Garland Publishers, 2014.
3. H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, Amon and M. P. Scott, Molecular Cell biology, 7/e, W.H Freeman and Company, 2014.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain the scope and importance of biotechnology
2. Understand the application of biotechnology in transgenic plant development.
3. Understand the role of biotechnogy in animal husbandry and livestock improvement
4. Explain the potential of biotechnology in industry in strain improvement

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1									2			3			
CO2		2									2		3			
CO3			3							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

FINA1031	**PRINCIPLES AND PRACTICE OF BANKING**	**L**	**T**	**P**	**S**	**J**	**C**

		3	0	0	0	0	3
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**None**						

Course Description:

The significance of the banking sector in India has been continuously upward for several decades. The sector is playing a role of a catalyst in the development of the economy. The Banks started playing a critical role in the social development process and became a partner in Government's welfare schemes and policies. Principles of and Practices of Banking course explores the fundamental principles and practices of banking and credit in India. It helps students to understand basics of banking and regulation to recent developments in Banking technology

Course Educational Objectives:

1. To understand the Indian financial system, role of commercial Banks, RBI in India and the regulations of Indian Banks.
2. To comprehend the banking Principles
3. To give the student adequate exposure to banking practice.
4. To acquaint and apply innovations in the banking sector.
5. To give an overall exposure to banking Principles and Practice.

UNIT 1 Banking System and Structure 9 Hours

Banking system and structure in India: Evolution of Indian Banks-Types of banks; Commercial Banks, Cooperative Banks, Role of RBI; Banking Regulation, Constitution, Objectives, Functions of RBI, Tools of Monetary control; Regulatory Restrictions on Lending. Types of Banking- Retail, Wholesale and International Banking.

UNIT 2 Risk management and Basel Accords 9 Hours

Introduction to Risk Management and Basel I, II &III Accords. Role and functions of CIBIL. Fair practices code for debt collection. Principles of Lending: Cardinal Principles, Non-fund-based limits, Credit appraisal Techniques. Cash management services and its importance.

UNIT 3 Functional Banks 9 Hours

Banker Customer Relationship: Types, Different Deposit Products & Services, Services to customers and Investors; PMLA Act; KYC Norms; Banker as lender: Types of loans, Overdraft facilities, Discounting of bills, Financing book Debts and supply bills- Charging of Security bills- pledge, mortgage

UNIT 4 Customer Protection 9 Hours

COPRA Act and its operational aspects; Banking Ombudsman Scheme; Role and duties Paying and collecting Banks; Banker Protection under Negotiable Instrument Act-Endorsement, Forged Instruments- Bouncing of Cheques and their implications; Operational aspects of opening and maintaining accounts of various types of account holders. Ancillary Services: Remittances & Safe Deposit lockers, Govt Business, EBT

UNIT 5 Banking Technology 9 Hours

Computer Systems: LAN,WAN, UPS, Core banking, Data warehousing, Data Mining. Digital Banking: ATMs, Electronic Kiosks-CDK, BNA, PBP; Cards – Types, Networks, Wallets; PPI. Electronic Banking – Internet & Mobile Banking. Trends In Communication Networks for Banking: EFT System, SWIFT, RTGS, NEFT, Automated Clearing System. Digital Payment Systems – NPCI

Textbooks:

1. Principles and Practices of Banking, IIFB, 5thEditionn 2021
2. Principles And Practices Of Banking (Paperback, N S TOOR & ARUNDEEP TOOR) 14th Edition

References:

1. Shekhar&Shekhar (2010),Banking Theory and Practice, New Delhi: Vikas Publishing House.
2. P.K. Srivastav(2011),Banking Theory and Practice, NewDelhi:Vikas Publishing House.
3. Sundaram& P.N. Varshney (2010), Banking Theory, Law and Practice, New Delhi:S.Chand& Co.
4. Padmalatha Suresh and Justin Paul (2013),Management of Banking and Financial Services, New Delhi: Pearson Education.

Journal(s):

1. GITAM Journal of Management, Visakhapatnam.
2. The Journal of Banking Studies, Mumbai.

Website(s):

1. htps://www.icai.org/

Course Outcomes:

1. Student acquires knowledge about theoretical aspects of banking and
2. Student acquires knowledge about relationship between banker and customer
3. Student learns about the practicalities of banking and the latest trends in banking.
4. Students develops skills about legal aspects and negotiable instruments.
5. Student enhance knowledge about latest banking trends and technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	0							3	1	0
CO2	1	2	0	1	0	0							2	1	1
CO3	2	2	3	2	1	0							0	1	1
CO4	1	2	3	2	1	2							2	0	1
CO5	0	0	0	0	1	1									

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

HRMG1021	HUMAN RESOURCE MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co- requisite	**None**						
Preferable exposure	**None**						

Course Description:

Success in today's competitive business environment is increasingly a function of effective management of its resources, particularly human resources, which are the most valuable assets of an organization. The efficiency and quality of service of an organization depend on its employee's enthusiasm and satisfaction with their jobs, which are directly related to their sense of being treated fairly. To become a successful manager, it is imperative to understand human sensitivities and factors that motivate individuals. Human Resource Management course provides the basic tools required as an HR professional in an organization

Course Educational Objectives:

1. To Understand the fundamentals, evolution, function & challenges of HRM
2. To Explore the role of HRM in procurement, development of human resources
3. To Analyze the basic factors in designing the compensation and collective bargaining
4. To Evaluate safety and health and establish effective separation practices.

UNIT 1 **Introduction** **10 Hours**

Introduction: Nature, scope and significance of HRM - Evolution of HRM – Recent trends in HRM – Functions of HRM – Challenges of HR managers.)

UNIT 2 **Procurement** **10 Hours**

Procurement: Human Resource Planning – HR Forecasting methods - Job analysis and Job design – Recruitment - Selection – Induction.

UNIT 3 **Development** **10 Hours**

Development: Identification of training needs - designing the training program – Methods of training – Difference between Training & Development.

UNIT 4 **Compensation and Integration** **10 Hours**

Compensation and Integration: Introduction - Basic factors in determining pay rates – Basic, Supplementary and Executive Remuneration – types of employee benefits and services - Quality of work-life – Collective Bargaining.

UNIT 5 **Separation and maintaining** **10 Hours**

Separation and Maintaining: Communication and Counseling - Safety and Health – Internal mobility - Retirement and Retirement benefits..

Textbooks:

1. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 16th edition.
2. George W Bohlander, Scott A Snell, "Principles of Human Resource Management," Cengage Learning, 2017.16th edition.
3. Aswathappa, K., Human Resource and Personnel Management: Text & Cases, TMGH
4. Subba Rao, P., Personnel and Human Resource Management (Text & Cases), Himalaya

References:

1. Edwin B Flippo, "Personnel Management," Tata McGraw Hill Publishing, New Delhi, 1984
2. John H. Bernardin, "Human Resource Management - An Experiential Approach," Tata McGraw Hill, New Delhi, 2013
3. Mirza, Saiyadain, "Human Resource Management," Tata McGraw Hill, New Delhi, 2013
4. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 2015 14th edition.

Journal(s):

- Harvard Business Review, Harvard Business School Publication USA
- People Matters Online Magazine
- Human Capital Magazine
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

On successful completion of this course, students will be able to:

- Understanding the concept of HRM and its importance.
- Describe the process of workflow analysis and identify why it is essential to HRM.
- Understand the concepts of Training and Development
- List various factors determining pay rates.
- Analyze the role of the supervisor in employee safety and minimize accidents at the workplace.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	0	2						3	1	0
CO2	1	2	1	3	1	1	1						2	1	1
CO3	2	1	2	2	1	0	1						0	1	1
CO4	2	1	2	1	1	1	3						2	0	1
CO5	0	0	2	3	0										

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 8 Decent Work and Economic Growth

SDG Justification: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

<table>
<tr><td rowspan="2">MKTG3011</td><td rowspan="2">SALES AND DISTRIBUTION MANAGEMENT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co- requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Sales Management focuses on the sales techniques and the management of the sales force. The success of any sales and marketing department lies in the effectiveness of the Sales Force. The goal of the Sales Management course is to examine the elements of an effective sales force as a key component of the organization's total marketing effort. A successful Sales Manager needs to understand the fundamentals of the sales process, the relationship between sales and marketing, sales force structure and issues in recruiting, selecting, training, motivating, compensating and retaining sales people.

Course Educational Objectives:

1. To understand the planning and staffing needs in professional sales
2. To learn how to manage and motivate a professional sales team as a Sales manager
3. To analyse the key success factors for sales executive performance.

UNIT 1

Introduction to Sales Management - Evolution of Sales Management, importance of Sales Management, types of Selling, difference between Selling and Marketing, Modern Day Sales Activities, Selling Skills, Selling Strategies, Selling Process.

UNIT 2

Sales Planning and Budgeting: Sales planning process, sales forecasting methods, sales budgeting process, methods used for deciding sales budget, types of quotas and quota setting procedure, reasons for establishing or revising sales territories, routing and scheduling sales persons, market cost analysis.

UNIT 3

Sales Force Management: Recruitment and selection of the sales force, training the sales force, sales force motivation, sales force compensation, sales force control and evaluation.

UNIT 4

Introduction to Distribution Management -Definition, need for Distribution Channels, designing the Marketing Channels, Motivating and Evaluating Channel Members, Capturing the Customer requirements

UNIT 5

Managing Distribution Channels - Managing Channel Information Systems, reasons for Channel Conflicts, Managing Conflict, Managing, Ethical issues in Sales and Distribution Management

Textbooks:

1. Krishna K Havaldar, Vasnt M Cavale, Sales and Distribution Management, 2nd edition, Tata Mcgraw Hill, 2011.

References:

1. Tapan K. Panda &Sunil Sahadev (2011), Sales and Distribution Management 2nd edition Oxford Press.
2. S.L. Gupta, M.K.Rampal (2009) Cases in Sales and Distribution Management, Himalaya Publication house.
3. K.Sridhara Bhat (2011) Sales and Distribution Management, 1st, Himalaya Publication house.
4. S.A.Chunawalla (2012) Sales and Distribution Management, 3rd edition, Himalaya Publication house.
5. Dinesh kumar (2012) Marketing Channels ,Oxford Press.
6. Richard R Still, Edward W Cundiff, Norman &A P Govoni(2011) Sales and Distribution Management, 5th edition, Pearson Publications.
7. Spiro Stanton & Rich (2010) Management of Sales Force, 13th edition, Tata McGraw Hill.
8. Prof. M.V. Kulkarni (2010) Sales and Distribution Management, Everest Publishing House.
9. Anne T Coughlan etal (2011), Marketing Channels, 7th edition, Pearson education.
10. Mark W Johnston, Greg W Marshall (2009), Sales Force Management, 9th edition, Tata McGraw Hill.
11. Dr.S.L.Guptha (2010), Sales and Distribution Management, 2nd edition, Excel books.
12. PingaliVenugopal (2012) Sales and Distribution Management, Sage Publications

Journal(s):

- Indian Journal of Marketing & Journal of Advertising Research
- GITAM Journal of Management, GITAM Institute of Management, GITAM Deemed to be university, Visakahapatnam
- Harvard Business Review, Harvard Business School Publication Co. USA
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

On successful completion of this course, students will be able to:

1. Students would be able to understand the planning and staffing needs in professional sales.
2. Students would learn how to manage and motivate a professional sales team, as a sales manager.
3. Students would be able to analyze the key success factors for sales executive performance.
4. Students would learn how to manage and motivate distribution channel members.
5. Students can manage distribution channels and manage conflicts

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	0	2	0	0	0	0	1	3	1	0
CO2	1	2	1	3	1	1	1	0	0	0	0	1	2	1	1
CO3	2	1	2	2	1	0	1	0	0	0	0	1	0	1	1
CO4	2	1	2	1	1	1	3	0	0	0	0	1	2	0	1
CO5	0	0	2	3	0	1	1	0	0	0	0	1	1	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

Programme Core

CSEN1041	COMPUTER ENGINEERING WORKSHOP	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course will provide student a much-needed knowledge of computer hardware and networking, enabling them to identify and rectify the onboard computer hardware, software and network related problems. With the help of this course the student will be able to understand the hardware specifications and installation of System Software MS-Windows, Linux and the required device drivers. In addition, hardware and software level troubleshooting process, tips and tricks would be covered. Usage of web browsers, e-mails, news groups and discussion forums would be covered. In addition, awareness of Ms Office- Word, Excel and PowerPoint and other Cloud based productivity enhancement and collaboration tools would be introduced.

Course Educational Objectives:

1. To get familiar with hardware components of a computer, I/O Devices, ports etc.
2. To understand basic command of Linux.
3. Learn how to use Internet for productivity and self-paced lifelong learning.
4. Understand the concepts of Compression, Multimedia and Antivirus tools.
5. Study Office Tools such as Word processors, Spreadsheets and PowerPoint etc.

UNIT 1 PC Hardware and Software 6 hours

Task 1: Identification of peripherals of a PC, Laptop, Server and Smart Phones: Prepare a report containing the block diagram along with the configuration of each component and its functionality, Input/ Output devices, I/O ports and interfaces, main memory, cache memory and secondary storage technologies, digital storage basics, networking components and speeds.

Task 2: Introduction to operating system. Installation of Windows and Linux operating systems. Windows: -Evolution of operating system. Introduction to software. Types of software (MS office, VLC media player, Win rar), open office, web browser, etc.)

Task 3: This task covers basic commands and system administration in Linux, including basic Linux commands in bash, ping, ssh, ifconfig, scp, netstat, ipstat, nslookup, traceroute, telnet, host, ftp, arp, wget,route.
Task 4: Every student should individually set up and configuring a new Virtual Machine and Exporting and packaging an existing Virtual Machine into a portable format.
Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT 2 Internet and World Wide Web 6 hours
Task 5: Internet: Introduction and evolution of internet. Study of various internet-based services like email, social network, chat, etc. Introduction to cyber security and cyber laws.
Task 6: Internet Services: Web Browser usage and advanced settings like LAN, proxy, content, privacy, security, cookies, extensions/ plugins.
Task 7: Server: Introduction to server. Difference between server and normal desktop. Evolution of servers. Study of various servers like email, data, domain, etc.

UNIT 3 Word & PowerPoint 6 hours
Task 8: MS Word: Importance of MS office - -Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word.
Task 9: Creating a Newsletter: Features to be covered: - Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.
Task 10: MS PowerPoint: Basic power point utilities and tools which help ful to create basic power point presentation. Topic covered during this includes PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows.
Task 11: Introduction to HTML & Basic syntax of html Attributes, elements, lists, and basic programs.

UNIT 4 Excel 6 hours
Task 12: Excel Orientation: The importance of MS office 2007/10 tool Excel as a Spreadsheet tool, Accessing, overview of toolbars, saving excel files, Using help and resources. Creating a Scheduler - Features to be covered: - Gridlines, Format Cells, Summation, auto fill, Formatting Text.
Task 13: Calculating GPA -. Features to be covered: - Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP, Sorting, Conditional formatting.

UNIT 5 **Cloud based productivity enhancement and collaboration tools** **6 hours**

Task 14: Store, sync, and share files with ease in the cloud using Google Drive
Document creation and editing text documents in your web browser using Google docs
Handle task lists, create project plans, analyze data with charts and filters using Google Sheets
Create pitch decks, project presentations, training modules using Google Slides.

Task 15: Manage event registrations, create quizzes, analyze responses using Google Forms

o Build public sites, internal project hubs using Google Sites

o Online collaboration through cross-platform support using Jam board

o Keep track of important events, sharing one's schedule, and create multiple calendars using Google Calendar.

Textbooks:

1. Computer Fundamentals, Anita Goel, Pearson Education, 2017
2. PC Hardware Trouble Shooting Made Easy, TMH

References:

1. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr.N.B.Vekateswarlu, S.Chand

Coursera Courses:

1. https://www.coursera.org/learn/technical-support-fundamentals

Journal(s):

Website(s):

1) https://explorersposts.grc.nasa.gov/post631/2006-2007/computer_basics/ComputerPorts.doc
2) https://explorersposts.grc.nasa.gov/post631/2006-2007/bitsnbyte/Digital_Storage_Basics.doc
3) https://www.thegeekstuff.com/2009/07/linux-ls-command-examples
4) https://www.pcsuggest.com/basic-linux-commands/
5) https://www.vmware.com/pdf/VMwarePlayerManual10.pdf
6) https://geek-university.com/vmware-player/manually-install-a-guest-operating-system/
7) https://gsuite.google.com/learning-center/products/#!/

Course Outcomes: After successful completion of the course the student will be able to:

1. Disassemble and assemble the computer system.
2. Install any system software and application software.
3. Perform hardware and software trouble shooting by checking solutions from web
4. Record any activities in a document. Prepare Graphs, perform computations using formulas etc.
5. Prepare presentations using different useful features.

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN1051	DIGITAL LOGIC CIRCUITS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

Digital logic circuits are the basic building blocks of modern computers. To understand the working of computers, one needs to know how numbers are represented and processed using digital logic circuits. This course first teaches number representation in computers and Boolean algebra. After covering minimization of expressions and basic logic gates, the design of combinational and sequential circuits that perform a specific function are discussed. The aim of the course is to provide the student with an understanding of how data is represented and processed at the hardware level. This course acts as a foundation for a course on Computer Architecture and Organization.

Course Educational Objectives:

- Facilitate the student to represent numbers in different number systems and convert numbers from one number system to another.
- Introduce logic gates and theorems and properties of Boolean algebra.
- Familiarize the student with techniques for minimization expression and establish its necessity.
- Demonstrate the design of combinational and sequential logic circuits.

UNIT 1 Number Systems 9 hours

Positional representation of numbers, Decimal, Octal, Hexadecimal number systems, General radix 'r' system, Conversions, Complements, Binary codes, Arithmetic with signed and unsigned numbers (addition, subtraction), Introduction to error detection and error correction.

UNIT 2 Boolean Algebra and Logic Circuits 9 hours

Boolean Algebra and Logic Circuits: Axiomatic definition of Boolean Algebra, Basic theorems and Properties of Boolean Algebra, Boolean Functions, Minterms and Maxterms, Canonical and Standard Forms, Digital logic gates, Synthesis using AND, OR and NOT gates, NAND and NOR logic networks.

UNIT 3 Gate-Level Minimization: 9 hours

The K-Map method, two variable K-Map, three variable K-Map, four variable K- Map, five variable K-Map, six variable K-Map, K-Maps with don’t care conditions (incompletely specified functions), Tabular method for minimization (Quine McCluskey Method), Sum of products (SOP) and Product of sums (POS)simplification.

UNIT 4 COMBINATIONAL LOGIC: 9 hours

The K-Map method, two variable K-Map, three variable K-Map, four variable K- Map, five variable K-Map, six variable K-Map, K-Maps with don’t care conditions (incompletely specified functions), Tabular method for minimization (Quine McCluskey Method), Sum of products (SOP) and Product of sums (POS) simplification.

UNIT 5 SEQUENTIAL CIRCUITS: 9 hours

Flip Flops, Basic latch, R-S flip flop, D flip flop, T flip flop, JK flip flop, Registers, Shift registers, Synchronous and Asynchronous (ripple) counters, BCD counter (synchronous and asynchronous), Ring counter, Johnson counter, Registers and Shift Registers.

Textbooks:

1. M Morris Mano, Michael D. Ciletti Digital Design, 5/e, Pearson Education, 2011

References:

1. ZVI Kohavi, Switching Theory and Finite Automata, 2/e, McGraw Hill, 1978
2. Stephen Brown & Zvonko Vranesic, Fundamental of digital logic with Verilog Design, 2/e, Tata McGrawHill,2007

Course Outcomes:

After successful completion of the course the student will be able to:

1. Interpret a given number in different number systems .
2. Design logic circuits using gates to perform a Boolean function .
3. Solve Boolean expressions into their simplified form
4. Explain the working of combinational and sequential circuits
5. Design a combinational or sequential circuit to perform a given function

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1						2				2	1	
CO2	1	2	1						2				2	1	
CO3	2	2	1						2				2	1	2
CO4	2	2	2						3				2	2	2
CO5	2	2	2						3				2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN1071	DATA COMMUNICATIONS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

A large majority of computer applications require communication of data from one device to another. As such, this course deals with data communications, including conversion of data into a signal, propagation of the signal through a medium and conversion of the signal back into data. Proper communication also requires the two communicating devices to follow a common protocol. This course covers the concepts of layered network architecture, properties of different transmission media and data communication principles. Various signal encoding techniques and their merits and demerits are taught, together with basic error and flow control techniques and multiplexing. The course acts as a foundation for later courses.

Course Educational Objectives:

- Introduce the concepts of Data Communications and different models
- Impart the characteristics of various transmission media.
- Familiarize different analog and digital transmission techniques.
- Expose the basic error control and flow control techniques.
- Acquaint with static channel allocation using TDMA and FDMA.

UNIT 1 Data communication, Data networking and the Internet 6 hours

A communication model, data communications, networks, the Internet.

Protocol Architecture: Need for protocol architecture, TCP/IP protocol architecture, OSI model, TCP/IP Vs OSI model.

UNIT 2 Data transmission 6 hours

Concepts and terminology, analog and digital data transmission, transmission impairments, channel capacity. Transmission Media: Guided and unguided

UNIT 3 Signal encoding techniques 6 hours

Digital data to digital signals, digital data to analog signals, analog data to digital signals, Analog data to analog signals.

UNIT 4 Digital Data Communication Techniques 6 hours

Asynchronous and synchronous transmission, types of errors, error detection techniques, error correction techniques (single bit) Data link control protocols: Flow control, error control.

UNIT 5 Multiplexing 6 hours

Frequency division multiplexing, characteristics, synchronous time division multiplexing, characteristics, statistical time division multiplexing, characteristics.

Textbooks:

1. William Stallings, Data and Computer Communications, 8/e, Pearson Education., 2013.

References:

1. Fred Harshall, Data Communications, Computer Networks and Open systems,4/e, Pearson Education, 2005.
2. Behrouz A Forouzan, Data Communications and Networking, 4/e, McGraw Hill, 2012.

Course Outcomes:

After successful completion of the course the student will be able to:

1. illustrate and summarize the OSI and TCP/IP network architectures
2. compare the properties of various transmission media
3. utilize error correction and detection techniques to detect or correct errors
4. analyze flow control schemes for data transmission
5. explain basic signal encoding and multiplexing techniques

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1									1			1		
CO2	1	1								1			1		
CO3	1		1							1				1	
CO4	2			3						1					2
CO5	1	1			2					1			2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG9 (Industry, Innovation and Infrastructure): This course teaches the fundamentals of Data Communications. Communication of data helps foster innovation by connecting scientific communities and enables growth in industries that require digital connectivity, such as the IT industry.

SDG Justification:

CSEN1101	OPERATING SYSTEMS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides a comprehensive understanding of the key concepts and functionalities of operating systems. It covers key topics including scheduling algorithms, process management. and process synchronization in detail. Additionally, the course explores memory management techniques and file system structures to enhance students' knowledge of operating systems operations.

Course Educational Objectives:

- To introduce basic concepts of the operating system, its functions and services.
- To elaborate on the concepts of process management and synchronization.
- To expose issues with deadlocks.
- To familiarize with memory management schemes.
- To discuss mass storage structures and system protection.

UNIT 1 Operating system Structures: 8 hours

Introduction: What operating systems do, computer system organization, computer-system architecture, operating system structure, resource management, Protection and security, kernel data structures

Operating system Structures: operating system services, system calls, loaders and linkers, operating system structure, building and booting an operating system.

UNIT 2 Process Management & CPU Scheduling 8 hours

Process Management: Process concepts, process scheduling, Operations on processes, inter- process communication

CPU Scheduling: Multithreaded programming, Multi-core Programming, Multi-threading Models, Scheduling-criteria, scheduling algorithms, algorithm evaluation.

UNIT 3 Process Synchronization & Deadlock 8 hours

Process Synchronization: Critical section problem, Peterson’s solution, synchronization hardware, Mutex locks, semaphores, monitors, classic problems of synchronization.

Deadlock: System model, deadlock characterization, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

UNIT 4 Memory Management & Virtual memory 8 hours

Memory Management: contiguous memory allocation, paging, segmentation, structure of page the table, swapping.

Virtual memory: Demand paging, Copy-on-Write, page-replacement, allocation of frames, thrashing.

UNIT 5 Mass-storage structure & System Protection 8 hours,

File Concepts: File concept, access Methods, directory and disk structure, protection.

Mass-storage structure: Overview of Mass-Storage Structure, disk scheduling, Swap space management

System Protection: Goals of protection, principles of protection, Domain of protection, Access matrix.

Software requirements: Linux's Shell

Operating System: Ubuntu, Linux Operating System

1. Familiarity and usage of Linux System calls

a. Process management: fork(), exec(), wait(), sleep() ...,

b. File management: open (), read (), write (), seek (), close ()...

2. Simulate the following CPU scheduling algorithms

A) FCFS b) SJF c) Round Robin d) Priority

3. Write a program to Implement Producer Consumer Problem solution

4. Simulate Bankers Algorithm for Dead Lock Avoidance

5. Simulate the page replacement algorithms

a) FIFO b) LRU c) LFU d) Optimal Page Replacement

6. Simulate Paging Technique of memory management.

7. Simulate all File Organization Techniques

a) Single level directory b) Two level c) Hierarchical

8. Write a program to implement disk scheduling algorithms.

a) FCFS b) SCAN c) C-SCAN

TextBooks:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, 10/e, John Wiley, 2018.

References:

1. Andrew S Tanenbaum, Modern Operating Systems, 2/e, Pearson/PHI, 2014.
2. Crowley, Operating System- A Design Approach, McGraw-Hill, 2012.
3. Stallings, Operating Systems - Internal and Design Principles, 5/e, 2013.
4. Pal Chaudhary, Operating system principles & Design, 1/e, PHI Learning, 2013.
5. Deitel and Deitel, Operating System, Pearson Education, 2003.
6. D.M. Dhamdhere, Operating systems- A Concept based Approach,2/e, McGraw Hill, 2010.

Course Outcomes:

After successful completion of the course the student will be able to:

1. illustrate the basic and overall view of operating system
2. analyze the concept of a process, process life cycle, process states and state transitions
3. implement and practice CPU scheduling strategies, process synchronization techniques and memory-management schemes
4. simplify and resolve Deadlock handling situation
5. evaluate Disk storage management, protection and security mechanisms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					2									2	
CO2			2											3	
CO3	3	3	2										2	1	1
CO4		1	1											1	
CO5		1	1												1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN1111</td><td rowspan="2">OBJECT ORIENTED PROGRAMMING WITH JAVA</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN1011:Problem Solving and Programming with C</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course enables the students to gain knowledge on various object-oriented aspects of Java. The course tours the students through classes, inheritance, interfaces, packages, exceptions, generics, graphical programming concepts. The knowledge gained in this course can be applied to develop standalone applications for Android, Real Time Programming etc.

Course Educational Objectives:

- To familiarize object-oriented programming concepts and techniques.
- To illustrate classes and class libraries, developing classes for simple applications.
- To illustrate the usage of Arrays and Strings.
- To demonstrate various types of Inheritance mechanisms.
- To introduce packages applicability and usage of Exceptions.

UNIT 1 Java Programming Fundamentals P - 12 hours

Java Programming Fundamentals

Java Language, Key Attributes of Object-Oriented Programming, Java Development Kit, Simple Program,Create Blocks of Code, Keywords, Identifiers, The Java Class Libraries.

Data Types and Operators: Java’s Primitive Types, Literals, Variables, Scope and Lifetime of Variables,Operators- Arithmetic, Relational, Logical, Bitwise, Assignment. Type conversion in Assignments, Using a Cast, Operator Precedence.

Program Control Structures: if, switch, for, enhanced for, while, do-while, break, continue.

Exercises:

1. Program to read a number from the user and print whether it is positive or negative.

2. Program to solve quadratic equations (use if, else if and else).

3. Take three numbers from the user and print the greatest number.

4. Program that keeps a number from the user and generates an integer between 1 and 7 and displays the name of the weekday.

5. Program that reads in two floating-point numbers and tests whether they are the same up to three decimal places.

6. Program that takes a year from user and print whether that year is a leap year or not.

7. Program to display the first 10 natural numbers.

8. Program to input 5 numbers from keyboard and find their sum and average.

9. Program in Java to display the multiplication table of a given integer.

10. Program in Java to display the pattern like right angle triangle with a number.

Input number of rows : 5

Expected Output :

1

12

123

1234

12345

UNIT 2 Introduction to Classes Objects and Methods P - 12 hours

Introduction to Classes Objects and Methods

Class Fundamentals, Objects creation, Reference Variables and Assignment, Methods, Returning a Value, Using Parameters, Constructors, Parameterized Constructors, new Operator, this Keyword, finalize() method, Wrapper Classes, Parsing, Auto boxing and Unboxing. I/O: Command-Line Arguments, Scanner and Buffered Reader Classes,

A Closer Look into Methods and Classes: Controlling Access to Class Members, passing objects to methods, passing arguments, Returning Objects, Method Overloading, Overloading Constructors, Understanding Static, Variable-Length Arguments.

Exercises:

1. Program to read two numbers and perform the arithmetic operations using methods.

2. Program that performs arithmetic operations with values of type char.

3. Design a class to overload a method compare() to return the greater of two as follows:

   void compare(int, int)

   void compare(char, char)

   void compare(String, String)

4. Program that creates a class Account that stores a variable balance. The class has methods to start account, to deposit money, to withdraw money and tell the current balance amount.

5. Program to implement a Book class that stores the details of a book such as its code, title and price (Use constructors to initialize the objects).

6. Differentiate between static and non-static methods in java.

7. Illustrate the usage of 'this', 'final' and 'finalize' using a java program.

8. Write a java program to implement the concept of dynamic method dispatch
9. How to pass the variable length arguments in java, illustrate with an example program.
10. Write a java program to overload the constructors.
11. Read the command line arguments and print the total number of arguments and itsvalues.

UNIT 3 **Arrays and Strings & Strings** **P - 12 hours**

Arrays and Strings

Arrays: 1D Arrays, Multidimensional Arrays, Irregular Arrays, Array References, Using the Length Member.Arrays class of util package, Array Lists, Vector class

Strings: String class, constructors, length(), string literals, concatenation, toString(), Character extraction,string comparison, searching strings, modifying, data conversion, changing the case, joining, split().

StringBuffer class: constructors, length(), capacity(), ensureCapacity(), setLength(), charAt(), setCharAt(),getChars(), append(), insert(), reverse(), delete(), deleteCharAt(), replace().

Exercises

1. Program for sorting a given list of names in ascending order.
2. Program to multiply two given matrices?
3. Program to find Maximum and minimum value in an array of size “M”, passed as argument.
4. Program to read and print an array of size N rows with variable column size .(Hint: Irregular array).
5. Program that copies contents of one array to another using length member.
6. Program to find element from an sorted array using binary search (java.util.package)

7. Program to delete duplicate elements from an array of size 5.

8. Program that reverses an array and stores it in the same array.

9. Program to implement all String methods on a Input String.

10. Convert a given integer array of Size “N” into string.

11. Program to read and print a given string using different methods.

12. Program to reverse the words in a string.

13. Program to read a string and replace all the vowels with a ‘$’ symbol.

14. Program to count the number of occurrences of a search string in a given text string.

UNIT 4 Inheritance and Interfaces P - 12 hours

Inheritance and Interfaces

Inheritance: Basics, Member Access and Inheritance, Constructors and Inheritance, Using Super, Multilevel Hierarchy, Constructor execution hierarchy, Superclass References and Subclass Objects, Method Overriding, Abstract Classes, Using final.

Interfaces: Fundamentals, Creating and Implementing an Interface, Using Interface References,

Implementing Multiple Interfaces, Extending Interfaces, Nested Interface.

Exercises:

1. Define a class Point with two fields x and y each of type double. Also , define a method

distance(Point p1, Point p2) to calculate the distance between points p1 and p2 and return the value in double. Use Math.sqrt( ) to calculate the square root.

2. A class Shape is defined with two overloading constructors in it. Another class Test1 is partially defined which inherits the class Shape. The class Test1 should include two overloading constructors as appropriate for some object instantiation. You should define

the constructors using the super class constructors. Also, override the method calculate() in Test1 to calculate the volume of a Shape.

3. Create a class named 'Member' having the following members: Name, Age, Phone number, Address, Salary. It also has a method named 'printSalary' which prints the salary of the members. Two classes 'Employee' and 'Manager' inherits the 'Member' class. The 'Employee' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an employee and a manager by making an object of both of these classes and print the same.

4. Create a class named 'Shape' with a method to print "This is This is shape". Then create two other classes named 'Rectangle', 'Circle' inheriting the Shape class, both having a method to print "This I rectangular shape" and "This is circular shape" respectively. Create a subclass 'Square' of 'Rectangle having a method to print "Square is a rectangle". Now call the method of 'Shape' and 'Rectangle' clas by the object of 'Square' class.

5. Create a class with a method that prints "This is parent class" and its subclass with another method that prints "This is child class". Now, create an object for each of the class and call

   - method of parent class by object of parent class
   - method of child class by object of child class
   - method of parent class by object of child class

6. Create a class telephone with ( ) , lift ( ) and disconnected ( ) methods as abstract methods create another class smart telephone and demonstrate polymorphism

7. Design a vehicle class hierarchy in Java, and develop a program to demonstrate Polymorphism.

8. Write a program to find the roots of a quadratic equation using interface and packages.

   - Declare an interface in package Quad1
   - Declare another package Quad2 and implement the interface

9. Write a Program to generate Fibonacci Series by using Constructor to initialize the Data Members.

10. Develop a program to demonstrate multiple inheritance through interface.

UNIT 5 Packages and Exception Handling P - 12 hours

Packages: Package Fundamentals, Member Access, Importing Packages, Static import.

Exception Handling: Exception Hierarchy, Fundamentals, Consequences of an Uncaught Exception, Handling errors, Multiple Catch, Throwing and Rethrowing an Exception, Throwable, using finally, using throws, Creating Exception Subclasses.

Exercises:

1. Program to demonstrate the visibility of members in subclasses of same and different packages.
2. Program to create a user defined package in Java.
3. Program to find the roots of a quadratic equation using interface and packages.
   - Declare an interface in package Quad1
   - Declare another package Quad2 and implement the interface
4. Define a Interface Polygon in package pack1. create a class triangle from Polygon in package pack2, override method to calculate area of the triangle and raise an exception if it is an equilateral triangle.
   Note : Exception has to be defined in package pack3.

5. Develop a program to demonstrate exception handling by using THROW, MULTIPLE CATCH & FINALLY statements.
6. Create a class Student with attributes roll no, name, age and course. Initialize values through parameterized constructor. If age of student is not in between 15 and 21 then generate user-defined exception "AgeNotWithinRangeException". If name contains numbers or special symbols raise exception "NameNotValidException". Define the two exception classes.

7. Program to throw a user defined exception for employee details
    - If an employee name is a number, a name exception must be thrown.
    - If an employee age is greater than 50, an age exception must be thrown
8. Program to demonstrate nested exception.
9. Create an Account class with data members accno, name,bal. Include methods deposit(), withdraw(). Raise an exception when balance in account is less than 1000.
10. Create a Student class with data members Rollno, Name, marks in subjects. Include methods to compute average. Raise an exception if the student has more than 2 backlogs.

TextBooks:

1. Herbert Schildt, Dale Skrien, Java Fundamentals A Comprehensive Introduction, 1/e, Tata McGraw Hill, 2017.
2. Herbert Schildt, The Java complete References, 9/e, Tata McGraw Hill,2014.

References:

1. Y.DanielLiang , An Introduction to JAVA Programming, 10/e, Tata McGraw Hill.
2. Kathy Sierra, Head First Java, 2/e, Shroff Publishers, 2012.
3. Balagurusamy , Programming with JAVA, 2/e, Tata McGraw Hill, 2014.

Course Outcomes:

After successful completion of the course the student will be able to:

1. describe the data types, operators and control structures
2. understand the concepts of Object Oriented Programming
3. make use of Arrays and Strings related operations
4. apply features of OOPs to build real time applications
5. demonstrate the ease of handling various scenarios of program execution without abrupt interruption

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1													
CO2	1	2												1	
CO3	1	2	1	1									1	2	1
CO4	1	2	2	1									1	2	
CO5	1	2	1	1									1	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN2001</td><td rowspan="2">DATA STRUCTURES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN1011: Problem Solving and Programming with C</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The study of data structures, a fundamental component of a computer science education, serves as the foundation upon which many other computer science applications are built. Knowledge of data structures is a must for students who wish to work in the design and implementation of any software system. The organization of data in an efficient way for application is the major focus of the course.

Course Educational Objectives:

- Introduction to sort and search techniques.
- Familiarize with linear data structures and operations on them.
- Understand the concepts of stack and Queue and their applications.
- Edify non-linear data structure graph and its applications.
- Represent and manipulate data using non-linear data structure trees to design algorithms for various applications.

UNIT 1 Searching and sorting 9 hours

Introduction to data structures, Array / List based representation and operations.

Searching: Linear search, Binary search.

Introduction to Sorting: Insertion sort, selection sort, bubble sort, merge sort, quick sort

UNIT 2 **Linked list** **9 hours**

Linked lists: Creation of single linked list, double linked list, circular linked list, and operations on it.

UNIT 3 **Stacks & Queues** **9 hours**

Stacks: Definitions, operations and applications, array and linked representation of stacks.

Queues: Definitions and operations, array and linked representation of queues and Types of Queues.

UNIT 4 **Trees** **9 hours**

Trees: Definitions and properties, representation of binary trees, operations, binary tree traversals, binary search tree, AVL trees, and operations on AVL trees, heap sort.

UNIT 5 **Graphs** **9 hours**

Graphs: data structure for graphs, properties of graphs, types of graphs, graph representations, Graph traversals, directed acyclic graph, shortest path algorithms, spanning trees and min spanning tree.

List of experiments:

1. Perform Linear Search on an array.
2. Perform Binary Search on a list stored in an array.
3. Develop a program to implement bubble sort technique.
4. Develop a program to implement selection sort technique.
5. Develop a program to implement insertion sort technique.
6. Develop a program to implement quick sort technique.
7. Develop a program to implement merge sort technique.
8. Design a program to create a singly linked list for the following operations
   - Insert a Node at Beginning, at Ending and at a given Position
   - Delete a Node at Beginning, at Ending and at a given Position
   - Search, Count the Number of Nodes and Display

9. Design a program to create a doubly linked list for the following operations
   - Insert a Node at Beginning, at Ending and at a given Position
   - Delete a Node at Beginning, at Ending and at a given Position
   - Search, Count the Number of Nodes and Display
10. Create a Circular singly linked list for adding and deleting a Node.
11. Create a stack and perform various operations on it.
12. Convert the infix expression into postfix form.
13. Perform String reversal using stack
14. Evaluation of postfix expression
15. Create a queue and perform various operations on it.
16. Construct a binary tree and perform various traversals.
17. Construct a binary search tree and perform a search operation.
18. Implement Depth First Search, Breadth First Search traversals on a graph.
19. Implement Dijkstra's Shortest Path Algorithm
20. Develop a program to implement heap sort technique.

TextBooks:

1. Fundamentals of Data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Universities Press (India) Limited

References:

1. Data Structures (Revised First Edition) | Schaum's Outline Series by Seymour Lipschutz
2. Data Structures and Algorithms: Concepts - Techniques and Applications, by G. A. V. Pai,2017

Course Outcomes:

After successful completion of the course the student will be able to:

1. Analyze various searching and sorting algorithms.

2. Demonstrate operations on linear data structures

3. Explain the representations, traversals, and applications of graphs.

4. Illustrate the mechanisms for creating, altering, and traversing various types of trees.

5. Choose a data structure that gives the best performance for a given application.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1	2											1	
CO2	1	2	2	2									1	2	
CO3	1	2	2	2									1	2	1
CO4	1	2	2	2									1	2	1
CO5	1	2	2	2									1	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN2011</td><td rowspan="2">COMPUTER ORGANIZATION AND ARCHITECTURE</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN1051: Digital Logic Circuits</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Computer Architecture and Organization provides a comprehensive knowledge on the structure and behaviour of computer hardware architecture and application of the design concepts. The basicconcepts of this course can have a view as to how a computer system works. This course enables the students to learn the basics of hardware components from basic gates to memory and I/O devices and instruction set architectures.

Course Educational Objectives:

- Attain the knowledge of fundamental circuit components and techniques for designing the circuits
- Describe and understand the processor memory hierarchy
- Understand the concepts of interrupts and I/O devices
- Attain the general knowledge of advances in microprogramming and Their implementation in computer design
- Experience the design process in the context of a reasonable size hardware system

UNIT 1 **Register Transfer and Micro operations**: **8 hours**

Register transfer language, register transfer, bus and memory transfers, arithmetic micro-operations, logic micro-operations, shift micro-operations, arithmetic logic shift unit

UNIT 2 Basic Computer Organization and Design 11 hours

Basic Computer Organization and Design Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory-references instructions, input-output and interrupt, complete computer description. Design ofthe basic computer, Design of accumulator logic. Micro programmed Control: Control memory, address sequencing, micro program example, Design of control unit.

UNIT 3 Central Processing Unit 10 hours

Central Processing Unit: Introduction, general register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control.

Pipeline and Parallel Processing: Parallel processing, pipelining, arithmetic pipeline, instruction pipeline.

Computer Arithmetic: Introduction, addition and subtraction, decimal arithmetic unit, Booth’s multiplication algorithm.

UNIT 4 Input-Output Organization 8 hours

Peripheral devices, I/O Interface, Asynchronous Data Transfer,Modes of Transfer, Priority Interrupt, DMA, I/O Processor, Serial Communication.

UNIT 5 Memory Organization 8 hours

Memory Hierarchy, Main Memory, Auxiliary Memory, AssociativeMemories, Cache Memory, Virtual Memories, Memory Management Hardware

TextBooks:

1. M. Morris Mano, Computer System Architecture, 3/e, Pearson education, 2008

References:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization,5/e, McGraw Hill,2001
2. John P. Hayes, Computer Architecture and Organization, 3/e, McGraw Hill, 1998.
3. William Stallings, Computer Organization and Architecture, 6/e, Pearson PHI, 2012.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Classify the machine's instruction set architecture (ISA) including basic instruction fetchand execute cycles, instruction formats, control flow, and operand addressing modes
2. Build the design and functioning of a machines central processing unit (CPU) includingthe data path components (ALU, register file) and the control unit
3. 3.Understand the basic input/output functioning including program controlled I/O andinterrupt I/O
4. Analyze the organization of different types of memories
5. Analyze the performance of processors and cache

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2									1	2	2
CO2	2	2	2	2		2			2				1	2	2
CO3	1	2	1	2					2				2	2	2
CO4	1	1	1	2									2	2	2
CO5	1	1	2	2									2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN2021	**COMPUTER NETWORKS**	**L**	**T**	**P**	**S**	**J**	**C**
		3	**0**	**2**	**0**	**0**	**4**
Pre-requisite	**CSEN1071: Data Communications**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

The course is designed to impart a basic understanding of the working of computer networks, with the Internet as the case in point. Starting with the application layer with which the user interacts directly, it covers the important principles and protocols in the application, transport, network and link layers. Brief introductions to socket programming and wireless networks are provided.

Course Educational Objectives:

- Familiarize the student with the components of the Internet and the concept of layered protocol architecture.
- Expose the student to the important principles behind the working of various layers of a network.
- Enable the student to write simple network applications using socket programming.
  Demonstrate the working of the most important protocols used in the Internet.
- Acquaint the student with the basics of wireless networking.

UNIT 1 Computer networks and the Internet 9 hours

Computer networks and the Internet: Internet, The Network Edge, The Network Core: Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and Their Service Models, History of Computer Networking and the Internet

UNIT 2 Application Layer 9 hours

Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS-The Internet's Directory Service, Socket Programming: Creating Network Applications

UNIT 3 Introduction and Transport 9 hours

Introduction and Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless

Transport: UDP, Principles of Reliable Data Transfer, Connection-oriented Transport: TCP, Principles of Congestion Control: TCP Congestion Control

UNIT 4 The Network Layer 9 hours

Introduction, Virtual Circuit and Datagram Networks, Inside Router, The Internet Protocol (IP), Routing Algorithms-The Link State (LS) Routing Algorithm, The Distance Vector (DV) Routing Algorithm, Hierarchical Routing

UNIT 5 The Link Layer, Wireless and Mobile Networks 9 hours

Introduction to the Link Layer, Multiple Access Links and Protocols, Switched Local Area Networks. Introduction to Wireless and Mobile Networks, Wireless Links and Network Characteristics, WiFi:802.11 Wireless LANs (Architecture and MAC Protocol), Mobile IP

Laboratory

Exp no Name of the exercise Proposed no. of Lab sessions

1. Write a report that includes a diagram showing the topology, type of connection devices, and speed of the wired and wireless LAN in your organization. Also find out the MAC and IP addresses and the subnet mask of your computer. – 1

2. Install and run a network diagnosis tool such as TCP dump or Wireshark. Start capturing packets on an active interface, open a browser and type the address of your favourite search engine. Wait till the page loads and stop capture. List out the type and number of
each type of packets captured. – 2

3. Write a program to create a server that listens to port 53 using stream sockets. Write a simple client program to connect to the server. Send a simple text message “Hello” from the client to the server and the server to the client and close the connection. - 2

4. Write a program to create a chat server that listens to port 54 using stream sockets. Write a simple client program to connect to the server. Send multiple text messages from the client to the server and vice versa. When either party types “Bye”, close the connection - 1

5. Write a program to create a server that listens to port 55 using stream sockets. Write a simple client program to connect to the server. The client should request for a text file and the server should return the file before terminating the connection – 1

6. Write a program to create a server that listens to port 56 using stream sockets. Write a simple client program to connect to the server. Run multiple clients that request the server for binary files. The server should service each client one after the other before terminating the connection.
- 2

7. Write a program to create a server that listens to port 57 using stream sockets. Write a simple client program to connect to the server. Run multiple clients that request the server for text files. The server should service all clients concurrently. – 2

8. Write a program to create a server that listens to port 59 using datagram sockets. Write a simple client program that requests the server for a binary file. The server should service multiple clients concurrently and send the requested files in response. - 2

TextBooks:

1. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e, Pearson, 2012.

References:

1. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, 5/e, Prentice Hall, 2011
2. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, 3/e, Morgan Kaufmann, 2011.
3. Richard Stevens, UNIX Network Programming – Volume 1, 3/e, Prentice Hall of India, 1997.
4. Afaqui, M. Shahwaiz, Eduard Garcia-Villegas, and Elena Lopez-Aguilera. "IEEE 802.11 ax: Challenges and requirements for future high efficiency WiFi." IEEE wireless communications 24, no. 3 (2016): 130-137.
5. Hiertz, Guido R., Dee Denteneer, Sebastian Max, Rakesh Taori, Javier Cardona, Lars Berlemann, and Bernhard Walke. "IEEE 802.11 s: the WLAN mesh standard." IEEE Wireless Communications 17, no. 1 (2010): 104-111.
6. https://www.coursera.org/learn/computer-networking
7. https://www.geeksforgeeks.org/basics-computer-networking/
8. https://www.netacad.com/portal/web/self-enroll/m/course-860135
9. https://www.ece.rutgers.edu/~marsic/books/CN/links/

Course Outcomes:

After successful completion of the course the student will be able to:

1. interpret the concept of modular network design using layered protocol architecture

2. list the various components in the Internet and their functions

3. analyze various types of services provided by each layer in the network architecture

4. discuss the working of the important protocols used in the Internet

5. develop simple network applications and test them

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			1	2					1			2		
CO2		2	3							1			2	3	1
CO3	2			3		1				1		1		3	
CO4	1			2	3				1	1	1		2	1	3
CO5	2				1	3	1	1					1	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

<u>SDG9 (Industry, Innovation and Infrastructure):</u> This course teaches the fundamentals of Computer Networks with the Internet as an example. Global networks such as the Internet help foster innovation by connecting scientific communit es and enable growth in industries that require digital connectivity.

SDG Justification:

<table>
<tr><td rowspan="2">CSEN2031</td><td rowspan="2">ARTIFICIAL INTELLIGENCE</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">MATH2361: Probability and Statistics</td></tr>
</table>

Course Description:

This course enables the students to think critically about what makes humans intelligent, and how computer scientists are designing computers to act more like us. Artificial Intelligence (AI) is the study of how to make computers make things that can 'think' and act the right way, given the circumstances. AI plays an important role in the design and development of systems with intelligent behaviour. The primary objective of this course is to provide an introduction to the basic principles and applications of Artificial Intelligence.

Course Educational Objectives:

- To understand the fundamentals of Artificial Intelligence
- To solve problems by using search algorithms
- To gain insight into competitive environments using adversarial search algorithms
- To learn knowledge representation and knowledge representation techniques
- To address the uncertainty and to learn the ways of learning

UNIT 1 Basics of Artificial Intelligence 9 hours, P - 4 hours

Introduction: Introduction to AI – concept of Intelligence, Artificial Intelligence, Foundational Areas of AI, Approaches to AI- Rationalist, Empiricist Approaches, Applications of AI and Limitations of AI

Intelligent Agents: Agents and Environments, Examples, The Concept of Rationality, Nature of Environments, The Structure of Agents.

UNIT 2 Solving Problems by Searching 9 hours, P - 8 hours

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies: Breadth-first Search, Depth-first Search and DFS variations, Lowest-cost-first Search, Informed (Heuristic) Search Strategies: Greedy Best-first Search, A* search, Recursive Best First Search,Heuristic Functions.

Beyond Classical Search: Local Search Algorithms and Optimization Problems: Hill-climbing Search and variations to resolve problems with steepest ascent, Genetic Algorithms.

UNIT 3 Adversarial Search and Logical Agents 9 hours, P - 6 hours

Adversarial Search: 2-Player Games, Optimal Decisions in Games: AND-OR graph, Minimax algorithm, Alpha-Beta Pruning. Chance based games.

CSP, Constraint Networks, Solving CSP by Search Logical Agents: Knowledge-based Agents, Propositional Logic, Propositional Theorem Proving: Inference.

UNIT 4 First-Order Logic 9 hours, P - 6 hours

Propositional Logic – Proof by Resolution, Forward Chaining, Backward Chaining,

First-Order Logic: Syntax and Semantics of First-Order Logic, Models for First-Order Logic, Quantifiers, Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution in First-Order Logic.

UNIT 5 Uncertainty and Learning 9 hours, P - 6 hours

Uncertainty: Acting under Uncertainty, Conditional Probabilities, Full Joint Distributions, Bayes Rule and its Applications: Bayesian Networks.

Basics of Learning: Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Unsupervised Learning.

Lab Exercises suggested:

1. Revisit/Refresh the Study of Python and PROLOG (can use any other programming Language also)
2. Write a program to control the VACUUM Cleaner moves (Intelligent systems design process)
3. Write a program to solve Monkey & Banana Problem.
4. Write a program to solve Water-Jug problem (PROLOG)
5. Write a program to solve 8-tiles puzzle problem (Using heuristics).
6. Write a program to solve Shortest path problem: (i) Using BFS (ii) Using Lowest-cost-first search
7. Write a program to implement TIC – TAC - TOE game (Understanding Minimax Algorithm and Alpha – Beta pruning)
8. Write a program to implement Hangman game (Or Wordle).
9. Write a program to understand Propositional logic using KANREN, SYMPY, pyDatalog packages in Python.
10. Write a program to understand Inferential logic using KANREN, SYMPY, pyDatalog packages in Python.
11. Write a program to implement a binary classification using Decision Trees (Understanding Decision Trees)

Lab Infrastructure:

1. Python, PROLOG on Windows or Linux
2. Python packages KANREN, Sympy, pyDataLog

Textbooks:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach,3 rd Edition, Pearson, 2015
2. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, 2nd Edition, Cambridge University Press, 2017

References:

1. George F Lugar, Artificial Intelligence, Pearson, 6th edition(2017)
2. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, TMH Education Pvt. Ltd., 2008.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson.
4. David Poole Book Reference site: https://artint.info/2e/html/ArtInt2e.html
5. Russel lecture reference site: https://inst.eecs.berkeley.edu/~cs188/sp19/
6. Microsoft AI project s Site: https://www.microsoft.com/en-us/ai/ai-lab-projects
7. https://nptel.ac.in/courses/106/105/106105079/ (Nptel course on artificial Intelligence by Prof. Dasgupta maps to the syllabus and beyond and can be used as listening material for the relevant topics)

Course Outcomes:

After successful completion of the course the student will be able to:

1. Relate to the concept of artificial intelligence, the role of intelligent agents, uninformed and informed search techniques
2. Analyse and solve problems using various Search mechanisms
3. interpret real-world problems in competitive environments
4. create knowledge representation at features level and apply inference for finding solutions
5. infer the ways of acting on uncertainty

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGs: 3, 6, 11

SDG:3 Good Health and Well-being

Statement: Artificial intelligence (AI) has the potential to personalize healthcare monitoring, diagnosis and treatment for the individual in the community and at home. It puts consumers in control of health and well-being.

SDG:6 Clean Water and Sanitation

Statement: Artificial intelligence (AI) will help to resolve challenges related to clean water and sanitation. It is helping utilities and municipalities to better manage their water and wastewater systems to ensure a clean and sanitized water supply.

SDG:11 Sustainable Cities and Communities

Statement: Artificial Intelligence (AI) enabling smart urban solutions brings multiple benefits, including more efficient energy, water and waste management, reduced pollution, noise and traffic congestions

SDG Justification:

CSEN2061	DATABASE MANAGEMENT SYSTEMS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATH1041: Discrete Mathematics						

Course Description:

This course provides fundamental and practical knowledge on database concepts by means of organizing the information, storing and retrieve the information in an efficient and a flexible way from a well-structured relational model. This course ensures that every student will gain experience in creating data models and database design

Course Educational Objectives:

- Focus the role of a database management system in an organization and construct ER Diagram
- Demonstrate basic database concepts, including the structure and operation of the relational data model and basic database queries using SQL
- Applying advanced database queries using Structured Query Language (SQL)
- Evaluating logical database design principles and database normalization
- Demonstrate the concept of a database transaction, concurrency control, and data object locking and protocols

UNIT 1 Introduction to DBMS and Database Design 9 hours,P - 6 hours

Introduction to DBMS: File system vs DBMS, advantages of DBMS, storage data, queries, DBMS structure, Types of Databases – Hierarchical, Network, Relational, Key-Value, Object Oriented, XML DB

Overview of File Structures in database

Data base Design: data models, the importance of data models.

E-R model: Entities, attributes and entity sets, relationship and relationship set, mapping cardinalities, keys, features of ER model, conceptual database design with ER model.

UNIT 2 Relational Model and Basic SQL 9 hours,P - 6 hours

Relational model: Integrity constraints over relations and enforcement, querying relation data, logical database design, views, destroying/altering tables and views.

Basic SQL: Introduction to SQL, Basic SQL Queries: DML, DDL, DCL, TCL

UNIT 3 Advances SQL and PL/SQL 9 hours,P - 6 hours

Structured Query Language (SQL): Select Commands, Union, Intersection, Except, Nested Queries, Aggregate Operators, Null values, Relational set operators, SQL join operators

Relational Algebra(RA): Selection, Projection, Set operations, Joins

Relational Calculus (TRC, DRC): Tuple Relational Calculus, Domain Relational Calculus

PL/SQL, Assertions, Triggers

UNIT 4 Schema Refinement and Normal Forms 9 hours,P - 6 hours

Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional Dependencies, Reasoning about Functional Dependencies. Normal Forms, Properties of Decomposition, Normalization, different types of dependencies.

UNIT 5 Introduction to Transaction Management, Concurrency Control and Crash Recovery 9 hours,P - 6 hours

Introduction to Transaction Management: ACID properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control.

Concurrency Control: 2PL, Serializability and Recoverability, Introduction to Lock Management, Lock Conversions, Dealing with Deadlocks, Concurrency control without locking. Crash Recovery: Aries, Recovering from a System Crash.

DBMS LAB

1. Developing a sample ER model for the specified database.
2. Create a database and learn to set various constraints (can use Sailors example from textbook1, University example from textbook2)
3. Familiarization of SQL DDL commands-create, alter, drop, rename and truncate
4. Use of DML commands-select, insert, update and delete
5. Use of different of operators for nested sub-queries.
6. Use of Joins
7. Use of grouping functions
8. Creating Views
9. PL/SQL programming environment
10. Declaring triggers and use of cursors.

Lab infrastructure

1. Oracle Server and Client System
2. SQL Server
3. MS Access

Textbooks:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3e, 2014

Note: File Structure refer Chapter 8

2. H.F.Korth and A.silberschatz, Database System Concepts, McGraw-Hill, 6e, 2011.

References:

1. D. Ullman, Principles of Database and Knowledge – Base Systems, Vol 1,1/e, Computer Science Press,1990.

2. RamezElmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education, 7e, 2016.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand database design principles
2. Apply data Modelling using E-R diagrams
3. Create refined data models using normalization
4. Build database queries using Structured Query Language
5. Understand the transaction management and concurrency control

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN2081	DATA VISUALIZATION AND EXPLORATION WITH R	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**MATH2361: Probability and Statistics**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

The course is designed to enable the student to write programs for problem solving. After an introduction to R, R Studio, Exploratory Data Analysis, Using R for Data Visualization and Graphics for Communication are designed to work together to make data science fast, fluent. This course lays for developing program logic and for writing programs in R according to the developed logic.

Course Educational Objectives:

- To make the fundamentals of statistical analysis in R environment.
- To be familiar with standard techniques for visualizing data.
- To be able to transform raw data into formats suitable for analysis.
- To be able to perform basic exploratory analysis.
- To be able Check for missing data and other mistakes using exploratory analysis

UNIT 1 Data Visualization 9 hours, P - 6 hours

Data Preparation-Importing data, Cleaning Data, Introduction to Base graphics, lattice graphics, Univariate Graphs: bar graphs, pie charts, histograms, line charts, stacked bar graphs, box plots, Bivariate Graphs, Multivariate Graphs, Maps-Dot density maps, choropleth maps, Time-dependent graphs, Survival plots, Mosaic plots,3-D Scatter plot, Biplots, Heat maps, Customizing Graphs, Saving Graphs

UNIT 2 Introduction to R 9 hours, P- 6 hours

Introduction: Importance of R and R Studio (IDE).
R Language Constructs: Variables, Data types, Arithmetic and Boolean operators. R data structures: Introduction to Data Structure in R, Vectors Lists, Data Frames, Matrices, Arrays, Strings, Factors. Implement Graphs, Plots and Maps with R

UNIT 3 Data Visualization with ggplot2&Graphics for Communication 9 hours, P - 6 hours

Data Visualization with ggplot2
Introduction, Aesthetic Mappings, Facets, Geometric Objects, Statistical Transformations, Position Adjustments, Coordinate Systems, The Layered Grammar of Graphics.
Graphics for Communication: Introduction, label, Annotations, scales, zooming, themes.
Implement Graphics-Annotations, Scales, Zooming, Themes using ggplot2 with R

UNIT 4 Exploratory Data Analysis 9 hours, P- 6 hours

Overview of EDA, Types of EDA, Procedure for conducting EDA, Exploring a new data set, summarizing numerical data, anomalies in numerical data, Visualizing relationship between variables, variation, missing values, co variation, patterns and models, Describing data-measures of central tendency, Measures of dispersion and skewness,A survey of probability concepts, The normal probability distribution. Implement Handling of Missing Values and Variance in EDA using R

UNIT 5 Statistical Modeling&R Markdown 9 hours, P -6 hours

Statistical Modeling Data, Statistics, Analysis of covariance: variance (ANOVA),Correlation Plots, Simple Linear Regression, , Multiple Linear Regressions, Logistic Regression, Clustering model.
R Markdown: Introduction, Code Chunks, Markdown Basics, R Notebooks, Output Formats.
Implement Regression techniques and Clustering Model using R

TextBooks:

1. Jared P. Lander, R for Everyone, 2/e, Pearson Publications, 2017.

2. Ronald K, Exploratory Data Analysis Using R,1/e, CRC Press, 2018.

3. Garrett Grolemund and Hadley Wickham, R for Data Science, O'Reilly Media, 1/e, 2017.

References:

1. NormanMatloff,TheArtofRProgramming,CengageLearning,1/e,2011.

2. Seema Acharya, Data Analytics Using R ,1/e,McGrawhill.

3. Dr.Tania Moulik, Applied Data Visualization with R and ggplot2,1/e,Packt.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the basics in R programming in terms of constructs
2. Illustrate the distribution of data through visualizations
3. Gain an understanding of the grammar of graphics, the theory behind ggplot2
4. Choose and apply the most suitable techniques for exploratory data analysis
5. Explore linear and logistic regression, generalized linear models, general estimating equations

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1											1	1	2
CO2			1										1	1	3
CO3		1											1	1	2
CO4			1										1	1	3
CO5			1										1	1	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN2091	OOSE BASED APPLICATION DEVELOPMENT	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**CSEN1111: Object Oriented Programming with Java**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

Object Oriented Software Engineering course builds on Object-Modelling concepts. Object Oriented analysis and design methodology is introduced and is compared with function oriented design approach. In this course students learn to model analysis and design using UML in the context of an iterative, use case-driven, architecture-centric process. A case tool for development of UML diagrams is introduced. Design Patterns are discussed for development standardization. The course takes the student through Unified Software Development Process using Object Oriented methodologies.

Course Educational Objectives:

- Develop models using UML Notation
- Analyse Requirements with Use cases
- Related Analysis to Design
- Design Solutions with patterns and architectural layers
- Apply concepts to semester long software project

UNIT 1 Introduction to Software Engineering 9 hours ,P - 6 hours

Introduction: Review of Software life cycle stages, Software Processes. Introduction to OOAD, comparison with Functional approach to software development.
Overview of UML: Use Case Diagrams, Class Diagrams, Interaction Diagrams, State Machine Diagrams, Activity Diagrams
Modelling Concepts: Systems, Models, and Views. Data Types - Abstract Data Types, Instances. Classes - Abstract Classes, Objects, Event Classes, Events, Messages. Object-Oriented Modelling- Falsification and Prototyping

UNIT 2 UML & Analysis 9 hours ,P - 6 hours

A Deeper View into UML: Static Modelling, Dynamic Modelling, Logical Architecture.
Dynamic Modelling: Use Case Diagrams, Class Diagrams, Interaction Diagrams, State Machine Diagrams, Activity Diagrams, Diagram Organization, Diagram Extensions.

Analysis Concepts: Object Models and Dynamic Models. Entity, Boundary, Control Objects. Generalization and Specialization

Analysis Activities: Requirements Model: From Use Cases to Objects

Identifying Entity Objects, Boundary Objects, Control Object. Mapping Use Cases to Objects with Sequence Diagrams, Modelling Interactions among Objects with CRC Cards. Identifying Associations, Aggregates, Attributes, Modelling State- Dependent Behaviour of Individual Objects, Modelling Inheritance Relationships between Objects. Reviewing the Analysis Model, Analysis Summary

UNIT 3 System Design 9 hours ,P - 6 hours

System Design: Decomposing the System

System Design Concepts: Subsystems and Classes, Services and Subsystem Interfaces, Coupling and Cohesion, Layers and Partitions, Architectural Styles. System Design **Activities**: From Objects to Subsystems, Analysis Model for a Route Planning System, Identifying Design Goals, Identifying Subsystems.

Static Modelling: Package Diagrams, Composite Structures, Component Diagrams, Deployment Diagrams. System Design Activities: Addressing Design Goals: Mapping Subsystems to Processors and Components, Identifying and Storing Persistent Data, Providing Access Control, Designing the Global Control Flow, Identifying Services, Boundary Conditions, Reviewing System Design

UNIT 4 Object Design 9 hours ,P - 6 hours

Object Design: **Design Patterns, Reusing Pattern Solutions**

Reuse Concepts. Reuse Activities: Selecting Design Patterns and Components, Encapsulating Data Stores with the Bridge Pattern, Encapsulating Legacy Components with the Adapter Pattern, Encapsulating Context with the Strategy Pattern, Encapsulating Platforms with the Abstract Factory Pattern, Encapsulating Control Flow with the Command Pattern, Encapsulating Hierarchies with the Composite Design Pattern, Heuristics for Selecting Design Patterns, Identifying and Adjusting Application Frameworks

Object Design: **Specifying Interfaces**

Interface Specification Concepts: Class Implementer, Class Extender, Class User, Types, Signatures, Visibility. **Contracts**: Invariants, Preconditions, Post conditions, Object Constraint Language.

OCL Collections: Sets, Bags, and Sequences.

OCL Quantifiers: for All and exists

UNIT 5 Implementation: Coding & Testing 9 hours ,P - 6 hours

Mapping Models to Code

Mapping Concepts: Model Transformation, Refactoring, Forward Engineering, Reverse Engineering, Transformation Principles.

Mapping Activities: Optimizing the Object Design Model, Mapping Associations to Collections, Mapping Contracts to Exceptions, Mapping Object Models to a Persistent Storage Schema.
Testing:An Overview of Testing. Testing Concepts: Faults, Erroneous States, and Failures, Test Cases, Test Stubs and Drivers, Corrections. Testing Activities: Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing.
Managing Testing: Planning Testing activities, Documenting Testing, Assigning Responsibilities, Regression Testing, Automating Testing.
Documenting Architecture: Architectural views: logical, deployment, security, data, behavioural.

Lab Activities Suggested:

Draw standard UML diagrams using a UML modelling tool and map design to code and implement. Test the developed code and validate whether the SRS is satisfied to a semester-long software engineering project by

following the sequence of steps given below

1. Identifying Requirements from Problem Statements

2. Modelling UML Use Case Diagrams and Capturing Use Case Scenarios

3. Identifying Domain Classes from the Problem Statements

4. State chart and Activity Modelling

5. Modelling UML Class Diagrams and Sequence Diagrams

6. Mapping diagram to code (Forward Engineering)

7. Designing Test Suites

*Project can be carried out in teams

Lab Infrastructure:

RationalPro, RationalRose, StarUML.

TextBooks:

1. Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java, Prentice-Hall.

2. Michael R. Blaha and James R Rumbaugh, Object-Oriented Modelling and Design with UML, Prentice Hall

3. Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and the Unified Process, Prentice-Hall.

References:

1. Stephen R. Schach, Object-Oriented Software Engineering, McGraw-Hill
2. Stephen R. Schach, Introduction to Object-Oriented Analysis and Design, McGraw-Hill
3. G. Booch, J. Rumbaugh and I. Jacobson, The Unified Modelling Language User Guide, Second Edition, Addison Wesley, 2005
4. UML2 and the Unified Process, Jim Arlow and Ila Neustadt, Addison Wesley,2005
5. https://pl.cs.jhu.edu/oose/resources/tools.shtml
6. https://pl.cs.jhu.edu/oose/resources/tools.shtml
7. https://www.upgrad.com/blog/software-development-project-ideas-topics-for-beginners/
8. http://www.cs.gordon.edu/courses/cs211/ATMExample/index.html

Course Outcomes:

After successful completion of the course the student will be able to:

1. Describe the OOAD paradigm (Unified Processes)

2. Employ the UML diagramming standards.

3. Demonstrate use of a software tool to support the planning, analysis and design phases

4. Use a case tool for all UML diagrams.

5. Develop prototypes of the system design, code, and Testing

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN3001</td><td rowspan="2">DESIGN AND ANALYSIS OF ALGORITHMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN2001: Data Structures</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course enables the students to gain knowledge in various techniques of designing algorithms, estimating the efficiency of the developed algorithms in terms of time and space. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

- Explain the asymptotic performance of algorithms.
- Demonstrate the complexity of an algorithm in terms of time and space.
- Help to design and implement programs in various programming paradigms.
- Familiarize with efficient algorithms in software design and development.

UNIT 1 Introduction to Algorithms 9 hours, P- 6 hours

Introduction to Algorithms: Algorithm specification, Performance Analysis. Divide and Conquer: The general method: Binary search, finding maximum and minimum, Merge sort, Quick sort, Selection, Strassen's Matrix multiplication.

UNIT 2 The Greedy Method 9 hours, P - 6 hours

The Greedy Method: The general method, Knapsack problem, Job sequencing with deadlines, optimal storage on tapes, minimum cost spanning trees, single source shortest paths.

UNIT 3 Dynamic Programming 9 hours, P - 6 hours

Dynamic Programming: The general method, multistage graphs, all pairs shortest paths, optimal binary search trees, reliability design, the travelling sales person problem.

UNIT 4 Basic search and traversing techniques hours,P- 6 hours

Basic search and traversing techniques: Techniques for Binary trees, Techniques for Graphs, connected components and spanning trees, Bi-connected components, and depth first search. Back Tracking: The General Method, Eight Queens problem, Sum of subsets, Graph coloring, Hamiltonian cycle.

UNIT 5 Branch and Bound& Algebraic Problems 9 hours,P - 6 hours

Branch and Bound: The method, traveling sales person problem, 0/1 knapsack problem, efficiency considerations.

Algebraic Problems: The general method, Evaluation and Interpolation.

TextBooks:

1. Ellis Horowitz, S. Sahni, Fundamentals of Computer Algorithms, 2/e, University Press, 1984.
2. Thomas H. Cormen, Charles E. Leiserson, Introduction to Algorithms, et.al., 3/e, MIT Press, 2012.

References:

1. Aho, Hopecraft, Ullman, The Design and Analysis of Computer Algorithms, 1/e, 2002.
2. Michel T. Goodrich & Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, 1/e, John Weily and Sons, 2001.
3. Sara Baase, Allen Van Gelder, Computer Algorithms: Introduction to Design and Analysis, 3/e, Pearson Education, 1999.
4. Mark Allen Weiss, Data Structures and Algorithm Analysis in JAVA, 3/e, Pearson Education, 2011.
5. Jon Kleinberg, Eva Tardos, Algorithm Design, 1/e, Pearson, 2013.

Course Outcomes:

After successful completion of the course the student will be able to:

1. define algorithm
2. compare various methods of designing algorithms
3. illustrate the merits and demerits of different designing techniques
4. identify best method to develop an algorithm
5. evaluate the algorithms in terms of efficiency

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1	1	1	1						1	3	3	
CO2	1	2	3	1	1			1	1		1		1	3	
CO3	1	2	3	1	1						1		2	3	
CO4	2	2	3	1	1			1	1				2	3	
CO5	3	2	3	1	1			1			1		2	3	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN3011</td><td rowspan="2">ARTIFICIAL NEURAL NETWORKS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Artificial Neural Networks to be more precise, represent a technology that is rooted in many disciplines: neurosciences, mathematics, statistics, physics, computer science and engineering. ANN find applications in such diverse fields as modelling, time series analysis, pattern recognition, signal processing and control by virtue of an important property: the ability to learn from input data with or without a teacher.

Course Educational Objectives:

- To understand the architecture, learning algorithm and issues of various neural networks.
- Analyse ANN learning, Error correction learning, Memory-based learning, Competitive learning and Boltzmann learning
- To adopt gradient - descent techniques in real time applications
- Provide knowledge on Generalization and function approximation and various architectures of building an ANN
- Implement and learn the applications of Self-organization Map

UNIT 1 Introduction to Neural Networks 9 hours, P - 6 hours

Introduction, The Basic Architecture of Neural Networks, Training a Neural Network with Backpropagation, Practical Issues in Neural Network Training, Common Neural Architectures.

UNIT 2 Shallow Neural Networks 9 hours, P - 6 hours

Neural Architectures for Binary Classification Models, Neural Architectures for Multiclass Models, **Autoencoder**: Basic Principles, Neural embedding with continuous bag of words, Simple neural architectures for graph embeddings

UNIT 3 Deep Neural Networks 9 hours, P - 6 hours

Introduction, Backpropagation, Setup and Initialization Issues, Gradient-Descent strategies, the bias-variance trade-off, Generalization Issues in Model Tuning and Evaluation, Ensemble Methods

UNIT 4 Attractor Neural Networks 9 hours, P - 6 hours

Associative Learning, Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

UNIT 5 Self-organization Feature Map 9 hours, P - 6 hours

Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, VectorQuantization, Self-organization Feature Maps, Application of SOM.

Textbooks:

1. Neural Networks and Deep Learning - Charu C. Aggarwal, Springer International Publishing AG, part of Springer Nature 2018 (Chapters 1, 2, 3)

2. Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition. (Chapters 4, 5)

References:

1. Neural Networks: A Comprehensive Foundation - Simon Haykin PHI, 2nd Edition 2005.

2. Introduction to Artificial Neural Systems-J.M. Zurada, Jaico Publications 1994.

3. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the origin, ideological basics, Learning process and various Neural Architectures of ANN.

2. Understand the concepts and techniques of Shallow neural networks through the study of important neural network models.

3. Training Deep Neural Networks and Teaching Deep Learners to Generalize.

4. Apply Attractor neural networks to particular application.

5. Design a self-organizing system that are capable of extracting useful information from the environment within which they operate.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				2			1			2	2	2	3
CO2		3		2		2			1			2	2	2	3
CO3		3	3	1	1	2			1			2	2	2	3
CO4	3	3	2	3		2			1			2	2	2	3
CO5		3		3		2			1			2	2	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:
SDGs: 3, 9
SDG:3 Good Health and Well-being
Statement: Artificial Neural Networks can be applied across all levels of health care organizational decision-making. Influenced by advancements in the field, decision-makers are taking advantage of hybrid models of neural networks in efforts to tailor solutions to a given problem and well-being.
SDG:9 Industry, Innovation and Infrastructure
Statement: The holistic understanding of Artificial Neural Networks has lead to develop various new models like CNN, RNN, RCNN, and GANs for achieving outstanding results on several complex cognitive tasks, matching or even beating those provided by human performance

SDG Justification:

CSEN3061	AUTOMATA THEORY AND COMPILER DESIGN	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**MATH1041: Discrete Mathematics**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

Finite Automata comprises theoretical computer science to study abstract machines for solving computation problems. Compilers play a significant role in fulfilling users' computing requirements, specified in programs in a high-level language, which translate into machine-understandable form. The process involved in such a transformation of a program is quite complex. This course intends to help the students learn the fundamentals of the theory of computation that can recognize formal languages typically illustrated by the Chomsky hierarchy and how this knowledge enables one to design a compiler. Automata Theory provides the basis for developing a compiler.

Course Educational Objectives:

- Impart the mathematical concepts of theoretical computer science from the perspective of formal languages in solving computational machines.
- Familiarize various formal languages, grammar, and their relationships.
- Demonstrate various finite state machines and recognize formal languages.
- Explore the basic techniques that underlie the principles, algorithms, and data structures in Compiler Construction.
- Gain experience in using automated tools that helps in transforming various phases of the compiler.

UNIT 1 Finite Automata and Regular Languages 9 hours

Central concepts of strings, languages and automata theory, Regular expressions and languages, Deterministic Finite Automata (DFA) and equivalence with Regular expression, Non- Deterministic Finite Automata, and equivalence with DFA, Minimization of Finite Automata by partitioning, Chomsky hierarchy of grammars

UNIT 2 Grammars 9 hours

Regular grammars equivalent with Finite Automata, Context-free grammars, and languages; Parse trees; Applications; Ambiguity in grammars and Languages, Simplification of Context-Free Grammars, Closure Properties of Context-Free Languages, Membership Algorithm (CYK).Push down automata, Equivalence of push down automata and context free grammar

UNIT 3 Introduction to Compiler Design 9 hours

The Structure of Compiler, The Science of Building a Compiler in Bootstrapping and Cross compiler, The role of the Lexical analyser, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical Analyzer Generator (LEX/FLEX).

UNIT 4 Parsing Techniques 9 hours

Top-Down parsing: Recursive Descent Parsing, Non-recursive Predictive Parsing, Bottom-Up parsing – Shift Reduce Parsing, Simple LR Parser, More Powerful LR Parsers (CLR&LALR), Parser Generator (YACC).

UNIT 5 Other Phases of Compiler Design 9 hours

Intermediate Code Generation: Three Address codes.
Code Optimization: The Principal Sources of Optimization, Basic blocks, and Flow Graphs, Optimization of Basic Blocks. Code Generation: Issues in designing a code Generator, The Target Language, A Simple CodeGenerator, Peephole Optimization.

TextBooks:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3/e, Pearson, 2008.

2. Alfred. V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey. D. Ullman, Compilers Principles,Techniques and Tools, 2/e, Pearson Education, 2008.

References:

1. Alfred. V. Aho, J.D. Ullman, Principles of compiler design, Narosa Publications, 2002

2. Peter Linz, An Introduction to Formal Language and Automata, Narosa Pub. House, Reprint 2000.

3. Michael Sipser, Introduction to Theory of Computation, 3/e, Wadsworth Publishing Co Inc, 2012.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Illustrate the concepts in the design of Finite State Machines to recognize Regular Languages

2. Analyze the relation between grammar and language, and design Context-Free Grammars for

formal languages

3. Define and analyse various phases involved in developing a compiler

4. Compare between bottom-up and top-down parsing techniques

5. Identify different machine-independent optimization generating target code techniques

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1	2	1
CO2	1	1											1	2	2
CO3	1	2											2	2	2
CO4	2	2	2	2					1				2	1	2
CO5	2	2	1						2				2	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

Course Code	Course Title	L	T	P	S	J	C
CSEN3082	Deep Learning	2	1	0	0	0	3
Course Owner	Department of CSE	Syllabus version				2.0	
Course Pre-requisite(s)	CSEN2001; CSEN3001	Contact hours				45	
Course Co-requisite(s)		Approved on:					
Alternate Exposure							

This course is designed to introduce modern techniques of neural networks and deep learning, which have revolutionized machine learning and artificial intelligence practice to graduate students. Deep Learning focuses to learn feature hierarchies with features at higher levels in the hierarchy formed by the composition of lower-level features. This course aims to cover the basics of Deep Learning and some of the underlying theory with a particular focus on supervised Deep Learning along with a good coverage of unsupervised methods.

Course Objectives

1. To summarize neural networks and regularization techniques.
2. To familiarize Convolution Neural Networks and its architecture.
3. To learn Recurrent Neural network architecture and its effectiveness
4. To illustrate deep unsupervised learning techniques
5. To inspect neural network architecture in real time applications

UNIT - I LTP 6 3 0

Deep Feed Forward Networks, Gradient descent, Back propagation, Regularization techniques: Parameter Norm Penalties, Norm penalties as constrained optimization. (6.1, 6.2, 6.5, 7.1, 7.2)

Learning Outcomes:

After completion of this unit, the student will be able to:

- Outline the concepts of Neural networks and its applications L2
- Understand Gradient descent and Back propogation algorithms L2
- Evaluate Neural Networks Regularization techniques L5

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II LTP 6 3 0

Convolution Network: Architectures, Convolution operations, Pooling layer, Variants of the basic Convolution Function, Efficient Convolution algorithms, Random and unsupervised features, Neuro Scientific Basis for Convolutional Networks (9.1, 9.3, 9.5, 9.8, 9.9, 9.10)

Learning Outcomes:

After completion of this unit, the student will be able to

- Interpret the mechanism of Convolution neural network. L2
- Analyse the working principles of pooling layer L4
- Assess Various efficient convolutional algorithms L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III LTP 6 3 0

Sequence Modelling: RNN, Encoder and decoder archerites, DRN, Recursive Neural Networks, LSTM and other Gated RNN, GRU (10.2, 10.4, 10.5, 10.6, 10.10, 10.11)

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the Encoder and Decoder architectures of RNN L2
- Differentiate RNN and Recursive NN L2
- Inference the LSTM and GRU algorithms L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV LTP 6 3 0

Auto encoders: Under complete auto encoders, regularized encoders, stochastic encoders and decoders Deep generative models: Boltzmann Machines, restricted Boltzmann machines, Deep Belief networks, Deep Boltzmann machines for real world data (14.1, 14.2,14.3, 20.1 to 20.5). . Introduction to Generative Adversarial Networks(GANs) and its applications

Learning Outcomes:

After completion of this unit, the student will be able to

- Relate auto Encoders learning L2
- Illustrate Boltzmann machines L2
- Summarize belief networks L2
- Analyse the Generative adversarial networks for Image applications

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V LTP 630

Applications of Deep Learning: Large scale Deep learning, Computer vision, speech recognition, NLP, other applications (12.1 to 12.5)

Learning Outcomes:

After completion of this unit, the student will be able to

- Develop a neural network model for Object detection L5
- Analyse the Generative adversarial networks for Image applications L4
- Compare Image segmentation and generation techniques. L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press,2015.

Reference Book(s):

1. Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Deep Learning, First Edition, Pearson

2. Sandro Skansi, Introduction to Deep Learning, Springer

Website(s):

https://www.coursera.org/deeplearning-ai

Course Outcomes: After successful completion of the course the student will be able to:
1. Understand the role of neural networks and its various applications.
2. Construct the architecture of CNN and its usage.
3. Outline the RNN architecture and its effectiveness.
4. Investigate auto encoders techniques in deep learning.
5. Analyse the applications of Deep Learning and Image Processing.

	Programme Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1							1	2	1	1	1		1
CO2	1	2	3		2					1		1	1	1	1
CO3	1	2	3		2					1		1	1	1	1
CO4	1	2	2		2					1		1	1	1	
CO5	2	2	3	2	2	2	1	1		2	1	1	1	1	

1-Low, 2- Medium and 3- High Correlation

Tutorial Exercise

1. Build a Feed forward neural network and measure the performance using different optimizers.
2. Build Feed forward neural network using different Regularization techniques.
3. Write a program to implement artificial neural network without back propagation.
4. Write a program to implement artificial neural network with back propagation.
5. Write a program to implement image classification using CNN.
6. Write a program to implement text classification using RNN, LSTM.
7. Write a program to implement image generation using GANS.
8. Build a regularized Deep Autoencoder.
9. Build an autoencoder to perform denoising.
10. Demonstrate dimensionality reduction using Autoencoder.

Programme Elective

<table>
<tr><td rowspan="2">CSEN1131</td><td rowspan="2">SOFTWARE ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The purpose of this course is to impart knowledge on the basic principles of software engineering and enabling the learner to understand software lifecycle stages. Systematic development of software products or solutions is emphasized throughout the course to enable the student ensure quality of development activities.

Course Educational Objectives:

- Provide Introduction to Software Engineering and process of Software production
- Enable understanding of widely varying nature of software solutions and domain and technology aspects of software
- Deconstruct different stages of Software products' life cycle and software Evolution, life cycle processes
- Facilitate Analysis of requirements for software solution development
- Summarize architecture, design, and implementation considerations of software solution
- Exposure to quality aspects across the stages, planning aspects

UNIT 1 Introduction to Software Engineering 9 hours

The story of Software development and issues faced, Need for Systematic process for addressing issues,Products, custom solutions, services, domains, Technologies, Software life cycle, software development lifecycle, software release process, source control, versioning, maintenance of software. DevOps.

Software Development Processes: Waterfall, Iterative, Spiral.

UNIT 2 Software development phases and processes 9 hours

Software development and processes – RAD, RUP, Agile: Scrum, Prototyping

Development phases of Software in relation to Processes

What to develop? – Requirements gathering and Analysis, Types- functional, non-functional, system, User Interface, quality requirements and putting together– UML use cases, scenarios.

UNIT 3 Requirements, design and solution 9 hours

Considerations for architecture, design, Data, modules, interfaces – application architectures.

System design: modular design – cohesion and coupling, Structural Design -Top down, Bottom up approaches; data models, User Interface guidelines; UML Activity, Sequence, Component, Collaboration, Deployment diagrams

UNIT 4 Implementation and Ensuring Quality of software and Metrics 9 hours

How to implement – practices to follow for development – language, platform choices, coding practices, cost of bugs through life cycle

Quality from requirements to release and across versions: Faults and Fixes, Reliability models: Logarithmic Poisson Model

Testing mechanisms across life cycle: Functional, system integration, user testing, testing on different platforms.Testing Tools

Quality across versions and metrics for quality; Quality Models: ISO, CMM, Boehm, McCall; Metrics: Process and Product metrics - LOC, Function Points, Token Count

UNIT 5 9 hours

Software Management - Planning for software development

Estimation of time, resources, the cost for software development: COCOMO, Function Point, Putnam Resource Allocation Models

Planning activities and re-planning, Risk Analysis

Release mechanisms, Configuration Management, Licensing methods and Maintenance

Software Life Cycle Management - planning, tracking, communication, negotiation, delivery, quality aspects.

Lab Activities Suggested:

1. Implement weather modeling* using the quadratic solution in stages: hard-coding variables keyboard input, read from a file, for a single set of input, multiple sets of inputs.
   a. save all versions, debug, fix problems, create a Github account

2. Develop weather modeling using the quadratic model in teams of 5 using Waterfall, Iterative, Agile modes

3. a. Teams of 5 to work on gathering requirements for different simple projects related to University and student activities

b. Represent requirements in terms of lists, use cases, scenarios (UML)
c. try simple architecture and design of modules. Represent in activity, sequence, collaboration diagrams(UML)

4.a. Testing quadratic modeling of weather modeling example

   b. Testing using open source testing tools: Selenium, Jmeter

5.a. Understand cost drivers using the COCOMO site for team projects

   b. Create a project plan in Jira

Lab Infrastructure:

1. Eclipse, Visual Studio, SQL Server, MS Access, Oracle
2. StarUML /RationalPro, jira

TextBooks:

1. Ian Sommerville, "Software Engineering", 10th Edition, Pearson Education, 2015 (overall – Part I: 1 to 9, Part IV: parts of 23 to 25)

2. Klaus Pohl, Chris Rupp, "Requirements Engineering Fundamentals" 2nd Edition, RockyNook, 2015.

3. Rajib Mall, Fundamentals of Software Engineering, 4/e, PHI, 2009. (for metrics))

4. K. K. Aggarwal & Yogesh Singh, "Software Engineering", 3rd Edition, New Age International, 2008. (for metrics)

5. Steve Mcconnell, "Code complete", 2nd Edition, Microsoft Press, 2004, Print 2015 (for design)

6. Frederic P. Brooks, "The Mythical Man-Month: Essays on Software Engineering", Addison-Wesley,1995, print 2010 (for project management)

References:

1. Michael R Blaha, James R Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd

Edition,Pearson Education, 2005
2. Axel van Lamsweerde, “Requirements Engineering” Wiley Publications, 2009
3. http://vlabs.iitkgp.ernet.in/se/
4. http://softwarecost.org/tools/COCOMO/

Course Outcomes:

After successful completion of the course the student will be able to:

1. Demonstrate understanding of the process of Software Development

2. Determine Suitability of processes for varying software applications development

3. Differentiate Development phases through the life cycle of software

4. Reflect on design choices and development standards

5. Check and verify software quality from requirements to release of software and across versions

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

Course Code	Course Title	L	T	P	S	J	C
CSEN1151	**Fundamentals of E-Commerce**	3	0	0	0	0	3
Course Owner	Department of Computer Science and Engineering	Syllabus version			1.0		
Course Pre-requisite(s)		Contact hours			45		
Course Co-requisite(s)		Approved on:					
Alternate Exposure							

Course Objectives

1. Collate the Technologies underlying E-Commerce applications
2. Analyse the security threats and challenges for building E-Commerce Applications
3. Identify IT Infrastructure needs for E-Commerce platforms
4. Identify Software architecture demands to meet E-Commerce specifications
5. Develop a simple Ecommerce application using an open-source E-Commerce framework

UNIT - I	Foundations of Digital Marketing and E-commerce	L T P	900

Introduction-digital marketing and e-commerce, Roles and responsibilities in digital marketing and e-commerce, Advantages and challenges of digital marketing

The customer journey and the marketing funnel- Inclusive marketing, The marketing funnel, The top/bottom of the funnel: Awareness and consideration, The traditional marketing funnel to the digital marketing funnel

Digital marketing and e-commerce strategy-The value of brands for digital marketing, The elements of a digital marketing strategy, Attract customers with search engine optimization, Introduction to social media and email marketing, Attribution models for digital marketing

Learning Outcomes:

After completion of this unit, the student will be able to

• Examine the roles and responsibilities in digital marketing	L3
• Distinguish traditional and digital marketing funnel	L3
• Understand the elements and goals of a digital marketing and e-commerce strategy	L2

Pedagogy tools: Classroom teaching, self-reading, Lab work

UNIT - II	Attract and Engage Customers with Digital Marketing	L T P	900

Introduction-Strategies- to get customers introduced to a brand, to build interest in your product or service, to increase the conversion rate on a website, to increase the loyalty of customers after a purchase.

Search Engine Optimization (SEO)- SEO and its importance, Beginner SEO terms and recommendations, Other popular search engines, Best practices for links and promoting a website, Website structure and navigation, Optimize a website's content

Learning Outcomes:

After completion of this unit, the student will be able to

• Recognize strategies to build brand awareness among potential customers	L2
• Examine Optimize website content for SEO	L3
• Understand the purpose of SEO (search engine optimization) and essential SEO terms	L2

Pedagogy tools: Classroom teaching, self-reading, Lab Work

UNIT - III	Search Engine Marketing and display advertising	L T P	900

Introduction-Google Search Console, Google Search Console reports and metrics

Search Engine Marketing (SEM)-Understand the benefits of SEM, Common SEM ad formats in Google Ads, Best practices when creating a Google Ad in Search, Introduction to display advertising, optimization of a responsive display ad

Learning Outcomes:

After completion of this unit, the student will be able to

• Demonstrate search engine marketing (SEM)	L3
• Use of different ad formats in Google Ad	L2
• Illustrate Search Engine Marketing	L2

Pedagogy tools: Classroom teaching, self-reading, Lab Work

UNIT - IV	Email Marketing	L T P	900

Introduction-Email marketing, Entry-level email marketing jobs and tasks, do's and don'ts of email marketing, email marketing strategy

Types of email marketing -Acquisition emails, Welcome emails, Newsletters, Promotional emails, Retention emails

Tools for effective email marketing, Creation of an email in HubSpot, Set up a Mailchimp campaign, Common email marketing metrics, email marketing campaign, SMART goals for an email campaign

Learning Outcomes:

After completion of this unit, the student will be able to

• Understand how email marketing fits into a digital marketing strategy	L2
• Examine how to test, execute and optimize an email marketing campaign	L3
• Analyze email campaign results	L2

Pedagogy tools: Classroom teaching, self-reading, Lab Work

UNIT - V	Marketing Analytics and Measurement	L T P	900

Introduction-Media plans and performance goals, Gaining understanding through analytics and measurement, Introduction to Google Analytics, Big data for marketing analytics and automation

Work with Google Analytics-Monitor metrics, Create Explorations, Link Google Ads to Google Analytics, Export Google Ads and Google Analytics data, Dashboards, scorecards, and reports in Google Ads, View and apply recommendations in Google Ads

A/B tests in Google Ads-Monitor and Interpret A/B test results,

Data analysis and visualization in spreadsheets: sort, filter, pivot tables and charts

Learning Outcomes:

After completion of this unit, the student will be able to	
• Understand media planning and strategies	L2
• Evaluate metrics against performance goals and make adjustments to a marketing budget or strategy	L3
• Illustrate knowledge data analysis and visualization in spreadsheets	L2

Pedagogy tools: Classroom teaching, self-reading, Lab Work

Reference Book(s):

1. Kenneth C. Laudon, Carol Guercio Traver E Commerce 2021-2022: Business, Technology and Society, 17th edition, 2022, Pearson
2. Janice Reynolds, “The Complete Ecommerce Book” 2nd Edition, 2015, Taylor and Francis group
3. Ravi Kalakota, Andrew Winston, “Frontiers of Electronic Commerce”,2011, Pearson
4. Henry Chan, Raymond Lee, etc. , “E-Commerce Fundamentals and Applications”, Wiley

Coursera Courses:

1. Google Digital Marketing & E-commerce Professional Certificate

Website(s):

1. https://ecommercetrainingacademy.com/how-to-learn-ecommerce/

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand Technologies underlying E-Commerce applications
2. Analyse the security threats and challenges for building E-Commerce Applications
3. Identify IT Infrastructure needs for E-Commerce platforms
4. Identify Software demands to meet E-Commerce specifications
5. Develop a simple Ecommerce application using an open-source E-Commerce framework

	Programme Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												1	2	
CO2	1	2											2	2	
CO3		2											2		
CO4		2											2		
CO5	2	3											2	2	3

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:	
BOS :<< date >>	ACADEMIC COUNCIL: <<date>>
SDG No. & Statement:	

SDG 8 (Decent Work and Economic Growth): Engaging customers with Digital Marketing and working with Google Analytics
SDG Justification:

This course teaches the basic technology to attract and engage customers with digital marketing. This provides an opportunity to promote websites and increases the loyalty of customers after purchasing products or services. Digital Marketing provides a global reach to find new markets and allow companies to target a vast audience and expand their customer base. In addition, it enhances brand visibility, increases customer engagement, and drives business growth in the digital era. Working with Google Analytics improves the user experience, increases website traffic, and ultimately drives more sales and revenue.

CSEN2071	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	CSEN2021: Computer Networks						

Course Description:

The aim of this course is to introduce information security concepts to the students. This course develops a basic understanding of goals, threats, attacks and mechanisms, algorithms, and their design choices. The course also familiarizes students with a few mathematical concepts used in cryptology. The course emphasizes to give a basic understanding of attacks in cryptosystems and how to shield information from attacks. It also deals with message authentication, Digital signatures, and Network security.

Course Educational Objectives:

- Understand basics of security concepts and comprehend Classical Encryption Techniques
- Impart various symmetric cryptographic techniques
- Learn number theory related to RSA and Diffie-Hellman algorithms
- Study different hash functions and message authentication techniques
- Impart knowledge of application and transport layers security concepts

UNIT 1 Basics of Computer Networks 9 hours

Introduction: Computer Security Concepts, The OSI Security Architecture, Cryptography,

cryptanalysis, attacks, services, security mechanisms.

Classical Encryption Techniques: Substitution Techniques, Caesar Cipher, Monoalphabetic Ciphers, Play fair Cipher, Hill Cipher Polyalphabetic Ciphers. Transposition Techniques.

UNIT 2 Symmetric key cryptography 9 hours

Symmetric Key Cryptography: Block Ciphers and the Data Encryption Standard (DES) algorithm. Differential and linear cryptanalysis, triple DES. Block cipher design principles, Block cipher modes of operation, Advanced Encryption Standard (AES), Stream Ciphers: RC4.

UNIT 3 Number theory & Cryptography 9 hours

Number theory: Divisibility and The Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat’s and Euler’s Theorems, Testing for Primality, The Chinese Remainder Theorem. Public Key

Cryptography: Principles of public key cryptosystem, RSA algorithm, security of RSA. Diffie Hellman key exchange.

UNIT 4 Cryptographic Hash Functions 9 hours

Cryptographic Hash Functions: Applications of hash Functions, Secure Hash Algorithm (SHA). MAC and Digital Signatures: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, HMAC, DAA and CMAC. Digital signatures, Digital Signature Standard (DSS), Key management and distribution: Distribution of Public Keys, X.509 Certificates.

UNIT 5 Internet Security 9 hours

Internet Security: Introduction to SSL and TLS. Email Security: S/MIME. Firewalls: Types of Firewalls, configuring firewalls, Intrusion Detection and Preventions Systems.

Textbooks:

1. William Stallings, Cryptography and Network Security – Principles and Practice, 7/e. Pearson Education, 2017.

References:

1. Behrouz A Fourozen and Debdeep Mukhopadhyay, Cryptography and Network Security,3/e,McGraw Hill, 2015
2. Atul Kahate, Cryptography and Network Security, 4/e, McGraw Hill, 2019.
3. Buchmann, Introduction to Cryptography, Springer, 2004
4. Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C(cloth),2/e, Publisher: John Wiley& Sons, Inc., 1996.
5. Chwan-Hwa(John) Wu, Introduction to Computer Networks and Cybersecurity, CRC Press,2013
6. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks/home/week/3
7. https://www.coursera.org/learn/cybersecurity-roles-processes-operating-system-security/home/week/1
8. https://www.coursera.org/learn/cybersecurity-compliance-framework-system-administration/home/week/1

Course Outcomes:

After successful completion of the course the student will be able to:
1. illustrate working of classical encryption techniques
2. describe the working of symmetric encryption techniques
3. experiment the working of public key cryptography algorithms such as RSA, Diffie-Hellman
4. Apply Hash functions and message authentication techniques
5. Demonstration of firewall configuration.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1												
CO2	1	2	2	1											
CO3	2	2	2	1											
CO4	2	1	2	1		1		1							
CO5	2	1	2	1		1		1							

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 16: Provides safety and security to the citizens of the county in cyberspace, which creates peaceful and inclusive societies

SDG Justification:

CSEN2101	INTERNET OF THINGS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**CSEN2021: Computer Networks**						

Course Description:

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols and APIs used in the IoT.

Course Educational Objectives:

- Introduce the fundamental concepts of IoT and its characteristics
- Expose the student to sensors used for sensing different physical quantities
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with different application program interfaces for accessing Cloud services.
- Enable students to create simple IoT applications.

UNIT 1 Introduction to Internet of Things (IoT) 9 hours

Introduction to Internet of Things, Examples of IoT Devices, Evolution of IoT: M2M, WSN, CPS, Application Areas of IoT, Characteristics of IoT, Things in IoT, IoT Stack, Enabling Technologies, IoT Challenges, IoT Levels.

UNIT 2 Introduction to Sensors, Microcontrollers, and their Interfacing 9 hours

Introduction to Sensors, Microcontrollers, and their Interfacing

Sensors and Actuators, Single Board Microcontrollers and Computers, Arduino Platform, Board, Arduino IDE, Programming for Arduino, Raspberry Pi Platform, Raspberry Pi Processor, Raspberry Pi vs. Arduino

UNIT 3 Connectivity for IoT 9 hours

Why is networking required? WAN Structure, Network types, Addressing, TCP/IP basics, **Messaging and Transport Protocol**s: Messaging Protocols (CoAP, MQTT), **Addressing and**

Identification: Internet Protocol Version 4 (IPv4), Internet Protocol Version 6 (IPv6), Uniform Resource Identifier (URI)

UNIT 4 Cloud for IoT 9 hours

IoT with Cloud, Challenges, Selection of Cloud Service Provider for IoT Applications, Introduction to Fog Computing, Cloud Computing: Security Aspects, Case Study: *Streaming IoT Data to AWS/Google Cloud*

UNIT 5 IoT Data Analytics and Application Development 9 hours

Data, Statistics, Analysis of covariance: variance (ANOVA),, Correlation Plots, Simple Linear Regression, , Multiple Linear Regressions, Logistic Regression, Clustering model.
R Markdown: Introduction, Code Chunks, Markdown Basics, R Notebooks, Output Formats. Implement Regression techniques and Clustering Model using R

Suggested list of experiments:

1. Select any one development board (Eg., Arduino or Raspberry Pi) and control LED using the board.
2. Using the same board as in (1), read data from a sensor. Experiment with both analog and digital sensors.
3. Control any two actuators connected to the development board using Bluetooth.
4. Read data from the sensor and send it to a requesting client. (using socket communication) Note: The client and server should be connected to the same local area network.
5. Create any cloud platform account, explore IoT services and register a thing on the platform.
6. Push sensor data to the cloud.
7. Control an actuator through the cloud.
8. Access the data pushed from sensor to cloud and apply any data analytics or visualization services.
9. Create a mobile app to control an actuator.
10. Identify a problem in your local area or college which can be solved by integrating the things you learned so far and create a prototype to solve it (Mini Project).

Textbooks:

1. Misra, S., Mukherjee, A. and Roy, A., Introduction to IoT. Cambridge University Press, 2021.
2. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley India, 2019

References:

1. Simon Monk, Programming Arduino: Getting Started with Sketches, Mc Graw Hill Publications, 2011
2. Simon Monk, Programming the Raspberry Pi, Getting Started with Python, Mc Graw Hill Publications, 2015
3. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, Mc Graw Hill Publications, 2017
4. Manoj R. Thakur, NodeMCU ESP8266 Communication Methods and Protocols: Programming with Arduino IDE Amazon Media, 2018.

Website(s):

1. https://www.arduino.cc/
2. https://www.raspberrypi.com/software/

Course Outcomes:

After completion of this course, the student will be able to:

1. choose the sensors and actuators for an IoT application (L4)
2. select protocols for a specific IoT application (L2)
3. utilize the cloud platform and APIs for IoT application (L3)
4. experiment with embedded boards for creating IoT prototypes(L5)
5. design a solution for a given IoT application (L6)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1										3	3		1
CO2	1	1		1					2			2	3		2
CO3	1	2										2	3	3	
CO4	3	3	3		3							2	3	3	
CO5	3	3	3	3		2	2		2	3	3	3	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG7 (Affordable and Clean Energy): The Internet of Things course studies application development involving the Smart Grid, which results in efficient usage of energy resources. This results in reduced energy costs and carbon footprint.

SDG11 (Sustainable Cities and Communities): The Internet of Things course teaches basics necessary for the development of applications such as Smart Transportation, Smart Water and waste management, Smart Infrastructure and Utilities etc. These applications can be leveraged for the development of sustainable cities and communities.

SDG Justification:

CSEN2111	AGILE SOFTWARE DEVELOPMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	CSEN1131: Software Engineering						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Agile software development practices enable customer centric software development with collaborative teamwork centred around people. This course elaborates agile development principles and techniques covering the entire software development process from problem conception through development, testing and deployment to equip the learner with practical software development methodology.

Course Educational Objectives:

- To understand the agile concept and its importance in software development. .
- To acquire complete knowledge on Extreme programming.
- To know complete modelling of agile processes on the XP environment.
- To acquire knowledge on Scrum.
- To familiar with Feature driven development .

UNIT 1 Introduction 9 hours

Introduction: The Agile manifesto, Agile methods, XP: Extreme Programming, DSDM, SCRUM,
feature- Driven Development, Test Driven Development, modelling misconceptions, agile modelling,
tools of misconceptions, updating agile models.

UNIT 2 Extreme Programming 7 hours

Extreme Programming: Introduction, core XP values, the twelve XP practices, about extreme programming, planning XP projects, test first coding, making pair programming work.

UNIT 3 Agile Modelling and XP 8 hours

Introduction, the fit, common practices, modelling specific practices, XP objections to agile modelling, agile modelling and planning XP projects, XP implementation phase

UNIT 4 Scrum 8 hours

Scrum Framework, Agile Principles, Sprints, Requirements and User Stories, Product backlogs, Estimation and Velocity, Roles, Planning, Multi-level Planning, Release Planning, Sprint planning.

UNIT 5 Feature-Driven Development 8 hours

Feature-Driven Development: Introduction, incremental software development, Regaining Control,
motivation behind FDD, planning an iterative project, architecture centric, FDD and XP.
Test Driven Development: Unit Tests, Integration Tests, End-to-End Tests, Customer Tests.
Release Management: Version Control, Continuous Integration.

TextBooks:

1. John Hunt, Agile Software Construction,1st Edition, Springer,2005
2. Craig Larman, Agile and Iterative Development: A Manager's Guide, Addison-Wesley, Pearson Education – 2004
3. Pearson, Robert C. Martin, Juli, James Shore, Chromatic 2013, The Art of Agile Development, O'Reilly Media
4. Elisabeth Hendrickson, Agile Testing, Quality Tree Software Inc 2008.

References:

1. Andrew Stellman, Jenifer Greene, Headfirst Agile, O'Reilly, 2017
2. Peggy Gregory, Casper Lassenius, Xiaofeng Wang Philippe Kruchten (Eds.), Agile Processes in Software Engineering and Extreme Programming, 22nd International Conference on Agile Software Development, XP 2021 Virtual Event, June 14–18, 2021, Proceedings, Springer
3. Peggy Gregory, Philippe Kruchten (Eds.), Agile Processes in Software Engineering and Extreme Programming – Workshops XP 2021 Workshops Virtual Event, June 14–18, 2021 Revised Selected Papers, 2021
4. Ian Somerville, Software Engineering, 10th edition, Pearson, 2016

Course Outcomes:

After successful completion of the course the student will be able to:

1. use agile methods in various development environments.
2. apply Xtreme programming confidently.
3. understanding of Agile Modelling XP Projects.
4. design and develop applications in Scrum environments.
5. develop abilities on Feature Driven Development.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					1							2		
CO2			3	2					2					1	
CO3		2	2												1
CO4		1											2		
CO5			1		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4 Quality Education
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Learning about the importance of Agility that suits with the current Software industry requirements lead to develop the various applications

SDG Justification:

Course Code	Course Title	L	T	P	S	J	C
CSEN2121	CLOUD COMPUTING	3	0	0	0	0	3
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	--	Contact hours				45	
Course Co-requisite(s)	--	Approved on:					
Alternate Exposure	--						

This course will help the students to get familiar with Cloud Computing Fundamental concepts, technologies, architecture and state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations.

Course Objectives

1. To understand basic concepts related to cloud computing technologies and the concept of cloud delivery models IaaS, PaaS and SaaS.
2. To evaluate the underlying principles of Data Center, cloud virtualization, cloud multitenancy and service technologies.
3. To implement different infrastructure and specialized mechanisms related to cloud storage and usage monitor.
4. To identify the technical foundations of cloud systems architectures.
5. To understand the fundamentals of current standards, protocols, security mechanisms in cloud environment.

UNIT - I Understanding Cloud Computing LTP 9-0-0

Cloud origins and influences, basic concepts and terminology, goals and benefits, risks and challenges.

Fundamental Concepts and Models: Roles and boundaries, cloud characteristics, cloud delivery models, cloud deployment models.

Learning Outcomes:

After completion of this unit, the student will be able to

- define the cloud and the IT resource L1
- name the cloud consumers and cloud providers L1
- infer the goals and benefits L2
- classify the characteristics of cloud L2
- illustrate the delivery and deployment models L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Cloud Enabling Technology LTP 9-0-0

Data center technology, virtualization technology, web technology, multitenant technology, service technology

Learning Outcomes:

After completion of this unit, the student will be able to

- list the various Internet Service Providers L1

- illustrate the various technologies and components L2
- compare the computing hardware technologies L2
- select the web-based services L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Cloud Infrastructure Mechanisms LTP 9-0-0

Logical network perimeter, virtual server, cloud storage device, cloud usage monitor, resource replication

Learning Outcomes:

After completion of this unit, the student will be able to

- compare the various cloud infrastructure mechanisms L2
- build the hypervisor mechanism L3
- compare the physical server and virtual servers L4
- test for cloud storage device L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Fundamental Cloud Architectures LTP 9-0-0

SLA Monitor, Pay-Per-Use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi-Device Broker, State Management Database, Workload distribution architecture, resource pooling architecture, dynamic scalability architecture, elastic resource capacity architecture, service load balancing architecture, cloud bursting architecture, elastic disk provisioning architecture, redundant storage architecture.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe different cloud computing architectures L1
- list the components in the architectures and summarize their functionality L2
- compare the traditional and cloud application architectures L2
- understand the advantages of modular architectures in cloud environment L1

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Cloud Security Mechanisms LTP 9-0-0

Cloud Security Threats: Traffic Eavesdropping, Malicious Intermediary, Denial of Service, Insufficient Authorization, Virtualization Attack, Overlapping Trust Boundaries.

Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public key Infrastructure, identity and Access Management, Single Sign-on, Cloud Based Security Groups, Hardened Virtual Server Images.

Learning Outcomes:

After completion of this unit, the student will be able to

- understand the security risks associated with in cloud computing environments L1
- analyse different cloud security mechanisms L2
- apply different types of encryption methods L3
- compare various security mechanisms L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013.

Additional Reading

Reference Book(s):

1. John W. Rittinghouse, James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2012.
2. Anthony T.Velte, Toby J Velte Robert Elsenpeter, Cloud Computing a practical approach, Mc Graw Hill,2010.
3. Michael Miller, Cloud Computing: Web based Applications That Change the Way You Work and Collaborate Online, Que Publishing, 2008.

Course Outcomes: After successful completion of the course the student will be able to:

1. define the basic concepts, terminology and the fundamental models(L1)
2. demonstrate the set of primary technology components and characteristics associated with cloud computing(L2)
3. identify the building blocks of cloud environments(L3)
4. evaluate the specific runtime function in support of one or more cloud Characteristics(L4)
5. elaborate the risks and analyze different cloud security mechanisms(L4)

	1-Low, 2- Medium and 3- High Correlation														
	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1	1	1								1	1	
CO2	3	2	2	1	1							1	2	1	1
CO3	2	1	1	1	1								1	1	
CO4	3	2	2	1	1								1	1	
CO5	3	2	2	2	2							1	2	1	1

CSEN2131	COMPUTER GRAPHICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description

This course provides a comprehensive introduction to computer graphics. This focuses on fundamental concepts, techniques, and their cross-cutting relationship to multiple problem domains in graphics like rendering, animation, geometry, and imaging.

Course Educational Objectives:

To introduction basic concepts and principles of computer graphics.
To understand the design of various computer graphics related algorithms
To analyse 2D geometrical transformation and 2D viewing
To implement 3D geometrical transformations and viewing
To learn colour models and animation graphics

UNIT 1 Introduction to Graphics Systems 9 hours

Applications of Computer Graphics. Overview of Graphics systems: concepts of scan conversion, rasterization and rendering. Overview of coordinate systems, Video Display Devices- Raster Scan systems-random scan Systems-Graphics monitors and Workstations-Input devices.

UNIT 2 Graphics primitives 9 hours

Display and Drawing of Graphics Primitives: Point, Line, Circle, ellipse, Polygon and Text. line drawing algorithms- DDA, Bresenham's Circle generating mid-point Algorithm, Ellipse generating mid-point algorithm.

Filled Area Primitives: Polynomial, Spline Curves. Scan line polygon fill algorithm, boundary-fill and flood fill algorithms. Inside outside tests.

UNIT 3 2D Graphics: Geometrical transforms, 2D Viewing 9 hours

Two dimensional Transformations: Translation, scaling, rotation, reflection and shear. Matrix representations and homogeneous coordinate systems, composite transformations. Transformations between coordinate systems.

Two Dimensional Viewing: The viewing pipeline, viewing coordinate reference frame, window to viewport coordinate transformation. Clipping: Point clipping, Cohen-Sutherland Line Clipping, Sutherland –Hodgeman polygon clipping, Text Clipping.

UNIT 4 3D Graphics 9 hours

Three Dimensional Object representation: Three Dimensional Concepts and Object representations: Polygon Surfaces, Curved Lines and Surfaces.

Three Dimensional Geometric Transformations: Translation- Rotation-Scaling-Reflection Transformations-Composite Transformations, Three Dimensional Transformation Functions.

Three Dimensional Viewing: Viewing Pipeline, Viewing Coordinates, Projection Transformations: Parallel Projections Perspective Projections, Three Dimensional Clipping

UNIT 5 Illumination and Colour Models, Animation Graphic 9 hours

Light sources - basic illumination models –Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model -YIQ colour model - CMY colour model - HSV colour model - HLS colour model.

Animation Graphics: Design of Animation sequences – animation function – raster animation – key frame systems – motion specification –morphing.

Textbooks:

1. Donald Hearn & M. Pauline Baker, "Computer Graphics C Version", Pearson Education, New Delhi, 2014
2. Peter Shirley, Steve Marschiner, etc. ," Fundamentals of Computer Graphics" 3rd Edition, Taylor & Francis Group, CRC Press, 2009

References:

1. David F. Rogers, Procedural Elements for Computer Graphics, Tata McGraw Hill Book Company, New Delhi, 2003
2. J. D. Foley, S. K Feiner, A Van Dam F. H John, Computer Graphics: Principles & Practice in C, Pearson Education, 2004
3. Edward Angel, Dave Shreiner, "Interactive Computer Graphics" 6th Edition, Addison-Wesley.

Course Outcomes:

Upon successful completion of the course, students will be able to

- Learn the basic concepts and principles of computer graphics (L2).
- Design various algorithms related to computer graphics (L3)
- Analyse the 2D geometrical transformation and 2D viewing (L4)
- Implement 3D geometrical transformations and viewing (L4)
- Understand the colour models and animation Graphics (L1)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1							2	1			1
CO2	3	3	2	2	2					1		1	2	1	1
CO3	3	3	2	1	2					1		1	2	2	1
CO4	3	3	1	1	2					1		1	2	2	
CO5	3	1	1	1	2	2	1			2	2	1	1	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement

SDG 4: Quality Education
SDG 9: Industry, Innovation and Infrastructure

SDG Justification:

This course gives the experience on imagine the graphics and multimedia systems. This will ensure to kindle the aspiration for quality education and promote lifelong learning opportunities of multimedia systems and AR/VR. Further, it will help the innovations in these fields to build resilient infrastructure and promote sustainable industrialization.

CSEN2141	DATA ANALYTICS: DESCRIPTIVE, PREDICTIVE, PRESCRIPTIVE	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	MATH2361: Probability and Statistics						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course is designed for undergraduate engineering students to apply computer science knowledge on the raw data in building business model for taking decision more effectively to automate and visualize it.

Course Educational Objectives:

- To introduce basic concepts of business analytics and descriptive statistics.
- Discover best practices of data visualization for different types of data.
- To determine the similarities in the data and to find existing patterns.
- To Predict trends in data and build business decisions.
- Explore spread sheet model to analyse the data.

UNIT 1 Descriptive Statistics 9 hours

Introduction: Decision Making, Business Analytics Defined, A Categorization of Analytical Methods and Models, Big Data, Business Analytics in Practice, Legal and Ethical Issues in The Use of Data and Analytics.

Descriptive Statistics: Overview of Using Data: Definitions and Goals, Types of Data, Modifying Data in Excel, Creating Distributions from Data, Measures of Location, Measures of Variability, Analysing Distributions, Measures of Association Between Two Variables.

UNIT 2 Data Visualization and Probability 7 hours

Probability- An Introduction to Modelling Uncertainty: Events and Probabilities, Some Basic Relationships of Probability, Conditional Probability, Random Variables, Discrete Probability Distributions, Continuous Probability Distributions.

Data Visualization: Overview of Data Visualization, Tables, Charts, Advanced Data Visualization, Data Dashboards.

UNIT 3 Descriptive Data Mining & Linear Regression 8 hours

Descriptive Data Mining: Cluster Analysis, Association Rules, Text Mining.
Linear Regression: Simple Linear Regression Model, The Multiple Regression Model, Model Fitting, Big Data and Regression, Prediction with Regression.

UNIT 4 Predictive Data Mining & Spreadsheet Models 8 hours

Predictive Data Mining: Data Sampling, Preparation, And Partitioning, Performance Measures, Logistic Regression, K-Nearest Neighbours, Classification and Regression Trees.
Spreadsheet Models: Building Good Spreadsheet Models, Predictive and Prescriptive Spreadsheet Model.

UNIT 5 Decision Analysis 8 hours

Decision Analysis: Problem Formulation, Decision Analysis Without Probabilities and With Probabilities, Decision Analysis with Sample Information, Computing Branch Probabilities with Bayes' Theorem.
Case Study: Capital State University Game-Day Magazines.

TextBooks:

1**.** Business Analytics, Fourth Edition Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann

Coursera Courses:

1. GITAM Coursera Program for Faculty | Coursera
2. Getting Started with Data Analytics on AWS - Getting Started with Data Analytics on AWS | Coursera
3. GITAM Coursera Program for Faculty | Coursera

Website(s):

Book Companion Site (cengage.com)

References:

1. GITAM Coursera Program for Faculty | Coursera

2. Getting Started with Data Analytics on AWS - Getting Started with Data Analytics on AWS | Coursera

3. GITAM Coursera Program for Faculty | Coursera

Course Outcomes:

1. Apply different analytical methods and model
2. Distinguish the data and visualize it by applying different methods
3. Finding similarities and correlation between data
4. Predict the trend in data
5. Analyse the data and make the decision for business

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2		2			3						1				
CO3	1		1		2								1		
CO4											1				
CO5				2	3				2		1		2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN2151	E-COMMERCE	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course imparts knowledge on E-commerce concepts, building e-commerce web and mobile apps. It also provides knowledge on security issues in e-commerce related platforms.

Course objectives:

To identify the major categories, technologies and trends in e-commerce
To identify the essential processes of an e-commerce system.
To identify several factors and web store requirements needed to succeed in e-commerce.

To define various electronic payment types and associated security risks and the ways to protect against them.

To discuss the various marketing strategies for an online business and build e-commerce models

UNIT 1 INTRODUCTION 8 hours

Introduction to E-COMMERCE, Types of E-COMMERCE, Understanding E-COMMERCE: Organizing Themes

Learning Outcomes:

After completion of this unit, the student will be able to:

- Understand the basic concepts in e-commerce
- Identify the building blocks of e-commerce
- Choose the appropriate type of e-commerce for a given application

UNIT 2 E-COMMERCE BUSINESS STRATEGIES 10 hours

E-COMMERCE BUSINESS MODELS: Key Elements of a Business Model, Major BUSINESS-TO-CONSUMER (B2C) Business Models, Major BUSINESS-TO-BUSINESS (B2B) Business Models, How E-Commerce Changes Business: Strategy, Structure, and Process.

Learning Outcomes:

After completion of this unit, the student will be able to:

1. Understanding e-commerce business models, business concepts, and business strategies
2. Compare different business models for a given application
3. Choose the appropriate business model for B2B or B2C applications

UNIT 3 TECHNOLOGY INFRASTRUCTURE FOR E-COMMERCE 9 hours

Learning Outcomes:

After completion of this unit, the student will be able to:

Understand how the Web works.
Describe how Internet and web features and services support e-commerce.
Design basic e-commerce applications using the appropriate technology.

UNIT 4 BUILDING AN E-COMMERCE PRESENCE 9 hours

Building An E-COMMERCE Presence: A Systematic Approach, Choosing Software, Choosing Hardware.

Learning Outcomes:

After completion of this unit, the student will be able to:

1. Identify the steps in developing an e-commerce presence.
2. Analyze the major considerations involved in choosing web server and e-commerce merchant server software.
3. Choose the correct hardware and software for a given e-commerce application.

UNIT 5 E-COMMERCE SECURITY AND PAYMENT SYSTEMS 9 hours

The E-COMMERCE Security Environment, Security Threats in The E-COMMERCE Environment, E-COMMERCE Payment Systems.

Learning Outcomes:

After completion of this unit, the student will be able to:

1. Understand the impact of e-commerce crime and security problems
2. Analyze the advantages and disadvantages of different payment systems
3. Design e-commerce secure applications with suitable payment methods.

Text Books(s)

1. Kenneth C.Laudon, Carol Guercio Traver —E-commerce 2021–2022 business, technology, society, Pearson, 17th Edition

Reference Book(s)

Ravi Kalakota and Andrew B. Whinston, Frontiers of electronic commerce, Pearson, 1996.

Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, ECommerce fundamentals and applications, John Wiley, 2008.

S. Jaiswal, E-Commerce, Galgotia Publications, 2003.
International B2B (Business to Business) Marketing, Yonsei University.
https://www.coursera.org/learn/b2b-marketing
The Future of Payment Technologies, University of Michigan.
https://www.coursera.org/learn/paytech

Course Outcomes:

- Describe the underlying concepts of e-commerce and different e-business models.(L2)
- Analyze different e-commerce models for different online business applications (L4)
- Choose the appropriate security mechanisms for e-commerce applications (L4)
- Evaluate and choose different electronic payment systems in e-commerce (L4)
- Design and implement web and app-based applications for e-commerce (L5)

	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**												**1**	**2**	
CO2	**1**	**3**											**2**	**2**	
CO3		**2**											**2**		
CO4		**2**											**2**		
CO5	2	**2**	**3**										**2**	**2**	**3**

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

SDG 10 (Reduced Inequality): Reduce inequality within and among countries.

SDG Justification:

This course teaches the basic technology to sell products and services using the World Wide Web. This provides an opportunity for small and medium scale businesses to showcase their products and services to a larger section of customers and can help reduce inequality between countries with and without known global presence commercially.

<table>
<tr><td rowspan="2">CSEN2161</td><td rowspan="2">INTRODUCTION TO DATA SCIENCE</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed to provide an introduction into the field of Data Science. Students will develop skills in appropriate technology and basic statistical methods by completing hands-on projects focused on real-world data and addresses the social consequences of data analysis and application.

Course Educational Objectives:

The Course Enables Students to

- Provide a strong foundation for data science and application areas related to it.
- Understand the underlying core concepts and emerging technologies in data science.
- Learn the process of working with data on large scale.
- Explore the concepts of Data Processing.
- Learn basic concepts of Machine Learning.
- Prepare students for advanced courses in Data Science.

UNIT 1 Data Evolution 9 hours, P – 2 hours

Data Evolution: Data to Data Science – Understanding data: Introduction – Type of Data, Data Evolution – Data Sources. Preparing and gathering data and knowledge - Philosophies of data science - data all around us: the virtual wilderness - Data wrangling: from capture to domestication - Data science in a big data world - Benefits and uses of data science and big data - facets of data.

https://www.coursera.org/learn/intro-analyticthinking-datascience-datamining?specialization=data-science- fundamentals

UNIT 2 Digital Data-An Imprint 9 hours, P - 2 hours

Type of data analytics (Descriptive, diagnostic, perspective, predictive, Prescriptive.) Exploratory Data Analysis (EDA), EDA-Quantitative Technique, EDA - Graphical Technique. Data Types for Plotting, Data Types and Plotting, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms,

Binnings, and Density, Customizing Plot Legends, Customizing Color bars, Multiple Subplots, Text and Annotation, Customizing Ticks.

https://www.coursera.org/learn/data-visualization-r

UNIT 3 **Descriptive statistics** **9 hours, P - 2 hours**

Measures of Central Tendency – Measures of Variation – Quartiles and Percentiles – Moments – Skewness and Kurtosis. Exploratory Data Analytics Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA, Random variable, Variance, covariance, and correlation-Linear transformations of random variables, Regression.
https://www.coursera.org/learn/data-visualization-r

UNIT 4 **Data Science tools** **9 hours, P - 2 hours**

Overview and Demonstration of Open source tools such as R, Octave, Scilab. Python libraries: SciPy and sci- kitLearn, PyBrain, Pylearn2; Weka.
https://www.coursera.org/learn/open-source-tools-for-data-science

UNIT 5 **Ethics and Data Science LTP** **9 hours, P - 2 hours**

Data Ownership, The Five Cs, Implementing the Five Cs, Ethics and Security Training, Developing Guiding Principles, Building Ethics into a Data-Driven Culture, Regulation, Building Our Future, Case Study.
https://www.coursera.org/learn/intro-analyticthinking-datascience-datamining?specialization=data-science- fundamentals
https://www.coursera.org/learn/data-visualization-r

TextBooks:

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications,2016.

2. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.

3. Ethics and Data Science, Mike Loukides, Hilary Mason and D J Patil, O’Reilly, 1st edition, 2018.

Reference Book(s):

1. Data Science from Scratch: First Principles with Python, Joel Grus, O’Reilly, 1st edition, 2015.
2. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt,2 O’ Reilly, 1st edition, 2013.
3. Mining of Massive Datasets, Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014.
4. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013.
5. Data science Handbook – Field cady- wiley,2017
6. Statistical inference for data science-Brian Caffo,2016
7. Introducing Data science by Davy cielen, Arno D.B.Meysmen, Mohamed Ali.2020

Coursera Courses:

1. https://www.coursera.org/learn/what-is-datascience?specialization=introduction-data-science

2. https://www.coursera.org/learn/open-source-tools-for-data-ience?specialization=introduction- data-science

3. https://www.coursera.org/learn/data-science-methodology?specialization=introduction-data- science

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the fundamental concepts of data science.
2. Evaluate the data analysis techniques for applications handling large data and Demonstrate the datascience process.
3. Understand concept of machine learning used in the data science process.
4. Visualize and present the inference using various tools.
5. Learn to think through the ethics surrounding privacy, data sharing.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0
CO2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	0	0	0	0	0	1	1	1	0	0	0
CO4	1	1	1	1	0	0	0	1	1	1	1	0	1	0	0
CO5	1	1	0	0	0	0	0	0	1	1	1	1	0	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN2171	IoT Hardware	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

The "Internet of Things" is rapidly expanding and affecting our society, and the rapidly falling cost of basic IoT components enables individuals to create new designs and products at home. The course deals with IoT design considerations, limitations, and device-to-physical-world interfaces. Additionally, students will learn how to balance hardware and software design considerations. The course covers the fundamentals of hardware design and wiring required to construct useful circuits. The course covers the roles of fundamental passive elements and how to incorporate them into straightforward circuits. The objective of the course is to equip students with the design and implementation skills necessary to interact with simple sensors and actuators.

Course Educational Objectives:

- To introduce the correlation between embedded systems and the Internet of Things
- To introduce the role of microprocessors and microcontrollers
- To understand the existing platforms such as Arduino and Raspberry Pi
- To provide hands-on or simulation-based exposure for interfacing the Arduino and Raspberry Pi boards.

UNIT 1 Introduction to the Internet of Things and Embedded Systems 7 hours

Introduction to IoT, IoT Devices v/s Computers; Trends in adoption of IoT, Societal Benefits of IoT; Embedded Systems, Generic Embedded System Structure, Components of Embedded Systems; Basic Equipment, Sensors, and Actuators.

UNIT 2 Hardware and Software in IoT 7 hours

Integrated Circuits, Microcontroller Properties, Microcontroller Components; Compilation and Interpretation, Python v/s C, C++; Operating Systems in IoT

UNIT 3 The Arduino Platform 9 hours

Introduction to the Arduino Platform, Arduino Board, Arduino Schematics, Arduino IDE, Arduino Shields and Libraries, Arduino Basic Setup, Arduino Toolchain, Cross-Compilation, Arduino Sketches, Arduino Pins, Input and Output, Examples Arduino Setup.

UNIT 4 Interfacing with the Arduino 9 hours

Sensors, Resistive Sensors; Actuators, Analog Actuators; Interfacing Demonstrations: Pulse Width Modulation, Making Sounds, Music System; Ethernet Shield; WiFi Shield.

UNIT 5 The Raspberry Pi Platform 8 hours

Raspberry Pi Board, Raspberry Pi Processor, Raspberry Pi vs. Arduino, Raspberry Pi Setup, Raspberry Pi Configuration, Overclocking, General Purpose IO Pins, Protocol Pins, GPIO Access.

References:

1. (a) Introduction to the Internet of Things and Embedded Systems; UCI, 11 hours (b) The Arduino Platform and C Programming; UCI, 12 hours and (c) The Raspberry Pi Platform and Python Programming for the Raspberry Pi ; UCI, 12 hours, Coursera
2. Misra, S., Mukherjee, A. and Roy, A., 2021. Introduction to IoT. Cambridge University Press.
3. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley India, 2019.
4. Simon Monk, Programming Arduino: Getting Started with Sketches, Mc Graw Hill Publications, 2011
5. Simon Monk, Programming the Raspberry Pi, Getting Started with Python, Mc Graw Hill Publications, 2015
6. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, Mc Graw Hill Publications, 2017

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Enumerate and describe the components of an embedded system. (L1)
2. Classify and choose the sensors and actuators for an IoT application. (L3)
3. Outline the composition of the Arduino development board. (L2)
4. Outline the composition of the Raspberry Pi development board. (L2)
5. Experiment with Arduino and Raspberry Pi platforms for creating solutions for IoT applications. (L4)

APPROVED IN:
BOS :<< 09-06-2023 >> ACADEMIC COUNCIL: 27 <<06-07-2023>>

SDG No. & Statement:

SDG Justification:

CSEN2181	Programming Mobile Applications	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Object Oriented Programming with JAVA						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course familiarizes the student to the design and implementation of Android applications for mobile devices. Student can develop an app from the basics, assuming a basic knowledge of Java, and learn how to set up Android Studio, work with various Activities and create simple user interfaces to make their apps run smoothly. It teaches the basics of handling notifications, using multimedia and graphics and incorporating touch and gestures into mobile apps.

Course Educational Objectives:

- To elucidate the Android Platform and Android Development Environment using object oriented approach.
- To familiarize the different techniques such as Intents, Permissions, and Fragments for developing simpler applications.
- To exemplify the User Interface design and Threads in object oriented programming.
- To illustrate the usage of User Notifications, 2D Graphics, Multimedia and Event Handling.
- To demonstrate various features such as Sensors, Maps and SQLite Databases.

UNIT 1 Android Platform and Development Environment **10 hours**

Overview, Introduction to the Android Platform, The Android Development Environment. Application Fundamentals and the Activity Class: Application Fundamentals, Activity class (1 and 2), Introduction to Amazon Guest Lecture - AppStores and Free Ebook, Introduction to Amazon Guest Lecture - App Monetization, Programming Mobile Services for Android Handheld Systems.

UNIT 2 Intents, Permissions, and Fragments **10 hours**

The Intent Class, Explicit Activation, Implicit Activation via Intent Resolution, Android Permissions, Defining and Using Application Permissions, Component Permissions and Permissions Related to API's, The Fragment Class.

UNIT 3 User Interface Classes & Threads and Networking **10 hours**

User Interface Classes: Views and View Events, View Groups, Adapter Views and Layouts, Menus and Action Bar, Dialogs.

Threads and Networking: Threading Overview, Android's UI Thread, The ASYNCTASK Class, Networking, Android Networking Classes, Processing HTTP Responses.

UNIT 4 User Notifications, BroadcastReceivers, and Alarms & Graphics, Touch, and Multimedia **10 hours**

User Notifications, BroadcastReceivers, and Alarms:
Toast, Notification Area Notifications, The BroadcastReceivers Class, Registration, Broadcast, Processing, Event Delivery, Event Handling in onReceive(), Sticky Broadcasts.

Alarms & Graphics, Touch, and Multimedia:
2D Graphics, View Animation, Property Animation, MotionEvent, Touch Handling, Gestures, Multimedia Support Classes, Playing Audio, Watching Video, Recording Audio, Using the Camera.

UNIT 5 Sensors, Location and Maps, and Data Management **5 hours**

SensorManager and Sensor, SensorEvent and SensorEventListener, Filtering Sensor Values, Example Applications, Location, Location Support Classes, Maps, Map Support Classes, SharedPreferences, Internal Storage, External Storage, SQLite Databases.

References:

1. Programming Mobile Applications for Android Handheld Systems: Part 1
https://www.coursera.org/learn/android-programming

2. Programming Mobile Applications for Android Handheld Systems: Part 2
https://www.coursera.org/learn/android-programming-2

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Course Outcomes:

Upon successful completion of the course, students will be able to

6. Describe the Android Platform and Android Development Environment using object oriented approach. (L1).
7. Represents the different techniques such as Explicit Activation, Using Application Permissions, and Permissions Related to API's for developing simpler applications. (L2).

8. Apply features like User Interface Classes and Threads to build real time applications (L3).
9. Make use of Notifications, 2D Graphics, and Event Handling related operations (L3).
10. Analyse the Sensors, Location, Maps and Storage in Android Development Environment (L4).

APPROVED IN:
BOS :<< 09-06-2023 >> ACADEMIC COUNCIL: 27 <<06-07-2023>>

SDG No. & Statement:

SDG Justification:

CSEN3021	MICROCONTROLLERS AND APPLICATIONS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

While microprocessors are extensively used in data-dominated heavy weight computing systems, microcontrollers are pervasive in control-dominated low cost embedded computing systems. This course introduces the design of embedded computing systems using 8051 microcontroller and its interfacing methods.

Course Educational Objectives:

- To expose the use of embedded processors and distinguish their differences with microprocessors
- To introduce the architecture of 8051 microcontroller, assembly language instructions and IO ports
- To provide an understanding of interrupts, polling, serial port programming using C and assembly instructions
- To familiarize the development of embedded computing systems in commercial applications
- To demonstrate the concepts and development of 8051 based projects using assemblers/compilers/evaluation boards

UNIT 1 The 8051 Microcontrollers 9 hours P - 6 hours

Microcontrollers and embedded processors, overview of the 8051 family, 8051 assembly language programming, I/O Port programming.

UNIT 2 8051 programming in C 9 hours P - 6 hours

Data types and time delay in 8051 C, I/O programming in 8051 C, logic operations in 8051 C, accessing code ROM space in 8051 C.

UNIT 3 Hardware Interfacing 9 hours P - 6 hours

8051 hardware Connection and Intel Hex File, 8051 timer programming, 8051 serial port programming.

UNIT 4 Interrupts Programming 9 hours P - 6 hours

ADC, DAC and sensor interfacing, 8051 interfacing to external memory. Development of Home Security System, Elevator System, Smart Card Application, Soccer-Player Robot

UNIT 5 ARM 32 Bit MCUs 9 hours P - 6 hours

Introduction to 16/32 bit processors, ARM architecture and organization, ARM / Thumb programming mode, ARM / Thumb instruction set, development tools.

List of Experiments (but not limited to)

1. Assembly Language/C Language Programs for Data transfer/exchange between specified memory locations, Largest/smallest from a series.
2. Time delay generation and relay interface.
3. Display (LED/Seven segments/LCD) and keyboard interface.
4. Interfacing 8051 with ADC
5. Interfacing 8051 with DAC for wave form generation.
6. Stepper motor and DC motor interfacing with 8051
7. Interfacing 8051 with RAM/ROM
8. Interfacing peripherals with 8051 using interrupt mechanism

TextBooks:

1. Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems - Using Assembly and C, 2/e, Pearson Education, India, 2006.
2. Scott Mackenzie, Raphael Phan, The 8051 Microcontroller, 4/e, Pearson Education, 2007.
3. Rajkamal, Microcontrollers, Architecture, Programming, Interfacing and System Design, 2/e, Pearson Education, India, 2012.

References:

1. 1. A.V. Deshmuk, Microcontrollers-Theory and Applications, Tata McGraw Hill , India, 2005.
2. PIC Microcontroller and Embedded Systems - Using Assembly and C, Mazidi and Mazidi, Pearson Education, 2008.
3. Mazidi, Muhammad Ali, Chen, Shujen, Ghaemi, Eshragh, STM32 Arm Programming for Embedded Systems, Pearson Education, 2018.

Course Outcomes:

After successful completion of the course the student will be able to:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : **ACADEMIC COUNCIL:**

SDG No. & Statement:

SDG Justification:

CSEN3041	ETHICAL HACKING	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

Introduces the ethical hacking methodologies. Covers applying cyber security concepts to discover and report vulnerabilities in a network. Explores legal and ethical issues associated with ethical hacking. Government agencies and business organizations today are in constant need of ethical hackers to combat the growing threat to IT security. A lot of government agencies, professionals and corporations now understand that if you want to protect a system, you cannot do it by just locking your doors

Course Educational Objectives:

- Learn aspects of security, importance of data gathering, foot printing and system hacking.
- Learn tools and techniques to carry out a penetration testing.
- How intruders escalate privileges?
- Explain Intrusion Detection, Policy Creation, Social Engineering, DDoS Attacks, Buffer Overflows and Virus Creation.
- Compare different types of hacking tools.

UNIT 1 **Finding Vulnerabilities** **9 hours P - 6 hours**

The Stages of the Penetration Test, Open-Source Intelligence Gathering, Port Scanning

Finding Vulnerabilities

Nessus, The Nmap Scripting Engine, Running a Single NSE Script, Metasploit Scanner Modules, Metasploit Exploit Check Functions, Web Application Scanning, Manual Analysis

UNIT 2 **9 hours P - 6 hours**

Capturing Traffic, Networking for Capturing Traffic, Using Wireshark, ARP Cache Poisoning, DNS Cache Poisoning, SSL Attacks, SSL Stripping,

Exploitation, MS08-067, Exploiting WebDAV Default Credentials, Exploiting Open phpMyAdmin, Downloading Sensitive Files, Exploiting a Buffer Overflow in Third-Party Software, Exploiting Third-Party Web Applications, Exploiting a Compromised Service, Exploiting Open NFS Shares

UNIT 3 **9 hours P - 6 hours**

Password Attacks, Password Management, Online Password Attacks, Offline Password Attacks, Dumping Plaintext Passwords from Memory with Windows Credential Editor Client-Side Exploitation, Bypassing Filters with Metasploit Payloads, Client-Side Attacks

UNIT 4 **9 hours P - 6 hours**

Social Engineering, The Social-Engineer Toolkit, Spear-Phishing Attacks, Web Attacks, Mass Email Attacks Post Exploitation, Meterpreter, Meterpreter Scripts, Metasploit Post-Exploitation Modules, Local Privilege Escalation, Local Information Gathering, Lateral Movement, Pivoting, Persistence

UNIT 5 **9 hours P - 6 hours**

Wireless Attacks, Monitor Mode, Capturing Packets, Open Wireless, Wired Equivalent Privacy, Wi-Fi Protected Access, WPA2, Wi-Fi Protected Setup
A Stack-Based Buffer Overflow in Linux, Memory Theory, Linux Buffer Overflow

TextBooks:

1. Georgia Weidman, Penetration testing A Hands-On Introduction to Hacking, No Starch Press 2014

2. Peter Kim, The Hacker Playbook 2 Practical Guide To Penetration Testing, Secure Planet LLC, 2015

References:

1. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, “Gray Hat Hacking the Ethical Hackers Handbook”, 3rd Edition, McGraw-Hill Osborne Media paperback

Course Outcomes:

After successful completion of the course the student will be able to:

1. Students will learn the underlying principles and techniques associated with the cybersecurity practice known as penetration testing or ethical hacking.

2. Student will become familiar with the entire penetration testing process including planning, reconnaissance, scanning, exploitation, post-exploitation and result reporting.

3. For every offensive penetration technique, the students will learn the corresponding remedial technique.

4. the students will develop a practical understanding of the current cybersecurity issues and the ways

5. how the errors made by users, administrators, or programmers can lead to exploitable insecurities.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2		3									3	2	1
CO2	2	2	3	3									3	2	
CO3	1	2		3									3	2	1
CO4	2	2		3	3								3	2	1
CO5	1	2		3									3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN3051	WIRELESS SENSOR NETWORKS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**CSEN2021: Computer Networks**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

With the increased availability of low-cost micro-electromechanical system (MEMs) devices, several applications of networked sensors and actuators have gathered interest in recent times. Such networks are called Wireless Sensor Networks (WSNs) and they need special algorithms and software owing to the resource-constrained nature of the devices that constitute them. This course starts with a brief introduction of WSNs. It then introduces the concepts of localization and time synchronization and methods to perform them in WSNs. After examining the issues in medium access control, routing, transport and application layers in WSNs, the most important algorithms for WSNs in each of these layers are discussed. Finally, WSN middleware and operating systems are introduced with examples.

Course Educational Objectives:

- To introduce to the students the concepts of localization and time synchronization in WSNs and ways to perform them.
- To enable the student to appreciate design issues in MAC for WSNs and popular MAC protocols for WSNs.
- To acquaint the student with the challenges in routing in WSNs and popular routing protocols for WSNs.
- To let the student examine the feasibility of TCP and UDP for WSNs and study WSN transport and application layer protocols.
- To familiarize the student with the design issues for middleware and operating systems for WSNs and example middleware and operating systems for WSNs.
- To enable the student to design end-to-end WSN applications using the appropriate technique at each layer.

UNIT 1 Introduction to Sensor Networks, Localization and Time Synchronization 9 hours

Introduction and Overview of Wireless Sensor Networks, Applications of WSNs, **Localization**: Overview, Key issues,
Localization approaches, Coarse-grained node localization using minimal information, Fine-grained node localization using detailed information, Network-wide localization, Time Synchronization: Overview, Key issues, Traditional approaches,Fine-grained clock synchronization, Coarse-grained data synchronization, Global Synchronization and Preamble Synchronization.

UNIT 2 MAC Protocols for WSNs 8 hours

Medium Access Control Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, Low-power MAC Algorithms, IEEE 802.15.4 LR-WPANs Standard, Sensor MAC.

UNIT 3 Routing for WSNs 10 hours

Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks, **Types of addressing**: Geographic addressing, Hierarchical addressing, Stochastic addressing, **Routing Strategies in Wireless Sensor Networks**: Neighbor Discovery, Mesh Networking and Routing, Optimized Link State Routing (OLSR) - basic working, Dynamic Source Routing (DSR), Ad-hoc On Demand Distance Vector (AODV), Delay-Tolerant Networking - definition, issues and basic approaches, Gossip Algorithms - basic working example.

UNIT 4 Transport Control and Application Protocols for Wireless Sensor Networks 8 hours

A brief review of Traditional Transport Control Protocols, Feasibility of Using TCP or UDP for WSNs, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols - CODA, RMST.

UNIT 5 Middleware and Operating Systems for Wireless Sensor Networks 9 hours

Middleware: Introduction, WSN Middleware Principles, Middleware Architecture, **Existing Middleware**: DDS, SensorWare.
Operating Systems: Introduction to Operating Systems for WSN, Linux kernel - basic functions and advantages, The microkernel, The modular kernel, ContikiOS - introduction and basic design, RIOT OS - introduction and basic design.

TextBooks:

1. Wireless Sensor networks- Technology, Protocols and Applications by Kazem Sohraby, Daniel Manoli , Wiley InterScience Publications 2007

2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017

3. Networking Wireless Sensors, Bhaskar Krishnamachari, Cambridge university press, 2005

References:

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, 2005.

2. Wireless Sensor Networks, C.S Raghavendra, Krishna M.Sivalingam, Taieb znati, Springer Science 2004.

Journal(s):

1. Wei Ye, J. Heidemann and D. Estrin, "An energy-efficient MAC protocol for wireless sensor networks,"Proceedings.Twenty-First Annual Joint Conference of the IEEE Computer and Communications Societies, 2002, pp.1567-1576 vol.3, doi: 10.1109/INFCOM.2002.1019408.

2. Heinzelman, W., Chandrakasan, A., and Balakrishnan, H., "Energy-Efficient Communication Protocols for Wireless Microsensor Networks", Proceedings of the 33rd Hawaaian International Conference on Systems Science (HICSS), January 2000.

Website(s):

https://www.isi.edu/scadds/projects/smac/

Course Outcomes:

After successful completion of the course the student will be able to:

1. Compare different localization and time synchronization approaches for WSNs.
2. Choose the appropriate localization and time synchronization technique for a WSN application.
3. Analyze the difference between protocol design at the MAC, network, transport and application layers for WSNs and that for the Internet.
4. Identify the best strategies at the MAC, network, transport and application layers for a given WSN application.
5. Examine the working of popular WSN operating systems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1		2	2								2		
CO2	1	2	3										2		
CO3	1	2		3	3							1	2		1
CO4	1	2	3	3									2		1
CO5	1	2		3	3								2		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG13 (Climate Action) The course teaches the working of Wireless Sensor Networks (WSNs), which can be deployed to monitor environmental pollution and the effects of climate change (such as melting of the polar icecaps and forest fires) in real time. This helps in monitoring and response to mitigate the harmful effects of such events on the climate.

SDG14 (Life Below Water) WSNs can be used to monitor oceanic conditions, endangered marine species etc. in real time. This can help in preserving the marine eco-system.

SDG15 (Life on Land) Applications of WSNs include monitoring of forest fires, tracking and monitoring of endangered species etc. This can help protect the terrestrial ecosystem of the Earth via quick and timely response to conserve precious flora and fauna.

SDG Justification:

CSEN3071	WEB APPLICATION DEVELOPMENT AND SOFTWARE FRAMEWORKS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course enables the students to learn developing web applications right from web application design, web content development, client-side scripting, server-side scripting and creation of responsive web pages. The course imparts knowledge of relevant architectures and technologies required for web application development.

Course Educational Objectives:

- Design static web page using Markup languages.
- Design and implement web pages using style sheets.
- Implement with java script web applications with dynamic web pages.
- Understand working of Web servers
- Develop web applications using frameworks.

UNIT 1 Introduction to Web Application Designing 9 hours, P- 6 hours

Introduction: Building a Web Application, Components – Client Side, Server-side Components, 2 tier, n-tier architectures, Networks, Protocols. MVC Pattern.

HTML5: Basic syntax, HTML document structure, text formatting, images, lists, links, tables, forms, frames. Cascading Style Sheets (CSS3): Levels of style sheets, style specification formats, selector forms, font properties, list properties, colour properties, alignment of text, background images, The Box Model.

UNIT 2 Client-Side Scripting 9 hours, P- 6 hours

JavaScript: Introduction, Functions, Arrays, DOM, Built-in Objects, Regular Expression, Event handling, Validation, Dynamic documents.

UNIT 3 XML, JSON 9 hours, P- 6 hours

Syntax of XML, document structure, and document type definition, namespaces, XML schemas, document object model, presenting XML using CSS, XSLT, XPath, XQuery, FLOWR.
JSON: Features, JSON vs. XML, JSON Data Types, JSON Objects, JSON Arrays, JSON HTML.

UNIT 4 Server-side processing with Java 9 hours, P- 6 hours

Introduction to Servlet, Life cycle of Servlet, Servlet methods, Java Server Pages.

Working with tomcat webserver Database connectivity – Servlets, JSP, JDBC, Practice of SQL Queries

UNIT 5 Web Application Frameworks 9 hours, P- 6 hours

Introduction to Web application development frameworks, Types of Frameworks. ReactJS. Angular JS. Angular JS: Introduction, Angular JS Expressions, Modules, Data Binding, Controllers, DOM, Events, Forms, Validations.

ReactJS: Introduction, components, Styling, Form programming, Building and Deployment

LAB Experiments:

1. Design static web pages required for any online services web site.
2. Apply Cascading Style Sheets to the Web pages.
3. Design dynamic webpages using Java script.
4. Write JavaScript to validate input fields

5. Write an XML file to display various contents.

6. Write a XSD to validate an XML file.

7. Design a web application and deploy on Tomcat webserver

8. Connect to a Database (MySQL/SQLServer/Oracle/MongoDB) and create data and query data using JDBC

9. Implement a Simple Application using JSON

10. Develop a Complete Web Application for a simple case study using ReactJS /AngularJS

Lab Infrastructure:

SQL Server, Tomcat Server, Notepad++ editor, Eclipse, Opensource – ReactJS, AngularJS

Textbooks:

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, 2013.
2. Pro Mean Stack Development, 1st Edition, ELad Elrom, Apress O'Reilly, 2016
3. Java Script & jQuery the missing manual, 2nd Edition, David sawyer mcfarland, O'Reilly, 2011.
4. Web Hosting for Dummies, 1st Edition, Peter Pollock, John Wiley & Sons, 2013.
5. RESTful web services, 1st Edition, Leonard Richardson, Ruby, O'Reilly, 2007.
6. FULL STACK REACT – The complete guide to ReactJS and Friends ,1st Edition, Anthony Accomazzo, Leanpub,2020.

References:

1. Dietel and Nieto, Internet and World Wide Web - How to program, PHI/Pearson Education, 2006.
2. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech, 2009
3. Web Technologies, 1st Edition 7th impression, Uttam K Roy, Oxford, 2012

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the fundamentals of web application development and frameworks.

2. Design interactive web pages with client and server side scripting

3. Apply validations on user input using Javascript

4. Compare and analyse XML and JSON documents.

5. Create and deploy Web Applications over web server.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN3091	DIGITAL FORENSICS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

The course is designed to enable the student to understand underlying principles and many of the techniques associated with the digital forensic practices and cybercrime, investigate attacks, handling evidence. Student can have a sneak review of Computer Forensics, Network Forensics, and Mobile Forensics

Course Educational Objectives:

- Familiarize the student about digital and computer forensics.
- Enable the student to learn analysis of crime scene.
- Manage and present evidence
- Demonstrate investigation process.

UNIT 1 **9 hours, P - 6 hours**

Forensic Science, Digital Forensics, Digital Evidence, The Digital Forensics Process, The Identification Phase, The Collection Phase, The Examination Phase, The Analysis Phase, The Presentation Phase

UNIT 2 **9 hours, P - 6 hours**

Digital Forensic Readiness, Law Enforcement versus Enterprise Digital Forensic Readiness, A Rationale for Digital Forensic Readiness, Frameworks, Standards, and Methodologies, Becoming “Digital Forensic” Ready, Enterprise Digital Forensic Readiness,

UNIT 3 **9 hours, P - 6 hours**

Evidence Collection: Data Acquisition, Forensic Copy, Examination: Disk Structures, File Systems Analysis: Analysis Tools, Timeline Analysis, File Hashing, Filtering, Data Carving, **Memory Analysis** : Collection Phase, Examination Phase

UNIT 4 **6 hours, P - 4 hours**

Embedded Systems and Consumer Electronics, Mobile Phones, Telecommunication Networks, Mobile Devices and Embedded Systems as Evidence, Malware and Security Considerations, Ontologies for Mobile and Embedded Forensics Collection Phase, Examination Phase

UNIT 5 **9 hours, P - 6 hours**

Computer Networking, Layers of Network Abstraction, The Internet, Tracing Information on the Internet, Collection Phase – Local Acquisition, Collection Phase – Network Acquisition, The Examination and Analysis Phases

TextBooks:

1. Andre Arnes, Digital Forensics, Wiley, 1st, 2017

References:

1. John R.Vacca, John Sammons ,Computer Forensics computer crime scene investigation, second edition,2014.

2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

Course Outcomes:

After successful completion of the course the student will be able to:

1. understand the basics of digital forensics.
2. implement the capture, duplication, and preservation of digital evidence.
3. analyse the digital evidence to find the digital artifacts.
4. understand basics of performing analysis to find the evidence
5. Understand the ways to capture network evidences

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2		3									3	2	
CO2	2	2	3	3									3	2	
CO3	1	2		3									3	2	
CO4	2	2		3	3								3	2	
CO5	1	2		3									3	2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN3101	BIG DATA ANALYTICS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	**CSEN2061: Database Management Systems**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

The course is designed to impart the insights of Big Data analytics which involves collecting data from different sources, manage it in a way that it becomes available to be consumed by analysts and finally deliver data products useful to the business organizations.

Course Educational Objectives:

This course enables students to

- Understand business decisions and create competitive advantage with Big Data analytics.
- Introducing Java concepts required for developing map reduce programs.
- Derive business benefit from unstructured data.
- Imparting the architectural concepts of Hadoop.
- To introduce programming tools Hbase & HIVE in Hadoop echo system.

UNIT 1 Understanding Big Data 9 hours

Introduction of big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

UNIT 2 NoSQL Data Management 9 hours

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemeless databases, materialized views, distribution models, sharding, master-slave replication, peer to peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

UNIT 3 **Basics of HADOOP** **9 hours**

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.

UNIT 4 **Introduction to distributed database** **9 hours**

HBase, data model and implementations, HBase clients, HBase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration

UNIT 5 **Tools for HADOOP** **9 hours**

Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries. Case study on analysing different phases of data analytics.

Textbooks:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

2. P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2014.

3. Tom White, "Hadoop: The Definitive Guide", 3/e,4/e O'Reilly, 2015.

References:

1. Douglas Eadline,"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351

Website(s):

https://www.coursera.org/specializations/big-data#courses

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand data analysis and its importance.
2. Design and analyse unstructured data using NoSQL.
3. Demonstrate the big data concepts using parallel processing.
4. Build a complete business data analytic solution and apply structure of Hadoop data.
5. Develop real time applications to study different stages of data analytic**.**

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO2	0	1	2	0	3	0	0	1	1	0	1	0	2	3	0
CO3	1	0	0	0	2	0	0	0	0	0	0	0	0	3	0
CO4	0	0	3	0	3	0	0	0	1	1	2	0	0	0	2
CO5	0	2	1	0	2	0	0	0	1	0	1	0	0	0	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN3121	AD-HOC AND SENSOR NETWORKS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite(s)	CSEN2021 Computer Networks						
Co-requisite(s)							
Alternative exposure							

Course Description:

The objective of this course is to build an understanding of the core issues encountered in the design of wireless ad hoc and sensor networks. It first covers the challenges in designing protocols for wireless ad hoc and sensor networks and then provides an overview of existing and emerging protocols at the medium access control, routing and transport layers of such networks. It also discusses ways for ensuring Quality of Service in such networks and the fundamentals of operating systems for sensor nodes.

Course Objectives

1. To create awareness of the issues and challenges in the design of wireless ad hoc networks.
2. To familiarize the student the working of MAC and Routing Protocols for ad hoc networks
3. To educate the student about the working of transport Layer protocols for ad hoc networks.
4. To familiarize the student the working of MAC and Routing Protocols for sensor networks
5. To educate the student about the working of transport Layer protocols and operating systems for sensor networks.

UNIT – I Medium Access Control IN AD HOC NETWORKS 9 hours

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols

Learning Outcomes:

After completion of this unit, the student will be able to

1. Describe the basics of Wireless and ad hoc networks. (L2)
2. Analyze the working of MAC Layer Protocols for ad hoc networks (L4)
3. Compare and contrast different MAC protocols for ad hoc networks (L4)
4. Choose the appropriate MAC protocol for a given ad hoc network. (L5)

Pedagogy tools: Classroom teaching, self-reading, Lab work

UNIT – II Routing for Ad hoc Networks 9 hours

Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols

Learning Outcomes:

After completion of this unit, the student will be able to:

Assess the suitability of traditional routing protocols for ad hoc networks. L4
Describe the working of routing protocols for ad hoc networks. L2
Compare and contrast different routing protocols for ad hoc networks L4
Choose the appropriate routing protocol for a given ad hoc network L5
Pedagogy tools: Classroom teaching, self-reading, practice

UNIT – III TRANSPORT & QOS IN AD HOC NETWORKS 9 hours

TCP‟s challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model.

Learning Outcomes:

After completion of this unit, the student will be able to

Assess the suitability of traditional transport protocols for ad hoc networks.(L4)
Explain the working of transport protocols for ad hoc networks (L2)
Describe the challenges in achieving QoS in ad hoc networks (L2)
Compare and contrast the strategies to achieve QoS for ad hoc networks(L4)
Choose the appropriate layer and strategy to achieve application QoS for a given ad hoc network. (L5)
Pedagogy tools: Classroom teaching, self-reading, practice

UNIT – IV MAC & ROUTING IN WIRELESS SENSOR NETWORKS 9 hours

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention- Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zigbee – Topology Control – Routing Protocols

Learning Outcomes:

After completion of this unit, the student will be able to

Describe the architecture of sensor networks. L2

Describe the working of various MAC Layer Protocols for sensor networks. L2
Compare and contrast different MAC protocols for sensor networks L4
Choose the appropriate MAC protocol for a given sensor network application. L5
Analyze the working of popular routing protocols for sensor networks. L4
Pedagogy tools: Classroom teaching, self-reading, practice,

UNIT – V TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS 9 hours

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples.

Learning Outcomes:

After completion of this unit, the student will be able to

Differentiate between data-centric and contention-based networking. L4
Analyze the transport layer working and its effect on QoS in sensor networks L4
Compare and contrast different operating systems for sensor networks L4
Choose the appropriate operating system for a given sensor network application. L5
Design the network model for a sensor network application. L6
Pedagogy tools: Classroom teaching, self-reading, practice

Textbook(s):

1.C.Siva Ram Murthy and B.S.Manoj, ―Ad Hoc Wireless Networks – Architectures and 2 Protocols‖, Pearson Education, 2006.
2. Holger Karl, Andreas Willing, ―Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc., 2005.

Reference Book(s):

1. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, ―Ad Hoc Mobile Wireless Networks‖, Auerbach Publications, 2008.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, ―Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.
3. Waltenegus Dargie, Christian Poellabauer, ―Fundamentals of Wireless Sensor Networks Theory and Practice, John Wiley and Sons, 2010
4. Xiang-Yang Li , "Wireless Ad Hoc and Sensor Networks: Theory and Applications, Cambridge university Press,2008.

Coursera Courses:

Wireless Ad Hoc and Sensor Networks by IIT, Kharagpur (also on NPTEL); https://www.classcentral.com/course/swayam-wireless-ad-hoc-and-sensor-networks-7888

Website(s):

https://www.youtube.com/channel/UC2Ca2J5RRG-T8PfLD9mmINw/videos

Course Outcomes:

After successful completion of the course the student will be able to

1. Analyze the working of medium access control and routing protocols for wireless ad hoc and sensor networks. L4
2. Modify existing transport layer protocols to provide QoS in wireless ad hoc and sensor networks. L6
3. Compare the working of various sensor node operating systems. L4
4. Choose the appropriate protocol stack for a given ad hoc/sensor network application. L5
5. Design ad hoc and sensor networks for real-life applications. L5

	Programme Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3												1	2	
CO2	1	3											2	2	
CO3		2											2		
CO4		2	2										2	2	
CO5	2	2	3										2	2	3

APPROVED IN:

SDG No. & Statement:

SDG7 (Affordable and Clean Energy) : Ensure access to affordable, reliable, sustainable and modern energy for all.

SDG11 (Sustainable Cities and Communities): Make cities and human settlements inclusive, safe, resilient and sustainable.

SDG Justification:

This course teaches the design of ad hoc and sensor networks. Such networks form the basis of the Internet of Things, which can be used for applications such as Smart Grid application development, which results in efficient usage of energy resources. Applications such as Smart Transportation, Smart Water and Waste Management, Smart Infrastructure and Utilities etc. also require sensor or/and ad hoc networking. This course teaches how such applications can use designed using networks of nodes, ultimately leading to digital solutions for sustainable cities and communities.

CSEN3141	ADVANCED COMPUTER NETWORKS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite(s)	CSEN2021 Computer Networks						
Co-requisite(s)							
Alternative exposure							

Course Description:

This course aims to provide understanding of advanced computer network concepts, building on the basic functions of various layers, protocols and standards used in practice to have a comprehensive and deep knowledge in computer networks.

Course Educational Objectives:

1. Introduce the concepts of network architecture and application programming interface concepts
2. Enable the students to understand various Internetworking protocols
3. Familiarize the students with advanced internetworking concepts such as Inter-domain routing and multicast communication
4. Introduce the concepts of end-to-end protocols, congestion control, and resource allocation techniques
5. Expose the student to the latest trends in traditional, multimedia applications and content distribution networks

UNIT 1 Introduction 9 hours

Introduction: Applications, Requirements – Perspectives, Scalable Connectivity, Cost-Effective Resource Sharing, Support for Common Services.

Network Architecture: Layering and Protocols, OSI Architecture, Internet Architecture. Implementing Network Software- Application Programming Interface (Sockets). Performance- Bandwidth and Latency, Delay × Bandwidth Product, Application Performance Needs.

UNIT 2 Internetworking 9 hours

Internetworking (Part - I): Switching and Bridging-Datagrams, Virtual Circuit Switching, Source Routing, Bridges and LAN switches. Basic Internetworking (IP)-What is an internetwork, service model, global addresses, Datagram Forwarding in IP, Subnetting and classless addressing, address translation (ARP), DHCP, ICMP, Virtual Networks and Tunnels.

UNIT 3 Internetworking and Advanced Internetworking 9 hours

Internetworking (Part - II): Routing - Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics. Implementation and Performance- Switch Basics, Ports, Fabrics, Router Implementation. Advanced Internetworking: The Global Internet – Routing Areas, Inter-domain Routing (BGP), IP Version 6 (IPv6). Multicast: Multicast addresses, Multicast routing (DVMRP, PIM.

UNIT 4 Advanced Internetworking and End-to-End Protocols 9 hours

Multiprotocol Label Switching (MPLS): Destination-Based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels, Routing among Mobile Devices: Challenges for Mobile Networking, Routing to Mobile Hosts (Mobile IP), End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP) - End-to-End Issues, Segment Format, Connection Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Performance, Alternative Design Choices. Congestion Control and Resource Allocation: Issues in Resource Allocation - Network Model, Taxonomy, Evaluation Criteria. Queuing Disciplines - FIFO, Fair Queuing.

UNIT 5 Applications 9 hours

Traditional Applications - Email, world wide web, HTTP, web services. Multimedia Applications, Session Control and Call Control (SDP, SIP, H.323), Resource Allocation for Multimedia Applications. Infrastructure services - DNS, SNMP. Overlay Networks - Routing Overlays, Peer-to Peer Networks, Content Distribution Networks.

Textbooks:

Larry L. Peterson, Bruce S. Davie. Computer Networks, A Systems Approach, Morgan Kaufmann Publishers, Fifth Edition, 2012

References:

1. W. R. Stevens. Unix Network Programming, Vol.1, Pearson Education, 1990.
2. Andrew S Tanenbaum and David J Wetherall, Computer Networks, 5/e, Pearson Education, 2010.
3. Darren Spohn, Data Network Design, 3/e TMH, 2002 4. D.Bertsekas, R.Gallager, Data Networks, 2/e, PHI, 1992.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Describe network architecture and application programming interface concepts (L2)
2. Explain working of internetworking protocols (L2)
3. Illustrate different routing protocols and end-to-end transmission (L3)
4. Distinguish the various protocols used at the transport layer (L2)
5. Summarize working of traditional, multimedia applications and overlay networks (L2)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			1	2					1			2		
CO2		2	3							1			2	3	1
CO3	2			3		1				1		1		3	
CO4	1			2	3				1	1	1		2	1	3
CO5	2				1	3	1	1					1	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

SDG9(Industry, Innovation and Infrastructure)

SDG Justification:

This course teaches the advanced topics of computer networks especially internetworking often among or between public, private, commercial, industrial, or governmental networks to have increased connectivity, scalability, collaboration, remote access and resource sharing.

CSEN3151	ADVANCED DATA STRUCTURES	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	**CSEN2001: Data Structures**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

After the students have gone through a course on data structures, where they learn the formal and abstract representations of data and its manipulation. Studying course on advanced data structures should teach the students concrete implementations and manipulation of such basic data structures and their use in design and analysis of non-trivial algorithms for a given computational task. On completion of such a course, students should be able to analyse the asymptotic performance of algorithms demonstrate their familiarity with major data structures, rule to manipulate those, and their canonical applications such as graphs and pattern recognition.

Course Educational Objectives:

- Analyze algorithms and data structures applying methods for amortized analysis
- Evaluate methods for performance improvement of dictionaries and hashing techniques.
- Analyze and assess various time and space efficient searching tree data structures
- Analyze and assess the applicability of fundamental graph algorithms to applications and external sorting schemes.
- Define and apply data structures for Pattern Matching and tries

UNIT 1 Review of basic Data Structures 9 hours

Recursion: illustrative examples; Array based sequences: low level arrays, Dynamic Arrays, amortized analysis; Stacks, Queues, Double Ended Queues.
Priority Queues: Priority Queue as ADT, Implementing Heap using Priority Queue, Sorting with Priority Queue.

UNIT 2 Maps and Hash Tables 9 hours

Maps, and Hash Tables: Maps and Dictionaries, Hash Tables.
Hash table representation: Hash functions, collision resolution-separate chaining, open addressing- linear probing, quadratic probing, double hashing, rehashing, extendible hashing, comparison of hashing and skip lists.

UNIT 3 Trees 9 hours

General Trees, Binary Trees, Implementing Trees, Binary search trees; Balanced search trees, AVL trees, Splay Trees, Red –Black Trees, Multiway search Trees, B-Trees, B-Tree of order m, height of a B-Tree, insertion, deletion and searching, Comparison of Search Trees.

UNIT 4 **Graphs** **9 hours**

The graph ADT, Representation in memory; Directed Acyclic Graph; Shortest path using Prim-Jarnik Algorithm and Kruskal's Algorithm; Disjoint Partitions and Union Find Structures. External Sorting: Model for external sorting, Multi-way merge, Polyphase merge.

UNIT 5 **Pattern Matching and Tries** **9 hours**

Pattern Matching: Pattern matching algorithms -Brute force, the Boyer –Moore algorithm, the Knuth-Morris- Pratt algorithm
Tries: Standard Tries, Compressed Tries, Suffix Tries, Search Engine Indexing.

Textbooks:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4rd Edition, Pearson,2014

2. Michael T. Goodrich, R.Tamassia and Michael H. Goldwasser, Data structures and Algorithms in Python,Wileystudentedition,JohnWileyandSons,2013.

3. Bradley N Miller, David Ranum, Problem Solving with Algorithms and Data Structures using Python, Franklin, Beedle& Associates publishing, 2013.

References:

1. Data structures using java, Langsam, Augenstein and Tanenbaum, PHI, 2003.
2. Peter Brass, Advanced data structures. Vol. 193. Cambridge: Cambridge University Press, 2008

Coursera Courses:

https://www.coursera.org/learn/algorithms-graphs-data-structures

Course Outcomes:

After successful completion of the course the student will be able to:

1. analyze the different algorithms and data structures.
2. implement different hashing techniques
3. assess the time and space efficient searching trees
4. implement graphs to real time applications
5. apply data structures for pattern matching

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1												1	
CO2	1	2		2										2	
CO3	1		2	2									1		1
CO4		1	2	2									1	2	1
CO5	1	2	2	2									1	2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN3161</td><td rowspan="2">ADVANCED OPERATING SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN1101: Operating Systems</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course motivates the student to get the knowledge of various types of advanced operating systems, learn the basics of distributed operating systems, and understand the working of the algorithms and its application at different conditions

Course Educational Objectives:

- To learn the basics of operating systems
- To understand the concepts of distributed operating systems
- To suggest an algorithm in the distributed operating system environment
- To assess the performance of the distributed operating system algorithms

UNIT 1 Introduction 9 hours

Introduction: Overview, Functions of an Operating System, Design Approaches, Types of Advanced Operating System, Synchronization Mechanisms, Concept of a Process, Concurrent Processes, The Critical Section Problem, Other Synchronization Problems, Language Mechanisms for Synchronization, Axiomatic Verification of Parallel Programs,
Process Deadlocks : Preliminaries, Models of Deadlocks, Resources, System State, Necessary and Sufficient conditions for a Deadlock, Systems with Single-Unit Requests, consumable Resources, Reusable Resources.

UNIT 2 Distributed Operating Systems 9 hours

Distributed Operating Systems: Introduction, Issues, Communication Primitives, Inherent Limitations, Lamport's Logical Clock, Vector Clock, Causal Ordering, Global State, Cuts, and Termination Detection.
Distributed Mutual Exclusion: Non-Token Based Algorithms, Lamport's Algorithm, Token Based Algorithms, Suzuki-Kasami's Broadcast Algorithm.
Distributed Deadlock Detection: Issues, Centralized Deadlock Detection Algorithms, Distributed Deadlock Detection Algorithms, Agreement Protocols: Classification, Solutions, Applications .

UNIT 3 Distributed Resource Management 9 hours

Distributed Resource Management: Distributed File systems, Architecture, Mechanisms, Design Issues,

Distributed Shared Memory: Architecture, Algorithm, Protocols, Design Issues, Distributed Scheduling: Issues, Components, Algorithms.

UNIT 4 Failure Recovery and Fault Tolerance 9 hours

Basic Concepts, Classification of Failures, Basic Approaches to Recovery, Recovery in Concurrent System, Synchronous and Asynchronous Check pointing and Recovery, Check pointing in Distributed Database Systems, Fault Tolerance, Issues, Two-phase and Non-blocking Commit Protocols, Voting Protocols, Dynamic Voting Protocols.

UNIT 5 Multiprocessor and Database Operating Systems 9 hours

Multiprocessor: Structures, Design Issues, Threads, Process Synchronization, Processor Scheduling, Memory Management, Reliability / Fault Tolerance.

Database Operating Systems: Introduction, Concurrency Control, Distributed Database Systems, Concurrency Control Algorithms.

Textbooks:

1. Mukesh Singhal and N. G. Shivaratri, Advanced Concepts in Operating Systems, McGrawHill, 2000

References:

1. Abraham Silberschatz, Peter B. Galvin, G. Gagne, Operating System Concepts, 6/e, Addison Wesley 2003.
2. Andrew S. Tanenbaum, Modern Operating Systems, 2/e, Addison Wesley, 2001

Course Outcomes:

After successful completion of the course the student will be able to:

1. define the basics of operating systems
2. understand the concepts of distributed operating systems
3. discuss the working of distributed operating systems algorithms
4. propose an algorithms for distributed operating systems environment
5. evaluate the performance of distributed operating systems algorithms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3			1							1		
CO2			3	2					2				1		
CO3		2			2										1
CO4		3												2	
CO5			3			2						2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN3171	ADVANCES IN INTERNET OF THINGS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite(s)	CSEN2021 Computer Networks						
Co-requisite(s)							
Alternative exposure							

Course Description:

The aim of this course is to enable students to know the recent advances in Internet of Things. The course has a detailed description on the advanced cloud architecture with different applications of IOT in the field of medicine, small wearable devices, Internet gateways and agriculture domain.

Course objectives:

- Introduce the advances in IOT and cloud with digital services and sustainable solutions.
- Introduce the industrial usage of IOT for strategic planning and smart cities
- Utilize the nuances of IOT and explore possible solutions in the field of medical sciences
- Examine small and wearable devices with respect to the IOT functionalities
- Introduce the smart transport systems.

UNIT I: Advanced IoT and Cloud (LTP) 9 0 0

Internet of Things and Data Analytics in the Cloud with Innovation and Sustainability : Introduction, The IoT and the Fourth Industrial Revolution, Internet of Things Technology, Standards and Protocols, IoT Ecosystem, Definition of Big Data, IoT, Data Analytics, and Cloud Computing, Creativity, Invention, Innovation, and Disruptive Innovation

Digital Services and Sustainable Solutions: Introduction, Why IoT is not Just “Nice to Have”, Services in a Digital Revolution, Mobile Digital Services and the Human Sensor, Not Just Another App, The Hidden Life of Things, The Umbrellas are not what they Seem, Interacting with the Invisible.

LearningOutcomes

After completion of this unit, the student will be able to:

• Explain the overview of IoT Technology and IoT Ecosystem
• Explain the need of Big data analytics in IoT.
• Explain the digital services and sustainable solutions.

UNIT II: Industrial Internet of Things (IIoT) Number of hours(LTP) 9 0 0

The Industrial Internet of Things (IIoT): Applications and Taxonomy: Introduction to the IIoT, Some Examples of IIoT Applications, Toward a Taxonomy of the IIoT, Standards and Protocols for Connectivity, Connectivity Architecture for the IIoT, Data-Centricity Makes DDS Different, The Future of the IIoT

Strategic Planning for Smarter Cities: Introduction, What is a Smart City?, Smart Cities and the Internet of Things, Why Strategic Planning Matters.

Learning Outcomes

After completion of this unit, the student will be able to:

- Explain the use cases of IIoT.
- Describe the Protocols and connectivity architecture for the IIoT
- Explain the strategic plan for the smart cities and role of IoT.

UNIT III: Internet of Medical Things (IoMT) Number of hours(LTP) 9 0 0

Next-Generation Learning: Smart Medical Team Training : Introduction, Learning, Analytics, and Internet of Things, IoT Learning Design Process, Conclusion.

The Brain–Computer Interface in the Internet of Things: Introduction , The Science Behind Reading the Brain, The Science of Writing to the Brain , The Human Connectome Project, Summary IoT Innovation Pulse

The Convergence of Exponential Technologies as a Driver of Innovation, Six Dimensions of the Pleco system, Five Principles of the Pleco system, The Biologic Organism Analogy for the IoT, Human IoT Sensor Networks, Role of the IoT in Social Networks,

Learning Outcomes:

After completion of this unit, the student will be able to:

- Explain the various steps for smart medical team training.
- Explain the science behind reading the Brain.
- Explain the principles of the Pleco system and IoT in Social Networks .

UNIT IV: Internet of Wearable Things (IoWT), IPv6 for IoT and Gateway Number of hours(LTP) 9 0 0

A Designer's Guide to the Internet of Wearable Things : Introduction, Interface Glanceability, The Right Data at the Right Time, Consistency Across Channels, From Public to Personal, Nonvisual UI, Emerging Patterns, Conclusion.

IPv6 for IoT and Gateway: Introduction, IP: The Internet Protocol, IPv6: The Next Internet Protocol, LoWPAN: IP for IoT , Gateways: A Bad Choice, Example IoT Systems, An IoT Data Model, The Problem of Data Ownership.

Learning Outcomes:

After completion of this unit, the student will be able to:

- Explain the IoWT
- Introduce IPv6 for IoT and Gateway.
- Explain the IoT Data Model.

UNIT V: IoT/ Connected and Autonomous Vehicles (LTP) 9 0 0

Connected and Autonomous Vehicles: Brief History of Automated and Connected Driving, Automated Driving Technology, Connected Vehicle Technology and the Cv Pilots, Automated Truck Convoys, On-Demand Automated Shuttles for a Smart City, A Unified Design Approach, Acronym and Description

Transit Hub: A Smart Decision Support System for Public Transit Operations: Introduction Challenges, Integrated Sensors, Transit Hub System with Mobile Apps and Smart Kiosks , Conclusion

Learning Outcomes:

After completion of this unit, the student will be able to:

- Explain the Automated driving Technology.
- Explain the Unified design approach for a smart city.
- Describe the smart decision support system for public transit operation.

Text Books(s)

Hwaiyu Geng, Internet of Things and Data Analytics Handbook, 2017 John Wiley & Sons, Inc.

Reference Book(s)

1. Holler Jan, Internet of Things: A Comprehensive Guide To Successful, Academic Press.
2. BK Tripathy and J Anuradha, Internet of Things (Iot) Technologies Applications Challenges and Solutions, Taylor & Francis.

Course Outcomes:

1. Explain the advances in IOT and cloud with digital services and sustainable solutions (L2)
2. Suggest the industrial usage of IOT for strategic planning and smart cities (L3)
3. Explore possible IoT solutions in the field of medical sciences (L3)
4. Justify the small and wearable devices to exploit IOT benefits (L3)
5. Design and implement smart transport systems (L5)

	Programme Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3		1						2	1	1	1	3
CO2	3	2	3		1						2	1	2	1	3
CO3	3	2	3		1						2	1	1	2	2
CO4	3	2	3		1						2	1	2	3	3
CO5	3	2	3		1						2	1	1	1	3

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:

SDG No. & Statement:

SDG7 (Affordable and Clean Energy) : Ensure access to affordable, reliable, sustainable and modern energy for all.

SDG11 (Sustainable Cities and Communities): Make cities and human settlements inclusive, safe, resilient and sustainable.

SDG Justification:

This course teaches the design of applications of the Internet of Things. The IoT is crucial for applications such as Smart Grid application development, which results in efficient usage of energy resources. Applications such as Smart Transportation, Smart Water and Waste Management, Smart Infrastructure and Utilities etc. also use IoT principles. This course teaches how such applications can use designed using networks of nodes, ultimately leading to digital solutions for sustainable cities and communities.

<table>
<tr><td rowspan="2">CSEN3181</td><td rowspan="2">ANDROID SECURITY INTERNALS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN1101: Operating Systems</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

There are more than one billion Android devices in use today, each one a potential target. Unfortunately, many fundamental Android security features have been little more than a black box to all but the most elite security professionals—until now. This course takes learners under the hood of the Android security system. This course describes Android security architecture from the bottom up, delving into the implementation of major security related components and subsystems, like Binder IPC, permissions, cryptographic providers, and device administration.

Course Educational Objectives:

- To study the Android's frameworks, security model and applications
- To learn the fundamentals of package format and verifications and user management process
- To understand the JCA providers and android JSSE implementation
- To implement online account management and its security
- To study various secure elements in NFC and Various SELinux policies

UNIT 1 Basics of Android 9 hours

Android's Architecture: Linux Kernel, Native User space, Dalvik VM, Java Runtime Libraries, System Services, Inter-Process Communication, Binder, Android Framework Libraries, Applications.

Android's Security Model: Application Sandboxing, Permissions, Code Signing and Platform Keys, Multi-User Support, SELinux, System Updates, Verified Boot

UNIT 2 Package and User Management 9 hours

Package Management: Android Application Package Format, Code Signing, APK Install Process, Package Verification.

User Management: Multi-User Support Overview, Types of Users, Command-Line Tools, User States and Related Broadcasts, User Metadata, User System Directory, Per-User Application Management, External Storage, Other Multi-User Features.

UNIT 3 Cryptographic Providers, Network Security and PKI and Credential Storage 9hours

Cryptographic Providers: JCA Provider Architecture, JCA Engine Classes, Android JCA Providers, Using a Custom Provider.

Network Security and PKI: PKI and SSL Overview, JSSE Introduction, Android JSSE Implementation.

Credential Storage: VPN and Wi-Fi EAP Credentials, Credential Storage Implementation, Public APIs

UNIT 4 Online Account Management, Enterprise Security and Device Security 9 hours

Online Account Management: Android Account Management Overview, Account Management Implementation, Google Accounts Support.

Enterprise Security: Device Administration, VPN Support, Wi-Fi EAP.

Device Security: Controlling OS Boot-Up and Installation, Verified Boot, Disk Encryption. Screen Security, Secure USB Debugging, Android Backup.

UNIT 5 NFC and Secure Elements, System Updates and Root Access 9 hours

NFC and Secure Elements: NFC Overview, Secure Elements, Software Card Emulation SELinux, SELinux Introduction, Android Implementation, Android 4.4 SELinux Policy

System Updates and Root Access: Bootloader, Recovery, Root Access, Root Access on Production Builds.

TextBooks:

1. Nikolay Elenkov, “An In-Depth Guide to Android’s Security Architecture”, October 2014.

References:

1. Karim Yaghmour, “Embedded Android”, O’Reilly Media, Inc., 2013, 412 pp; WSU Safari Books Online 9781449327958
2. Joseph Annuzzi, Jr., Lauren Darcey, Shane Conder, “Introduction to Android Application Development: Android Essentials”, Fourth Edition, Addison-Wesley Professional, 2013

Coursera Courses:

1. https://www.coursera.org/specializations/android-app-development

Journal(s):

1. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8319325
2. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7975551

Website(s):

1. https://nostarch.com/androidsecurity
2. https://developer.android.com/training/articles/security-tips
3. https://developer.android.com/topic/security/best-practices

Course Outcomes:

After successful completion of the course the student will be able to:

1. To understand Android architecture and its process
2. To understand the fundamentals of package and user management
3. To overview the network security and its credential storage implementation
4. To incorporate security in online account management
5. To understand secure elements in NFC and system updates.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		1		1						1	1		
CO2	3	1		1		1						1	1		
CO3	3	2	1	1	1	1		2				2	2	1	1
CO4	3	2	2		2	1		2				2	2		
CO5	3	2										2	1		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SGD 12: Cyber defense mechanisms ensure that no effect will be made to the industrial pattern

SDG Justification:

CSEN3191	CYBER SECURITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course enables the students to gain knowledge on various Cybercrimes. The course briefs the students regarding the global perspective of Cybercrimes, Cyber stalking, key loggers, crimes. The knowledge gained in this course can be applied to identify, classify, estimate the criminal plans of the attackers and predict the web threats and security implications.

Course Educational Objectives:

- Introduce the fundamentals of various cyber threats and attacks.
- Acquaint with the knowledge about various security tools.
- Understand IT security processes and technologies.
- Awareness on cyber security industry standards.
- Perception of securing devices and Internet security perimeter

UNIT 1 Introduction to Cybersecurity 9 hours

Cybersecurity Definition, Key Terms, Security Threats, Vulnerability Assessments, Roles in Security, Cybersecurity Today, Critical Thinking in Cybersecurity

Overview of actors and their motives: Hacking organizations, Major types of cyber-attacks, Network Security Model, Security services, Security Mechanisms, Threat Examples, Malware and Ransomware, Threat Protection, Internet Security Threats, Security Threat, The Cyber Kill Chain, Social Engineering, Cyberwarfare

UNIT 2 Overview of key security concepts 9 hours

CIA Triad, Non - Repudiation - How does it apply to CIA? Access Management, Key Concepts – Incident Response, Incident Response Process, Introduction to Frameworks and Best Practices, IT Governance Process, Cybersecurity Compliance and Audit Overview.

Overview of key security tools: Introduction to Firewalls, Firewalls - Packet Filtering, Firewalls – Application Gateway, Firewalls - XML Gateway, Firewalls - Stateless and Stateful, Antivirus/Antimalware

UNIT 3 Overview of People, Process and Technologies 9 hours

What is IT Security? Frameworks and their purpose, Roles in Security, Introduction to Process, Overview Business Process Management.

Overview of Information Technology Infrastructure Library (ITIL), Key ITIL Processes, identification and AAA, Access Control Methods, Access Control - Physical and Logical, Open Web Application Security Project (OWASP)

UNIT 4 Compliance Frameworks and Industry Standards 9 hours

What Cybersecurity Challenges do Organizations Face? Compliance Basics, Overview of US Cybersecurity Federal Law, National Institute of Standards and Technology (NIST) Overview, General Data Protection Regulation (GDPR) Overview, International Organization for Standardization (ISO) 2700x, SOC Reports, SOC Reports - Auditor Process Overview, Health Insurance Portability and Accountability Act (HIPAA), Payment

Card Industry Data Security Standard (PCI DSS), Center for Internet Security (CIS) Critical Security Controls. Client System Administration, Endpoint Protection, Endpoint Detection and Response, Unified Endpoint Management, Overview of Patching, Windows Patching

UNIT 5 Securing the perimeter 9 hours

Perimeter Security in the Real World, Security Challenges, The Basics of Internet Security, Understanding the Environment, Hiding the Private Network, Understanding Private Networks, Protecting the Perimeter, Understanding the Perimeter, Network Appliances, Proxy Servers, Demilitarized Zones (DMZs), Honeypots, Extranets.

TextBooks:

1. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Cyber Security Essentials 1/e, Sybex Wiley, 2019.

References:

1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, 1/e, CRC Press, 2011.
2. Chwan-Hwa(John) Wu, J. David Irwin, Introduction to Cyber Security, 1/e, CRC Press T&F Group, 2013
3. 3. Nina Godbole and SuNone Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1/e, Wiley INDIA.

Coursera Courses:

1. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks/home/week/1

2. https://www.coursera.org/learn/cybersecurity-roles-processes-operating-system-security/home/week/1

3. https://www.coursera.org/learn/cybersecurity-compliance-framework-system-administration/home/week/1

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand various Cyber security key terms and Internet security threats(L2)
2. Examine about incident response best practices and firewall implementations(L1)
3. Outline the business Process Management and access control methodologies(L3)
4. Awareness on various cyber security frameworks and industry standards (L2)
5. Knowledge about security perimeter construction(L2)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1												
CO2	2	2	2	2											
CO3	2	2	2	1											
CO4	2	1	2	1		1	0	1							
CO5	2	1	2	2		1	0	1							

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 16: Provides safety and security to the citizens of the county in cyberspace, which creates peaceful and inclusive societies

SDG Justification:

CSEN3201	DATA WAREHOUSING AND MINING	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	**CSEN2001: Data Structures**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

Due to the advent of technology, the internet, and advanced applications like social media, a huge amount of digital data has been accumulated in data centres or in Cloud storage devices, which has led to a situation "we are drowning in data but starving for knowledge". Various data mining techniques like Association Analysis, Classification, Clustering, Outlier Analysis and Web mining are applied to the data to extract golden nuggets useful for the decision-making process. Data warehousing (DW) is an integral part of the knowledge discovery process, where DW plays a vital role. DW is an integration of multiple heterogeneous data repositories under a unified schema at a single site. The students will acquire knowledge in Data modelling, design, architecture, data warehouse implementation and further development of data cube technology.

Course Educational Objectives:

- Illustrate the importance of Data Mining and its applications
- Explain various types of data, pre-processing techniques and OLAP operations
- Examine the characteristics of various data mining models
- Experiment with various data mining algorithms
- Illustrate the performance of data mining algorithms

UNIT 1 Introduction to Data Mining 8 hours, P - 4 hours

Introduction to Data mining: Motivation for Data Mining, Importance of Data Mining, Definition, kinds of data, Data mining functionalities, kinds of patterns to be mined, pattern interestingness, Classification of data mining systems. Four views of data mining, key components in the data mining.

Data understanding: Identifying key data properties and characterize different datasets, Objects and Attributes, Statistics, Visualization, and Data Similarity.

UNIT 2 Data Pre-processing and Data Warehousing 8 hours, P - 2 hours

Data Pre-processing: Need for pre-processing and various data pre-processing techniques. Data Cleaning, Data Integration, Data Transformation, Data Reduction.

Data Warehousing: Key characteristics of data warehousing and the techniques to support data warehousing. Data Warehouse, Data Cube and OLAP Data Cube Computation, Data Warehouse Architecture.

UNIT 3 Frequent Pattern Analysis 6 hours, P - 6 hours

Introduction to frequent pattern analysis, Apriori Algorithm, FP-growth Algorithm, Association and Correlation analysis.

UNIT 4 Classification 6 hours, P - 6 hours

Classification : Decision Tree Induction, Bayesian Classification, Support Vector Machines, Neural Network,Ensemble methods, Model Evaluation.

UNIT 5 Clustering and Outlier Detection Methods 8 hours, P - 6 hours

Clustering: Partitioning, Hierarchical, Grid-based, and Density-based Clustering algorithms; Probabilistic, High- dimensional, Bi-clustering, Graph, Constraint-based Cluster algorithms; **Outlier Detection Methods**: Types of Outliers, Outlier Detection Methods, Mining Complex Data, and Research Frontiers of Data Mining.

TextBooks:

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann publishers, 3/e, 2011. (Modules 2 – 5)

2. Jiawei Han, Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann publishers, 2/e, 2006. (Module 1)

References:

1. Michael Steinbach, Vipin Kumar, Pang-Ning Tan, Introduction to Data Mining, AddisonWesley, 1/e, 2006.
2. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson publishers, 1/e, 2006

Coursera Courses:

1.https://www.coursera.org/programs/gitam-coursera-program-for-faculty-p4k5n/browse?authProvider=gitam&productId=y-IghDp5Eeus1Q4-7xV-Ww&productType=s12n&query=Data+Mining+Methods&showMiniModal=true&source=search

Journal:

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=69

2. https://www.sciencedirect.com/book/9780123814791/data-mining-concepts-and-techniques

Course Outcomes:

After successful completion of the course the student will be able to:

1. Explain the functionality of various data mining components(L2)
2. Apply data pre-processing techniques and OLAP operations(L2)
3. Compare and contrast the strengths and limitations of various data mining models(L2)
4. Apply the data mining algorithms on real world datasets(L3)
5. Evaluate the performance of data mining algorithms(L4)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	0	0	0	0	0	0	0	0	0	3	2	2
CO2	2	2	2	0	0	0	0	0	0	0	0	0	2	2	2
CO3	1	1	3	3	3	0	0	0	0	2	0	0	2	2	2
CO4	2	0	0	3	3	2	0	0	0	2	0	0	0	2	2
CO5	2	0	0	3	3	2	0	0	0	2	0	0	0	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 8 : Decent Work and Economic Growth
The Data Warehouse is a huge repository, contains archived information about an organization(s). In the Data Mining process, the Data Warehouse play a key role. Interesting patterns are discovered using Data Mining techniques for business decision making process.

SDG Justification:

CSEN3211	DESIGN PATTERNS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**CSEN1111: Object Oriented Programming with Java**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course will introduce what design patterns really are, and are not. How to add functionality to Designs while minimizing complexity How to use design patterns to keep code quality high without Overdesign. This course presents design patterns addressing normally encountered design issues and possible implementations. This course helps in learning software design in a real world perspective.

Course Educational Objectives:

- Introduce the concept of design patterns, examine several patterns in detail, apply these patterns to specific problems and point the student to design pattern resources.
- Review of object oriented analysis and design principles, Definition of design patterns, Identification of recurring design problems.
- Possible solutions to these problems through the general arrangement and composition of objects and classes.
- Discussion of the advantages and disadvantages of the various solutions and providing implementation examples.

UNIT 1 Introduction 9 hours

History and origin of patterns, design patterns in MVC, describing design patterns, how design patterns solve design problems, selecting a design pattern, using a design pattern.
Design and implement
Case study – Design and implement using Object-Oriented Programming language .

UNIT 2 Design Patterns-1 9 hours

Creational: Abstract factory, builder, factory method, prototype, and singleton. Case study – Design and implement using Object-Oriented Programming language

UNIT 3 Design Patterns-2 9 hours

Structural Patterns: Adapter, bridge, composite, decorator, façade, flyweight, proxy. Case study – Design and implement using Object-Oriented Programming language

UNIT 4 **Design Patterns-3** **9 hours**

Behavioral patterns: Chain of responsibility, command, interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor.
Case study – Design and implement using Object-Oriented Programming language

UNIT 5 **Advanced Patterns** **9 hours**

Pattern catalogs and writing patterns. **Patterns and Case Study**: Designing a document editor, anti- patterns, case studies in UML, pattern community.

Textbooks:

1. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, Design patterns: Elements of Reusable Object Oriented Software, Addison Wesley, 1995.

References:

1. Alan Shalloway and James R. Trott, Design Patterns Explained: A New Perspective on Object Oriented Design, 2/e, Addison-Wesley, 2004.
2. Craig Larman, Applying UML and Patterns: An Introduction to object, oriented analysis and design and the unified process, 2/e, Prentice Hall, 2001.

Coursera Courses:

1. https://www.coursera.org/learn/design-patterns

B. Bafandeh Mayvan, A. Rasoolzadegan, Z. Ghavidel Yazdi, , “The state of the art on design patterns”, Journal of Systems and Software Volume 125Issue CMarch 2017 pp 93–118

Website(s):

1.https://dl.acm.org/doi/10.1016/j.jss.2016.11.030

Course Outcomes:

After successful completion of the course the student will be able to:

1. Defining Social Network analysis and its related applications

2. Demonstrate social networks using graph theory

3.Illustrate Modeling and Aggregation of Social network data

4.Analyze human behavior in social web and related commUNIT Ies

5.Classify, Create and visualize of social networks using tools

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												
CO4		3											2		
CO5			3		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

Course Code	Course Title	L	T	P	J	S	C
CSEN3221	Distributed Systems	3	0	0	0	0	3
Course Owner	Department of CSE	Syllabus version					
Course Prerequisite(s)	CSEN1101: Operating Systems CSEN2021: Computer Networks CSEN2001: Data Structures	Contact hours				45T	
Course Co-requisite(s)		Approved on:					
Alternate Exposure							

In a distributed system, various system components are located at different locations and act in a coordinated manner to perform tasks. This course is designed to provide an understanding of the principles on which distributed systems are based, their architecture, algorithms and how they meet the demands of contemporary distributed applications.

Course Objectives

1. To introduce to the students the challenges of Distributed Systems
2. To acquaint the student with various types of inter process and indirect communication in Distributed Systems..
3. To make the student understand various synchronization and coordination mechanisms.
4. To familiarize the student with Distributed Transaction management
5. To expose the student to the design principles of modern distributed file systems.

UNIT - I	Basics of Distributed Systems	LTP	7 0 0

Introduction: Examples of Distributed Systems, Trends in Distributed Systems, Focus on resource sharing, Challenges.

System models: Physical models, Architectural models, Fundamental models

Learning Outcomes:

After completion of this unit, the student will be able to

● interpret the basic elements and concepts related to distributed system technologies	L2
● analyze the challenges in designing distributed systems.	L4
● distinguish between the different models of distributed systems.	L4

Pedagogy tools: Blended learning, video lectures, self-reading, case study

UNIT - II	Inter process communication and Indirect communication	LTP	9 0 0

Inter process Communication: External data representation and marshalling, Multicast communication, Network virtualization: Overlay networks. Case study: MPI Remote Invocation: Remote procedure call(RPC)

Indirect Communication: Introduction, Group communication, Publish-subscribe systems, Message queues, Shared Memory approaches

Learning Outcomes:

After completion of this unit, the student will be able to

● experiment with MPI remote invocation and RPC	L3
● compare different indirect communication methods	L4
● choose the appropriate communication method for a distributed systems application.	L5

Pedagogy tools: Blended learning, Flipped classroom, video lectures, self-reading

UNIT - III	Synchronization and Coordination	LTP	10 0 0

Time and Global States: Introduction. Clocks, events and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states

Coordination and Agreement: Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication, Consensus and related problems.

Learning Outcomes:

After completion of this unit, the student will be able to

• summarize different synchronization schemes.	L2
• implement distributed mutual exclusion and election algorithms	L3
• experiment with group communication in distributed settings	L5
Pedagogy tools: Blended learning, video lectures, self-reading	

UNIT - IV	Distributed Transaction Controls	LTP	10 0 0

Distributed Transactions: Introduction, Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction Recovery

Learning Outcomes:

After completion of this unit, the student will be able to

• distinguish between flat and nested transactions	L4
• deduce the design issues in developing concurrency control mechanisms for distributed systems.	L4
• implement transaction recovery in distributed systems applications	L3

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - V	Peer-to-peer Systems and Distributed File Systems	LTP	9 0 0

Peer-to-Peer Systems: Introduction, Peer-to-peer Middleware, Routing Overlays.

Distributed File Systems: Introduction, File Service Architecture, Google File System (GFS), Hadoop Distributed File System (HDFS)

Learning Outcomes:

After completion of this unit, the student will be able to

• summarize the working of P2P middleware and routing overlays.	L2
• examine the working of any distributed file system.	L3
• experiment with various features of GFS and HDFS	L5

Pedagogy tools: Blended learning, case study, video lectures, self-reading

Textbook(s):

1. George Coulouris, Jean Dollimore and Tim Kindberg, Gordon Blair, “Distributed Systems Concepts and Design”, 5/e, Pearson Education, 2012.

Reference Book(s):

1. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.
2. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.
3. Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education, 2004.
4. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, USA, 2003.

Journal(s):

1. Bernstein, P. A., & Goodman, N. (1981). Concurrency control in distributed database systems. ACM Computing Surveys (CSUR), 13(2), 185-221.
2. H. Garcia-Molina. 1982. Elections in a Distributed Computing System. IEEE Trans. Comput. 31, 1 (January 1982), 48–59. https://doi.org/10.1109/TC.1982.1675885

Website(s):

https://static.googleusercontent.com/media/research.google.com/en//archive/gfs-sosp2003.pdf

https://hadoop.apache.org/docs/r1.2.1/hdfs_design.html

Course Outcomes: After successful completion of the course the student will be able to:

1. analyze the challenges in designing distributed systems. (L4)
2. choose the appropriate communication method for a distributed systems application. (L5)
3. experiment with distributed mutual exclusion and election algorithms and group communication. (L5)

4. implement transaction recovery and concurrency control in distributed applications. (L3)
5. design distributed applications. (L6)

	Programme Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2											2		
CO2	1	3		3									2		
CO3	1	3		3									1	1	2
CO4	1	2		2									1	2	2
CO5	1	2	3	3									1	1	3

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:	
BOS :<< date >>	**ACADEMIC COUNCIL: <<date>>**
SDG No. & Statement:	
SDG 9 (Industry, Innovation and Infrastructure): Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	
SDG Justification:	
This course teaches the basic technology to design and operate distributed computing systems, which are more resilient compared to centrally located systems. In addition, distributed systems form the foundation for cloud computing, which enables on-demand renting of computing resources. This helps small and medium IT businesses to develop applications without large capital expenditure.	

CSEN3231	IMAGE PROCESSING	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course emphasizes on an area of information science and engineering whose importance is growing with a wide range of applications. Image processing deals with processing of images which are digital in nature and provides basic concepts, methodologies and algorithms of digital image processing, focusing on the major problems concerned with digital images.

Course Objectives:

- To study the fundamental concepts involved in Digital Image Processing
- To implement image enhancement techniques in the spatial domain.
- To implement image enhancement techniques in the frequency domain.
- To work with various image compression techniques.
- To understand morphological and segmentation techniques

UNIT 1 **Introduction** **8 hours**

Digital image representation, fundamental steps in digital image processing, elements of digital image processing systems. Digital Image Fundamentals: Elements of visual perception, a simple image model, image sensing and acquisition, image sampling and quantization, basic relationships between pixels, mathematical operations used in digital image processing.

Learning Outcomes:

After completion of this unit, the student will be able to:

• learn creation and manipulation of digital images (L3).
• describe different modalities and techniques in image acquisition (L2).
• describe the ways of representing digital images and storing it efficiently depending on the desired quality (L4).
• learn the representation of images in two-dimensional data form (L2).

UNIT 2 **Image Enhancement in Spatial Domain and Fourier Transform** **8 hours**

Image Enhancement in Spatial Domain: Basic intensity transformation, histogram processing,

histogram equalization, histogram matching, fundamentals of spatial filtering, smoothing filters, sharpening filters.
Fourier Transform: Discrete Fourier Transform (DFT) on one variable and two variables, Properties of DFT.

Learning Outcomes:

After completion of this unit, the student will be able to:

• use the mathematical principles of digital image enhancement (L3).
• apply the concepts of feature detection and shape finding algorithms (L3).
• enhance image characteristics by adjusting the image intensity and isolating the region of interest (L4).
• understand how block processing works and investigate the implementation of spatial domain filters(L2).

UNIT 3 Image Enhancement in Frequency Domain 7 hours

Image Enhancement in Frequency Domain: Basics of filtering in the frequency domain, smoothing filters, sharpening filters, homomorphic filters. Color Image Processing: Color fundamentals, color models, smoothing and sharpening.

Learning Outcomes:

After completion of this unit, the student will be able to:

• understand how block processing works and investigate the implementation of frequency domain filters (L2).
• reduce the effects of unwanted distortions, such as noise, blurring, and background illumination (L3).
• enhance image characteristics by adjusting the image intensity and isolating the region of interest (L4).

UNIT 4 Image Compression 7 hours

Image compression: Fundamentals, basic compression methods: Huffman coding, arithmetic coding, run length coding, LZW coding, contour coding, predictive coding, wavelet coding.

Learning Outcomes:

After completion of this unit, the student will be able to:

• understand the fundamental algorithms and how to implement them (L2).
• apply Image transforms used in digital image processing (L3).
• design and implement algorithms that perform basic image processing (L4).

UNIT 5 Morphological Image Processing and Segmentation 8 hours

Morphological Image Processing: Erosion and dilation, opening and closing, hit or miss transform morphological algorithms, grey level morphological processing.

Segmentation: Image Segmentation: Fundamentals, point, line, and edge detection, basic global thresholding, region-based segmentation, watersheds, image segmentation based on color.

Learning Outcomes:

After completion of this unit, the student will be able to:

• extract image features and measurements using different segmentation and edge detection methodologies (L4).
• familiar with Morphological Image Processing, Image Segmentation (L2).
• acquaint the representation and description of image processing techniques and object recognition (L4).

Textbooks:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image processing, 3/e, Pearson Education, 2009.

References:

1. B. Chanda, D. Dutta Majumder, Digital Image Processing and Analysis, PHI Publications, 2006.
2. A.K. Jain, Fundamentals of Digital Image Processing, PHI Publications, 2006.
3. Qidwai and Chen, Digital Image Processing, An algorithmic approach with MATLAB, Taylor & Francis,2010.
4. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing using MATLAB, TMH Publications, 2011.

Course Outcomes:

Upon successful completion of the course, students will be able to:

- Illustrate the fundamental concepts involved in Digital Image Processing (L2).
- To implement image enhancement techniques in spatial domain (L3).
- To implement image enhancement techniques in frequency domain (L3).
- To analyze with various image compression techniques (L4).
- To apply morphological and segmentation techniques (L3)

.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1							2	1			1
CO2	3	3	2	2	2					1		1	2	1	1
CO3	3	3	2	1	2					1		1	2	2	1
CO4	3	3	1	1	2					1		1	2	2	
CO5	3	1	1	1	2	2	1			2	2	1	1	1	2

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG Number and Justification:

SDG2(Zero Hunger):

Imaging technologies play an important role in developing improved crops for sustainable agriculture

SDG3 (Good health and Well-being):

Imaging technologies are crucial to understanding many diseases. Imaging technologies support breakthrough developments that improve human health and well-being. Imaging technologies are critical for diagnosing diseases, viruses, and drug targets, and help develop new diagnostic tools.

SDG 13 and 14 (Climate action and Life below water):

Imaging technologies help to identify important biological patterns that help to drive large-scale ecosystem change. semi-automatic image analysis algorithms facilitate monitoring of chemical effects on marine invertebrates. This includes large-scale quantification of developmental defects in seaweed embryos due to exposure to various chemicals.

CSEN3241	INFORMATION RETRIEVAL SYSTEMS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides in-depth coverage of objectives and functionalities of an Information Retrieval Systems used for information retrieval, text mining and emphasizes both the applications and solid modeling techniques that can be extended for other applications.

Course Educational Objectives:

- Introduce the objectives and functionalities of information retrieval systems.
- Learndata structures and indexing the information.
- Familiarize the Document, Term Clustering and User Search Techniques.
- Explore Information Visualization and Text Search Algorithms.
- Understand Information System Evaluation and Multimedia Information Retrieval.

UNIT 1 Introduction to Information Retrieval Systems 9 hours

Introduction to Information Retrieval Systems: Definition, objectives, functional overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses, information Retrieval System Capabilities-Search capabilities, Browse Capabilities, Miscellaneous Capabilities

Cataloguing and Indexing: Objectives, Indexing process, Automatic indexing, Information Extraction

UNIT 2 Data Structures and Automatic Indexing 9 hours

Data Structure: Introduction, Stemming algorithms, Inverted file structures, N-gram data structure, PAT data structure, signature file structure.

Automatic Indexing: Classes of Automatic indexing, Statistical indexing, Natural language, Concept indexing.

UNIT 3 Document and Term Clustering ,User Search Techniques 9 hours

Document and Term Clustering: Introduction, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.

User Search Techniques: Search statements and binding, Similarity measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems.

UNIT 4 Information Visualization and Text Search Algorithms 9 hours

Information Visualization Introduction to Information Visualization, Cognition and Perception, Information Visualization technologies.

Text Search Algorithms: Introduction to Text Search Techniques, Software text search algorithms, Hardware Text Search Algorithms.

UNIT 5 Information System Evaluation, Query Languages and Multimedia Information Retrieval 9 hours

Information System Evaluation: Introduction to Information System Evaluation, Measures Used in System Evaluation, Measurement Example - TREC Results,
Query languages: Keyword-Based Querying, Pattern Matching.
Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Image Retrieval And Video Retrieval.

TextBooks:

1. 1.Kowalski, Gerald, Mark T Maybury, Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press, 2013.

2. Ricardo Baeza-Yates, Modern Information Retrieval, Pearson Education, 2008.

References:

1. Robert Korfhage, Information Storage & Retrieval, John Wiley & Sons, 1997.
2. C. J. van Rijsbergen, Information Retrieval, (PDF Version), 1979

Coursera Courses:

1 Natural Language Processing with Probabilistic Models
2 Text Retrieval and Search Engines
3. Machine Learning Foundation: A Case Study Approach
4. Machine Learning Clustering and Retrieval
5. Data Visualization with R
6. Visualization for Statistical Analysis
7. Information Visualization: Applied Perception

Course Outcomes:

After successful completion of the course the student will be able to:

1. Explain the functions of Information Retrieval Systems .
2. Demonstrate the working of Data Structures and Indexing .
3. Apply different clustering algorithms to retrieve the information .
4. Demonstrate information visualization technologies .
5. Demonstrate the System Evaluation and Query Languages .

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1	1		1			1			
CO2					1	1	1		1			1			
CO3					2	1	2		1			1			
CO4	2				2	1	2		1	1		1	2	1	
CO5	2				2	1	2		1	1		1	2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN3251</td><td rowspan="2">INTRODUCTION TO PATTERN RECOGNITION
AND MACHINE LEARNING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">MATH2291: Linear Algebra</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Pattern recognition theory and practice is concerned with the design, analysis, and development of methods for the classification or description of patterns, objects, signals, and processes. At the heart of this discipline is our ability infer the statistical behaviour of data from limited data sets, and to assign data to classes based on generalized notions of distances in a probabilistic space. Many commercial applications of pattern recognition exist today, including voice recognition, fingerprint classification, and retinal scanners. Recent developments in statistical modelling using Bayesian techniques, neural networks, decision trees, fuzzy logic, and syntactic structures have accelerated the growth of pattern recognition applications. The objective of this course is to Foundations of pattern recognition algorithms and machines, including statistical and structural methods. Data structures for pattern representation, feature discovery and selection, classification vs. description, parametric and nonparametric classification, supervised and unsupervised learning, use of contextual evidence, clustering, recognition with strings, and small sample-size problems

Course Educational Objectives:

- Understand the basic concepts of a pattern and apply the techniques for pattern recognition algorithms. Understand the basic methods of feature extraction, feature evaluation, and extend these methods for mining data
- Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real world data.
- Develop prototype pattern recognition algorithms that can be used to study algorithm behaviour and performance against multivariate data in real time scenarios.
- Acquire the knowledge about non-parametric and non-metric techniques

UNIT 1 Introduction 9 hours

Basics of pattern recognition system, various applications, Machine Perception, classification of pattern recognition systems Design of Pattern recognition system, Pattern recognition Life Cycle, **Statistical Pattern Recognition**: Review of probability theory, **Linear regression**, Gaussian distribution, Bayes decision theory and Classifiers, Normal density and discriminant functions

UNIT 2 Parameter estimation methods 9 hours

Maximum-Likelihood estimation, Expectation-maximization method, Bayesian parameter estimation Concept of feature extraction and dimensionality, Curse of dimensionality, Dimension reduction methods – Fisher discriminant analysis, Principal component analysis Hidden Markov Models (HMM) basic concepts, Gaussian mixture models.

UNIT 3 Non-Parameter methods 9 hours

Non-parametric techniques for density estimation - Parzen-window method, K-Nearest Neighbour method. Decision trees, Support Vector Machines, CART, Other Tree Methods

UNIT 4 Non-metric methods for pattern classification 9 hours

Non-numeric data or nominal data Decision trees: Concept of construction, splitting of nodes, choosing of attributes, overfitting, pruning, **Multivariate Decision Trees, Handling Missing Attributes during classification, Random forest, Model Evaluation and Confusion Matrix, ROC Curve , Other tree methods: ID3, C4.5, Rule-based methods.**

UNIT 5 Unsupervised Learning and Clustering 9 hours

Mixture Densities and Identifiability, Maximum Likelihood Estimates, Application to Normal Mixtures**, K- Means, Bi-secting K-means, DBSCAN clustering, Neighbourhood clustering,** Hierarchical Clustering**, Cluster Validation,** Component Analysis, Low-Dimensional Representations and Multidimensional Scaling**.**

List of Experiments:

1. Write a python program to characterize the density functions
2. Write a python program to model statistically the feature space using distribution functions
3. Write a python program to understand the distribution functions (Normal, Binomial, Poisson etc)
4. Write a python program to estimate co variance matrix and its properties
5. Write a python program to visualize the changes of distribution as changes in parameters (mean vector, covariance matrix)
6. Write a python program for perceptron learning and test the linear separability
7. Write a python program for Bayesian classification and analyze the decision boundaries by varying the means and covariance matrices
8. Write a python program to classify the given data using maximum likelihood Estimation. Write a program to solve Robot traversal problem (Understanding Means End Analysis)
9. Write a phyton program to understand Morkov Chians and Monto Calro methods. Write a program to implement Hangman game
10. Write a python program to Decision trees
11. Write a python program to build a Bayesian network for given data set
12. Write a python program to understand Kernel methods.

13. Write a program to implement a linear regression problem
14. Write a program to implement kNN neighbour problem
15. Write a program to implement logistic regression

TextBooks:

1. Bishop C M “Pattern recognition and Machine learning", 1/e, Springer, 2006.

2. Duda R O, Hart PE and Stork DG,“ Pattern Classification”, 2/e, john Wiley and Sons, 2003.

References:

1. Bishop C M “Neural Networks for Pattern Recognition” Oxford University Press, 1995
2. Gose E, Johnsonbaugh R and Jost S “Pattern Recognition and Image Analysis” Prentice hall of India, 2002
3. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons,New York, 1993

Coursera Courses:

1.https://www.coursera.org/learn/machine-learning
2.https://www.coursera.org/learn/python-machine-learning

Journal(s):

1. Elsevier, Neurocomputing
2. Elsevier, Pattern Recognition
3. IEEE Transactions on Pattern Analysis and Machine Intelligence
4. IEEE Transactions on Knowledge and Data Engineering

Website(s):https://www.journals.elsevier.com/neurocomputing

https://www.journals.elsevier.com/pattern-recognition
https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34
https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=69

Course Outcomes:

After successful completion of the course the student will be able to:

1. design and construct a pattern recognition system

2. assess major approaches in statistical and syntactic pattern recognition

3. aware of the theoretical issues involved in pattern recognition system design such as the 243 curse of dimensionality

4. implement pattern recognition techniques

5. distinguish between supervised and unsupervised techniques for pattern recognition

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2		2								3	3	
CO2		3											3		2
CO3		3		2									3		2
CO4		2	3	3	2								3	2	3
CO5	1	3											3		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGs: 9
Industry, Innovation and Infrastructure
Statement: Pattern recognition is the cognitive process that happens in the brain when it matches the information that we see with the data stored in our memories. Pattern recognition is the technology that matches incoming data with information stored in a database. Thus, pattern recognition is a type of machine learning since it uses machine learning algorithms to recognize patterns.

SDG Justification:

CSEN3261	MACHINE LEARNING AND ITS APPLICATIONS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**MATH2291: Linear Algebra**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

Machine Learning is a flourishing subject in Computer Science which devises models that can automatically learn from data and detect patterns from data. The applications of machine learning are diverse ranging from self- driven cars to disaster management systems. With easy availability of data from different devices and measurements, machine learning techniques become imperative in analysing trends hidden in the data. This course focuses on the major tasks of machine learning that can robustly address data that is non-linear, noisy as well as high-dimensional in nature.

Course Educational Objectives:

- To introduce various key paradigms of machine learning approaches
- To familiarize with mathematical relationships across various machine learning algorithms
- To understand various key approaches in supervised learning
- To understand various key approaches in unsupervised learning
- To illustrate the concept of the neural network

UNIT 1 Machine Learning Fundamentals 9 hours, P - 6 hours

Machine Learning Fundamentals: Use of Machine Learning, Types of machine learning systems, Machine learning challenges, Testing and validating, working with real data, Obtaining the data, Visualizing the data, Data preparation, Training and fine tuning the model.

UNIT 2 Supervised Learning 9 hours, P - 6 hours

Supervised Learning: Classification, training a binary classifier, performance measures, multiclass classification, error analysis, multi label classification, multi output classification. Linear Regression, Gradient Descent, Polynomial Regression, learning curves, regularized linear models, logistic regression.

UNIT 3 Unsupervised Learning 9 hours, P - 6 hours

Unsupervised Learning: Clustering, K-Means, using clustering for image segmentation, Semi-supervised learning, DBSCAN, other clustering algorithms.

Gaussian Mixtures, anomaly detection, selecting number of clusters, Bayesian Gaussian Mixture Models, anomaly and novelty detection algorithms.

UNIT 4 Dimensionality Reduction& Ensemble Learning 9 hours, P - 6 hours

Dimensionality Reduction: The curse of dimensionality, main approaches for dimensionality reduction, PCA, Non Negative Matrix Factorization.

Ensemble Learning: voting classifiers, bagging, random patches and random spaces, random forests, boosting, stacking.

UNIT 5 Neural Networks & Deep Neural Networks 9 hours,P - 6 hours

Neural Networks: From biological to artificial neurons, implementing MLPs with Keras, fine tuning neural network hyper parameters.

Deep Neural Networks: Vanishing/Exploding Gradients Problem, avoiding overfitting through regularization, Dropout Regularization.

List of Experiments:

1. Write a python program to characterize the density functions

2. Write a python program to model statistically the feature space using distribution functions

3. Write a python program to understand the distribution functions (Normal, Binomial, Poissonetc)

4. Write a python program to estimate co variance matrix and its properties

5. Write a python program to visualize the changes of distribution as changes in parameters

(mean vector, covariance matrix)

6. Write a python program for perceptron learning and test the linear separability

7. Write a python program for Bayesian classification and analyze the decision boundaries by

varying the means and covariance matrices

8. Write a python program to classify the given data using maximum likelihood

Estimation. Write a program to solve Robot traversal problem (Understanding Means End

Analysis)

9. Write a phyton program to understand Morkov Chians and Monto Calro methods. Write a

program to implement Hangman game

10. Write a python program to Decision trees

11. Write a python program to build a Bayesian network for given data set

12. Write a python program to understand Kernel methods.

13. Write a program to implement a linear regression problem

14. Write a program to implement kNN neighbour problem

15. Write a program to implement logistic regression

TextBooks:

1. Aurelion Geron, Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools and Techniques to build Intelligent Systems, 2/e, O'Reilly Media, 2019.(Chapters 1,3,4,5)

2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep learning, MIT press, 2016 (Chapter2)

References:

1. Tom M. Mitchell, "Machine Learning" First Edition by Tata McGraw- Hill Education.
2. Ethem Alpaydin,"Introduction to Machine Learning " 2nd Edition, The MIT Press, 2009
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning" By Springer, 2007.
4. Mevi P. Murphy, "Machine Learning: A Probabilistic Perspective" by The MIT Press, 2012.

Coursera Courses:

1. https://www.coursera.org/learn/uol-machine-learning-for-all

2. https://www.coursera.org/learn/introduction-to-machine-learning-supervised-learning

3. https://www.coursera.org/learn/machine-learning-with-python? (Clustering Week -4))

4. coursera.org/learn/mixture-models?specialization=bayesian-statistics (GMM & Bayesian GMM)

5. https://www.coursera.org/learn/ibm-unsupervised-machine-learning(Curse Dimensionality, PCA)

6. https://www.coursera.org/learn/supervised-machine-learning-classification

7. https://www.coursera.org/learn/introduction-to-deep-learning-with-keras(Week1 &Week 2Part-1)

8. https://www.coursera.org/learn/deep-neural-network(Week 1- part 2)

Course Outcomes:

After successful completion of the course the student will be able to:

1. To formulate the different machine learning problems
2. Apply various learning approaches on real time problems using Classification
3. Apply various learning approaches on real time problems using Regression
4. Apply various learning approaches on real time problems using Clustering
5. Construct the neural networks for classification problems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1			2	1	1	2	3	2	1
CO2	3	3	3	2	2	1			2	1	1	2	3	2	2
CO3	2	3	3	2	2	1			2	1	1	2	3	2	2
CO4	1	2	2	2	2	1			2	1	1	2	3	2	2
CO5	2	3	3	3	3	1			2	1	2	2	3	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGs: 3, 6, 11
SDG:3 Good Health and Well-being
Statement: Machine Learning has the potential to personalize healthcare monitoring, diagnosis and treatment for the individual in the community and at home. It puts consumers in control of health and well-being.

SDG:6 Clean Water and Sanitation
Statement: Machine Learning will help to resolve challenges related to clean water and sanitation. It is helping utilities and municipalities to better manage their water and wastewater systems to ensure a clean and sanitized water supply.
SDG:11 Sustainable Cities and Communities
Statement: Machine Learning enable smart urban solutions brings multiple benefits, including more efficient energy, water and waste management, reduced pollution, noise and traffic congestions

SDG Justification:

CSEN3271	PARALLEL COMPUTING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	CSEN1101: Operating Systems						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The goal of this course is to introduce the foundations of parallel computing including the principles of parallel algorithm design, analytical modelling of parallel programs, programming models for shared- and distributed-memory systems, parallel computer architectures, along with numerical and non-numerical algorithms for parallel systems.

The course will include emerging multicore hardware, shared-memory programming models, message passing programming models used for cluster computing, data-parallel programming models for GPUs, and problem-solving on large-scale clusters using MapReduce.

A key aim of the course is to gain a hands-on knowledge of the fundamentals of parallel programming by writing efficient parallel programs using some of the programming models.

Course Educational Objectives:

- Introduction to parallel computing foundations
- Programming models for shared and distributed-memory systems
- Data parallel programming models for GPUs
- Problem-solving on large-scale clusters using MapReduce
- Writing efficient parallel programs

UNIT 1 Introduction 9 hours

Automating Parallel programming, Parallel algorithms and parallel architecture, measuring the benefits of parallel computing, Amdahl's law for multiprocessor systems, applications of parallel computing, shared-memory multiprocessors (Uniform Memory Access – UMA), distributed-memory multiprocessors (Non-Uniform Memory Access – NUMA).

UNIT 2 Parallel Algorithm Design 9 hours

The task / channel Model, Foster's design methodology: Partitioning, communication, agglomeration, mapping. Application: Boundary value problem. Reduction: Finding a maximum value. Data input.
MapReduce Computation: Apache Hadoop, Hadoop Streaming, Example – wordcount

UNIT 3 **Applications** **9 hours**

Matrix Multiplication: Sequential Matrix Multiplication, Algorithms for processor Arrays
Sorting: Enumeration Sort, Lower bounds on parallel Sorting, Odd-Even Transposition sort, Bitonic Merge

UNIT 4 **Searching and Optimization** **9 hours**

Branch-and-Bound Search, Genetic Algorithms: Evolution, Sequential Genetic algorithms, initial population, selection process off-spring production, variations, Termination conditions, parallel genetic algorithms Successive refinement, Hill climbing.

UNIT 5 **Dictionary operations and Combinatorial Search** **9 hours**

Dictionary Operations: Ellis's Algorithm, Manber and Ladner's algorithm
Graph algorithms: Searching a graph, connected components,
Combinatorial Search: Divide and Conquer, Branch and bound, alpha-beta Search

Text Books:

1. Algorithms and Parallel Computing by Fayex Gebali, A John Wiley & Sons, Inc. Publication ISBN 978-0-470-90210-3
2. Parallel Programming in C with MPI and Open MP by M.J. Quinn, McGraw Hill. Publication ISBN 978-0072822564

References:

1. Parallel Computing Theory and Practice by Michael J. Quinn, McGraw Hill. Publication ISBN 978-0-07-049546-3.
2. Parallel Programming Techniques and Applications using Networked Workstations and parallel computers by Barry Wilkinson and Michael Allen, Pearson. Publication ISBN 978-81-317-0239-0

Coursera Courses:

1. Introduction to Big Data offered by UCSan Diego (Unit – 2)

2. Introduction to High-Performance and Parallel Computing offered by University of Colorado Boulder

Journal(s):

1. Journal of Parallel and Distributed Computing ISSN: 0743-7315

Course Outcomes:

After successful completion of the course the student will be able to:

1. Introduction to parallel computing foundations
2. Programming models for shared and distributed-memory systems
3. Data parallel programming models for GPUs
4. Problem-solving on large-scale clusters using MapReduce
5. Writing efficient parallel programs

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1					1	2	3	2	1
CO2	3	3	3	2	2	1					1	2	3	2	2
CO3	2	3	3	2	2	1					1	2	3	2	2
CO4	1	2	2	2	2	1					1	2	3	2	2
CO5	2	3	3	3	3	1					2	2	3	2	2

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4 : Induce Industry, Innovation and Infrastructure in computer science engineers
Statement: As technology is evolving, the substantiality depends on the ability to think innovatively
and build resilient infrastructure models for high-performance computing.

SDG Justification:

<table>
<tr><td rowspan="2">CSEN3281</td><td rowspan="2">SECURE SOFTWARE ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">CSEN1131: Software Engineering</td></tr>
</table>

Course Description:

This Course will help the students to get familiar with the security threats which arise during software development process and also helps to understand security services which needs to be adopted at each phase of Software Development Life Cycle

Course Educational Objectives:

- Understand the security threats related to Software Development
- Elicit, analyze, and specify security requirements through SRS
- Design and Plan software solutions to security problems using various paradigms
- Develop and apply testing strategies for Secure software applications
- Understand the security risks related to Software Project Management

UNIT 1 Security Issues in Software Development 9 hours

Introduction to Software Engineering – SDLC
Software Assurance and Software Security, Threats to Software Security, Sources of Software Insecurity, The Benefits of Detecting Software Security Defects Early, Managing Secure Software Development, Defining Properties of Secure Software, Security Properties of Software Assertion and Specification of Desired Security Properties

UNIT 2 Requirements Engineering for Secure Software 9 hours

Introduction to Requirements Engineering, Quality Requirements, Misuse and Abuse Cases, The
SQUARE Process Model, SQUARE Sample Outputs, Requirements Elicitation, Requirements Prioritization

UNIT 3 Secure Software Architecture and Design 9 hours

Introduction, Software Security Practices for Architecture and Design: Architectural Risk Analysis, Software Security Knowledge for Architecture and Design: Security Principles, Security Guidelines, and Attack Patterns

UNIT 4 Secure Coding and Testing 9 hours

Introduction, Code Analysis, Coding Practices, Software Security Testing, Security Testing Considerations Throughout the SDLC

UNIT 5 Governance, and Managing for More Secure Software 9 hours

Introduction, Governance and Security, Adopting an Enterprise Software Security Framework, How
Much Security Is Enough, Security and Project Management, Maturity of Practice.

Text Books:

1. Julia H Allen, Sean J Barnum, Robert J Ellison, Gary McGraw, Nancy R Mead, Software ecurity Engineering: A Guide for Project Managers, Addison Wesley, 2008.

References:

1. Developing Secure Software: Jason Grembi, Cengage Learning.
2. Software Securtiy: Richard Sinn, Cengage Learning.

Course Outcomes:

After successful completion of the course the student will be able to:

1. evaluate secure software engineering problems, including the specification, design, implementation, and testing of software systems
2. analyse the Threats in Software Development phase
3. determine the Security provisions and policies required in each phase of SDLC
4. understand the precautions needed at each phase of SDLC to avoid threats
5. comprehensive Understanding of security risks and project management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				2		1							2		
CO2			2	2	2				2					1	
CO3		2	2												2
CO4			3			2							2		
CO5			3		3							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 22nd AC (01-04-2022)**

SDG No. & Statement:

SGD 12: Cyber defense mechanisms ensure that no effect will be made to the industrial patterns

SDG Justification:

CSEN3291	SOFTWARE METRICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**CSEN1131: Software Engineering**						

Course Description:

This course is aimed at helping students build up an understanding of basic understanding and knowledge of the software metrics and measurement techniques. This course will initiate students to understand the importance of Metrics data collection, analysis and metrics for object-oriented systems, external product attributes, dynamic Metrics and Resource measurement.

Course Educational Objectives:

- Understand the software measurement and metrics.
- The ability to successfully estimate/measure/predict the quality of a software project
- The ability to define effective metrics for any software development situation Understand
- the issues of product and process metrics
- Able to understand the various software management models

UNIT 1 Introduction 9 hours

Measurement: What is it and Why do it: Measurement in everyday life, Measurement in software engineering, Scope of software metrics.

The Basics of Measurement: The representational theory of measurement, Measurement and models, Measurement scales and scale types.

UNIT 2 Empirical investigation 9 hours

Empirical investigation: Principles of empirical studies, Planning experiments.

Software metric data collection: Defining code data, Data collection for incident reports.

UNIT 3 Measurement of internet product attributes-Size, structure 9 hours

Measurement of internet product attributes - Size: Properties of software size, Code size, Design size, Requirements analysis and specification size, Functional size measures and estimators, Applications of size measures.

Measurement of internet product attributes - Structure: Aspects of structural measures, Control flow structure of program units

UNIT 4 Software quality metrics 9 hours

Software quality metrics overview: Product quality metrics, In-Process quality metrics, Metrics for software maintenance, Examples of metrics programs, Collecting software engineering data

UNIT 5 Quality management 9 hours

Quality management models: The Rayleigh model framework, Code integration pattern, The Problem Tracking report (PTR) sub-model, The PTR arrival and backlog projection model, Reliability growth models, Criteria for model evaluation, In-process metrics and reports, Orthogonal defect classification

Text Books:

1. Norman Fenton, James Bieman, Software Metrics – A Rigorous and Practical Approach, 3rd Edition, CRC Press
2. Stephen H.Kan, Metric and models in software quality engineering,2nd Edition, Addison Wesley Professional

References:

1. William A. Florac and Areitor D. Carletow, Measuring the Software Process, Addison - Wesley, 1995.
2. Robert B.Grady, Practical Software Metrics for Project Management and Process Improvement, Prentice Hall.

Course Outcomes:

After successful completion of the course the student will be able to:

1. understand and analyze the various measurements for software
2. apply various data analysis methods produce efficient, reliable, robust and cost effective software solutions
3. measure the various internet based s/w product attributes including size and structure
4. apply quality metrics for any s/w project and validate it
5. implement a case study of - Rayleigh Model for s/w management for any software company.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2				2							3		
CO2			3	2					2					2	
CO3	2		2												2
CO4		2											2		
CO5			3		2							2		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 22nd AC (01-04-2022)**

SDG No. & Statement:
SDG 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Knowing thoroughly about the metrics and measurement with respect to Software makes to develop the quality Software products

SDG Justification:

CSEN3301	SOFTWARE REQUIREMENTS MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**CSEN1131: Software Engineering**						

Course Description:

The purpose of requirements management is to ensure that the organization validates and meets the needs of its customers and external and internal stakeholders. Requirements management provides a way to avoid errors by keeping track of changes in requirements and fostering communication with stakeholders from the start of a project throughout the engineering lifecycle. Student able to identify requirements of the software problem/application and prepare estimation in terms of cost and effort.

Course Educational Objectives:

- Understand the various types of requirements of the software applications.
- Study the various aspects of Requirements engineering such s/w environment constraints and risk, feasibility etc.
- How to prepare an SRS document
- Acquaint with various software size estimation techniques.
- Demonstrate different approaches for software cost and effort estimation.

UNIT 1 Introduction 9 hours

Introduction, requirements, requirement engineering, requirements document, best way to write requirements, detailed requirements, difference between functional and nonfunctional requirements, system stakeholders, requirements engineering process, recognizing requirements engineering process problems, suggesting a good requirements engineering process. Practical process improvement: Process maturity, process assessment, process improvement, top ten guidelines.

UNIT 2 Requirements Elicitation 9 hours

Assess system feasibility, identify and consult system stakeholders, record requirement sources, system's operating environment, using business concerns to drive requirements elicitation, domain constraints, collect requirements from multiple view points, use scenarios to elicit requirements, operational process. Requirements Analysis and Negotiation: System boundaries prioritize requirements, assess requirements risk.

UNIT 3 Describe Requirements 9 hours

Describing Requirements: Standard templates use language, use diagrams, supplement natural language requirements, specifying requirements quantitatively.

Requirements Management: Uniquely identify each requirement, policies for requirements management, traceability policies, maintaining a traceability manual, change management policies, identify global system requirements, identify volatile requirements, record rejected requirements.

UNIT 4 Software Size Estimation 9 hours

Software Size Estimation: Software estimation, size based estimation, two views of sizing, function point analysis, Mark-II FPA, full function points, LoC estimation, and conversion between size measures.

UNIT 5 Effort, Schedule & Cost Estimation 9 hours

Effort, Schedule & Cost Estimation: What is productivity, estimation factors, approaches for effort and schedule estimation, COCOMO II, Putnam estimation model, algorithmic models, cost estimation tools: Desirable features of requirements management tools, some requirements management tools available, Rational Pro, desirable features in software estimation tools, some software estimation tools.

For Laboratory course: List of Experiments:

1. Develop requirements specification for a given problem (The requirements specification should include both functional and non-functional requirements)
2. Develop DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem (Use of a CASE tool required).
3. Develop structured design for the DFD model developed.
4. Develop UML Use case model for a problem (Use of a CASE tool any of Rational rose, Argo UML, or Visual Paradigm etc. is required)
5. Develop Sequence Diagrams(using case study)
6. Develop Class diagrams(using case study)
7. Develop Activity Diagram(using case study)
8. Develop State chart diagram (using case study)

Text Books:

1. Ian Sommerville and Pete Sawyer, Requirements Engineering: A good practice guide, John Wiley, 1997.
2. Rajesh Naik and Swapna Kishore, Software Requirements and Estimation, TMH, 2001.

References:

1. Don, Managing Software Requirements, A Use Case Approach, 2/e, Dean, Addision- Wesley, 2003.
2. Ian Graham, Requirements Engineering and Rapid Development, AddisionWesley, 1998

Coursera Courses:

1. Requirements Engineering: Secure Software Specifications Specialization, offered by University of Colorado, https://www.coursera.org/specializations/requirements-engineering-secure-software#courses
2. Client Needs and Software Requirements, offered by University of Alberta, https://www.coursera.org/learn/client-needs-and-software-requirements#syllabus
3. Budgeting and Scheduling Projects, offered by UCI, https://www.coursera.org/learn/schedule-projects#syllabus
4. Construction Cost Estimating and Cost Control, offered by Columbia University, https://www.coursera.org/learn/construction-cost-estimating#syllabus
   Engineering Project Management: Scope, Time and Cost Management, offered by RICE, https://www.coursera.org/learn/scope-time-management-cost

Journal(s):

1. Jingbai Tian,1 Jianghao Yin,1 and Liang Xiao, Software Requirements Engineer's Ability Assessment Method Based on Empirical Software Engineering, Wireless Communications and Mobile Computing, 2022
2. Ali Altalbe, "Software Requirements Management", International Journal of Advanced Research in Artificial Intelligence, Vol. 4, No.4, 2015
3. S. Arun Kumar and T.Arun Kumar, study the impact of requirements management characteristics in global software development projects: an ontology based approach, International Journal of Software Engineering & Applications (IJSEA), Vol.2, No.4, October 2011
4. ManjuGeogy Mrs and DharaniDr, A Scrutiny of the Software Requirement Engineering Process, Procedia Technology, Volume 25, 2016, Pages 405-410
   Luigi Buglione and Christof Ebert, Estimation Tools and Techniques

Website(s):

1. https://www.guru99.com/requirement-management-tools.html
2. https://www.requirementsmanagementtools.com/opensource.php
3. https://www.softwaretestingclass.com/software-estimation-techniques/
4. https://www.tutorialspoint.com/estimation_techniques/estimation_techniques_overview.htm
5. https://www.geeksforgeeks.org/software-engineering-project-size-estimation-techniques/
6. https://www.ibm.com/in-en/topics/what-is-requirements-management
7. https://u-tor.com/topic/estimation-techniques

Course Outcomes:

After successful completion of the course the student will be able to:

1. identify the functional and non-functional requirements of s/w application /problem/product (L3)
2. prepare feasible study report for a small s/w application (L2)
3. develop an SRS for specific case study (L3)
4. apply various s/w size estimation techniques to specific application or case study (L3)
5. apply cost and effort estimation methods to specific application or case study (L3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	2	-	2	-	-	-	-	1	-	3	1	2
CO2	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-
CO3	1	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	-	-	3	-	-	2	-	-	-	-	2	-	3	-	1
CO5	-	-	3	-	-	-	-	-	-	-	2	-	3	-	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 22nd AC (01-04-2022)**

SDG No. & Statement:

SDG 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. With the intense knowledge of Requirements engineering led to cost and time effective software products

SDG Justification:

CSEN3311	SOFTWARE TESTING METHODOLOGIES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**CSEN1131: Software Engineering**						

Course Description:

This course offers a tho rough exploration of various software testing methodologies. Students will learn various testing approaches and techniques, enabling them to design, execute, and analyze test cases for diverse software applications. The goal is to ensure functionality and identify defects before release. The key objectives include understanding testing levels, black-box and white-box techniques, test case design, software quality cost management and applying these concepts in real-world scenarios across different software development life cycles.

Course Educational Objectives:

- Understand the basic concepts of software testing.
- Develop proficiency in designing, executing and analyzing test cases for various software applications.
- Validate various test activities
- Understand the structure of testing
- Effectively identify, report and track software defects to ensure quality improvement

UNIT 1 Introduction 9 hours

Software testing definition, evaluation of software testing, software testing myths and facts, goals and model of software testing, software testing terminology, software testing life cycle, software testing methodology, verification and validation activities.

UNIT 2 Dynamic Testing 9 hours

Black Box Testing: Boundary value analysis, equivalence class testing. White-box testing: Introduction, basis path testing, loop testing. Static testing: inspections, structured walkthroughs, technical reviews.

UNIT 3 Validation Activities 9 hours

Unit validation testing, integration testing, function testing, system testing, accepting testing. Regression Testing: Objectives of regression testing, regression testing types, regression testing techniques.

UNIT 4 **Test Management** **9 hours**

Test organization, structure of testing group, test planning, detailed test design and test specifications. Efficient test suite management: Introduction, minimizing the test suite and its benefits, defining test suite minimization problem, test suite prioritization, types of test case prioritization, prioritization techniques.

UNIT 5 Software Quality Management 9 hours

Software quality, quality cost, quality control and quality assurance, quality management, QM and project management, quality factors, methods of quality management, software quality metrics, SQA models.

Text Books:

1. Naresh Chauhan, Software Testing: Principles and Practices, 1/e, Oxford University Press, 2010

References:

1. William E. Perry, Effective Methods for Software Testing, 3/e, Wiley, 2006.
3. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, 3/e, Auerbach publication, 2015.

Coursera Courses:

1. Introduction to Software Testing – University of Minnesota - https://www.coursera.org/learn/introduction-software-testing
2. Software Testing and Automation Specialization - University of Minnesota - https://www.coursera.org/specializations/software-testing-automation

Journal(s):

1. Nahid Anwar & Susmita Kar , "Review Paper on Various Software Testing Techniques & Strategies", Global Journal of Computer Science and Technology : C Software & Data Engineering, Volume 19, Issue 2, Version 1.0, Year 2019
2. Karuturi Sneha, Gowda M Malle, "Research on software testing techniques and software automation testing tools", International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS-2017)
3. Muhammad Abid Jamil, Muhammad Arif , Normi Sham Awang Abubakar , Akhlaq Ahmad, "Software Testing Techniques: A Literature Review", 6th International Conference on Information and Communication Technology for The Muslim World, 2016
4. Divyani Shivkumar Taley, Dr. Bageshree Pathak, "Comprehensive Study of Software Testing Techniques and Strategies: A Review", International Journal of Engineering Research & Technology(IJERT)
   Vol. 9 Issue 08, August-2020

Website(s):

1. https://www.inflectra.com/Ideas/Topic/Testing-Methodologies.aspx
2. https://www.simform.com/blog/software-testing-methodologies/
3. https://www.youtube.com/watch?v=6rNgPXz9A9s

4. https://senlainc.com/blog/the-main-types-of-software-testing-methodologies-and-testing-based-on-business-objectives/
5. https://www.globalapptesting.com/blog/software-testing-methodologies-
6. https://www.softwaretestinghelp.com/software-development-testing-methodologies/

Course Outcomes:

After successful completion of the course the student will be able to:

1. Demonstrate software testing life cycle
2. Describe various testing methods of Black-Box testing and White-Box testing
3. Analyse the performance of integration testing
4. Explain the concepts of test management
5. Illustrate working of software quality management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	-	-	3	-	-	-	-	-	-	1	-	-
CO2	1	-	-	2	2	3	-	-	-	-	-	-	-	3	2
CO3	1	2	-	2	-	2	-	-	-	-	-	-	-	2	3
CO4	-	2	-	-	-	2	-	-	-	-	2	-	2	-	-
CO5	-	-	-	-	2	2	-	-	-	-	3	-	1	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 22nd AC (01-04-2022)**

SDG No. & Statement:

SDG 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Students learn the various Testing methodologies in testing the code and will able to develop the robust Software products.

SDG Justification:

<table>
<tr><td rowspan="2">CSEN3321</td><td rowspan="2">THREAT INTELLIGENCE</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN3041: Ethical Hacking</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Threat intelligence can help organizations gain valuable knowledge about threats, build effective defense mechanisms and mitigate the risks that could damage their bottom lineand reputation. After all, targeted threats require targeted defense, and threat intelligence delivers the capability to defend more proactively.

Course Educational Objectives:

- Introduce the concepts of threat intelligence and its life cycle.
- Learn threat intelligence for security operations and incident response.
- Know about how to Identify and create intelligence requirements through practices such as threat modeling.
- Understand and develop skills in tactical, operational, and strategic-level threat intelligence.
- Generate threat intelligence to detect, respond to, and defeat focused and targeted threats.

UNIT 1 Introduction to Threat Intelligence 9 hours

What Have You Heard About Threat Intelligence?, Why Is Threat Intelligence Important?, Who Can Benefit From Threat Intelligence?, Data and Information Are Not Intelligence, Two Types of Threat Intelligence, Operational Threat Intelligence, Strategic Threat Intelligence, The Role of Threat Data, Feeds, The Role of Private Channels and the Dark Web; The Threat Intelligence Lifecycle: The Six Phases of the Threat Intelligence Lifecycle, Direction, Collection, Processing, Analysis, Dissemination, Feedback, Tools and People.

UNIT 2 Threat Intelligence for Security Operations 9 hours

Responsibilities of the SOC Team, The Over whelming Volume of Alerts, Context Is King: Triage requires lots of context, Usecase: Correlating and enriching alerts, Improving the “Time to No”, Beyond Triage.

Threat Intelligence for Incident Response: Continuing Challenges; A skills gap; Toomany alerts; too little time; Time to response is rising; A piecemeal approach; TheReactivity Problem; Minimizing Reactivity in Incident Response: Identification ofprobable threats, Prioritization; Strengthening Incident Response With ThreatIntelligence; Threat Intelligence in Action: Use case: Prepare processes in advance, Usecase: Scope and contain incidents; Essential Characteristics of Threat Intelligence: for Incident Response, Comprehensive, Relevant, Contextualized, Integrated.

UNIT 3 Threat Intelligence for Vulnerability Management 9 hours

The Vulnerability Problem by the Numbers: Zero day does not mean top priority, Time is of the essence; Assess Risk Based on Exploitability: Severity ratings can be misleading; The Genesis of hreat Intelligence: Vulnerability Databases: Exploitability versus exploitation, Next week versus now; hreat Intelligence and Real Risk: Internal vulnerability scanning, Risk milestones for vulnerabilities, Understanding the adversary; Sources of Intelligence; Use Case: Cross-Referencing Intelligence;Bridging the Risk Gaps Between Security, Operations, and Business Leadership. Threat Intelligence for Security Leaders: Risk Management: Internal data is not enough, Sharpening the focus; Mitigation: People, Processes, and Tools: Early warnings; Investment; Communication; Supporting Security Leaders; The Security Skills Gap; Intelligence to Manage Better.

UNIT 4 Threat Intelligence for Risk Analysis 9 hours

The FAIR Risk Model: Measurements and transparency are key; Threat Intelligence and Threat Probabilities; Threat Intelligence and the Cost of Attacks; Threat Intelligence for Fraud Prevention: Stand and Deliver; Know Your Enemy; Criminal Communities and the Dark Web: Gated communities, A strength — and a weakness; Connecting the Dots for Fraud Prevention: Use case: Payment fraud, Use case: Compromised data, Use case: Typo squatting and fraudulent domains.

UNIT 5 Third-Party Risk Looms Large 9 hours

Traditional Risk Assessments Fall Short; Three Things to Look for in Threat Intelligence: Automation and machine learning, Real-time updates to risk scores, Transparent risk assessments; Responding to High Third-Party Risk Scores; Threat Intelligence for Digital Risk Protection: Being Online Is Being at Risk; Types of Digital Risk; Uncovering Evidence of Breaches on the Web; Uncovering Evidence of Brand Impersonation and Abuse; Critical Qualities for Threat Intelligence Solutions.

List of exercises.

1. An Overview of key security tools such as Firewalls, anti-virus and cryptography.
2. Perform Malware analysis using open source tools
3. Demonstrate Kill Chain Analysis

4. Overview of different intelligence sharing platforms (STIX, MISP)

5. Case study on Network Protocol Analyzers

6. Demonstration on SIEM Deployment

Text Books:

1. Zane Pokorny, The Threat Intelligence Handbook: Moving Toward a Security Intelligence Program", 2nd Edition, CyberEdge Group, 2019

References:

1. Ali Dehghantanha, Mauro Conti, TooskaDargahi, Cyber Threat Intelligence, Springer, 2018.
2. The Threat Intelligence Handbook: A Practical Guide for Security Teams to Unlocking the Power of Intelligence, CyberEdge Group, 2018.

Coursera Courses:

1.https://www.coursera.org/learn/ibm-cyber-threat-intelligence For tutorial classes:

Course Outcomes:

After successful completion of the course the student will be able to:

1. Define the basic concepts, terminology and Threat Intelligence life cycle.

2. Discuss various applications and characteristics of Threat Intelligence.

3. Examine Vulnerabilities, Risks, and Mitigation strategies.

4. Explore fraud prevention systems and risk models.

5. Review third-party risk and various forms of digital risks.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1														
CO2	2	1		1	1										
CO3	2	1		1	1										
CO4	2	2		1	1										
CO5	3	2		2	1										

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SGD 12: Cyber defense mechanisms ensure that no effect will be made to the industrial patterns

SDG Justification:

CSEN3331	Machine Learning Techniques and Applications	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	MATH2291:Linear Algebra						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides foundational understanding of machine learning models (logistic regression, multilayer perceptrons, convolutional neural networks, natural language processing, etc.) as well as demonstrates the practical aspects of managing machine learning projects. The course also introduces the key steps of ML projects including data collection, model building, deployment, and maintenance of ML systems.

Course Educational Objectives:

- To introduce machine learning history and basics with application.
- To implement Convolution Neural Network and its Applications.
- To exemplify the Recurrent Neural network and Natural language processing.
- To organize Machine Learning algorithms for Big Data applications.
- To assess ML System Design and to introduce life cycle management of ML Systems.

UNIT 1 Introduction to machine learning 9 hours

Basic mathematics, logistic regression, multilayered perceptron (MLP), fundamentals of deep learning, simpler models. Transfer Learning, Model Selection, History of Neural Networks, learning deep networks as a minimization problem of a mathematical function, Validation methods, Gradient descent algorithm, optimization using gradient descent, stochastic gradient descent. Evaluating the Networks, Early Stopping

UNIT 2 Convolution Neural Network and Applications 9 hours

Hierarchical Structure of Images, Convolution Filters, Convolutional Neural Network, CNN Math Model, How the Model Learns, Advantages of Hierarchical Features, CNN on Real Images, Applications in Use and Practice, Deep Learning and Transfer Learning, Breakdown of the Convolution (1D and 2D), Core Components of the Convolutional Layer, Activation Functions, Pooling and Fully Connected Layers, Training the Network, Transfer Learning and Fine-Tuning.

UNIT 3 Recurrent Neural network and Natural language processing 10 hours

Introduction to natural language processing (NLP), Basics of word embeddings, Words to Vectors, word embedding implementation for NLP applications. Learning Model Parameters, Types of neural NLP models, recurrent neural networks, long short-term memory (LSTM), LSTM for Text Synthesis, Introduction to Reinforcement Learning, Reinforcement Learning Problem Setup, Non-Myopic Policy, Q Learning, Extensions of Q Learning, Limitations of Q Learning, Deep Q Learning Based on Images, Connecting Deep Q Learning with Conventional Q Learning.

UNIT 4 Organizing ML and Big Data 7 hours

Introduction to ML systems, Identifying Opportunities ML systems, Validating Product Ideas, Benefits of ML in Products, ML vs. Heuristics, ML Projects vs. Software Projects, CRISP-DM Data Science Process, CRISP-DM Case Study, Team Organization, Organizing the Project, Measuring Performance, Data Needs, Data Collection, Data Governance & Access, Data Cleaning, Preparing Data for Modeling, Reproducibility & Versioning

UNIT 5 ML System Design and life cycle management 7 hours

ML System Design Considerations, Cloud vs. Edge, Online Learning & Inference, ML on Big Data, ML Technology Selection, Common ML Tools, ML System Failures, ML System Monitoring, Model Maintenance, Model Versioning, Organizational Considerations for ML systems

References:

1. Coursera: Introduction to Machine Learning; Duke University. https://www.coursera.org/learn/machine-learning-duke
2. Coursera: Managing Machine Learning Projects; Duke University. https://www.coursera.org/learn/managing-machine-learning-projects?productTypeDescription=Courses&=null

Course Outcomes:

Upon successful completion of the course, students will be able to

11. Understand the underlying principles of machine learning algorithms (L2).
12. Apply Convolution Neural Network for image and signal processing applications (L3).
13. Experiment Natural language processing applications using Recurrent Neural networks (L3).
14. Analyse Machine Learning algorithms for Big Data (L4).
15. Compare ML Systems and its life cycle management (L2).

APPROVED IN:
BOS :<< 09-06-2023 >> ACADEMIC COUNCIL: 27 <<06-07-2023>>

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN3341</td><td rowspan="2">Programming Languages</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN1011: Problem Solving and Programming with C / CSEN1021: Python Programming</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is a study of programming languages with special focus on functional programming. It provides a framework to understand the basic language components in an effective manner to design simple, reusable, robust and efficient programs. By focusing on how the different language components interact and fit together, it leads to effective programming.

Course Educational Objectives:

- To introduce the basic concepts of programming languages
- To familiarize the student with the functional programming paradigm
- To enable the student to write programs in Meta Language (ML), Racket and Ruby
- To make the student understand how the various pieces of a programming language interact with each other.

UNIT 1 **7 hours**

Introduction, ML Variable Bindings and Expressions, Rules for Expressions, The REPL and Errors, Shadowing, Functions Informally, Functions Formally, Pairs and Other Tuples, Introducing Lists, List Functions, Let Expressions, Nested Functions, Let and Efficiency, Options, Boolean and Comparison Operations, Benefits of No Mutation, Java Mutation, Pieces of a Language.

UNIT 2 **9 hours**

Building Compound Types, Records, Tuples as Syntactic Sugar, Datatype Bindings, Case Expressions, Useful Datatypes, Pattern Matching So Far, Another Expression Example, Type Synonyms, Lists and Options are Datatypes, Polymorphic Datatypes, Each of Pattern Matching / Truth about Functions, A Little Type Inference, Polymorphic and Equality Types, Nested Patterns, More Nested Patterns, Nested Patterns Precisely, Optional: Function Patterns, Exceptions, Tail Recursion, Accumulators for Tail Recursion, Perspective on Tail Recursion

UNIT 3 **9 hours**

Introduction to First Class Functions, Functions as Arguments, Polymorphic Types and Functions, Anonymous Functions, Unnecessary Function Wrapping, Map and Filter, Generalizing Prior Topics, Lexical Scope, Lexical Scope and Higher-Order Functions, Why Lexical Scope, Closures and Recomputation, Fold and More Closures, Closure Idiom: Combining Functions, Closure Idiom: Currying, Partial Application, Currying Wrapup, Mutable References, Closure Idiom: Callbacks, Standard-Library Documentation, Abstract Data Types With Closures, Closure Idioms Without Closures, Java Without Closures, C Without Closures

UNIT 4 **7 hours**

Section Introduction, What is Type Inference, ML Type Inference, Type Inference Examples, Polymorphic Examples, The Value Restriction and Other Type-Inference Challenges, Mutual recursion

UNIT 5 **9 hours**

Modules for Namespace Management, Signatures and Hiding Things, A Module Example, Signatures for Our Example, Signature Matching, An Equivalent Structure, Another Equivalent Structure, Different Modules Define Different Types, Equivalent Functions, Standard Equivalences, Equivalence vs Performance.

References:

1. Programming Languages, Part A; University of Washington, Coursera.
2. Structure and Interpretation of Computer Programs by Gerald Jay Sussman and Hal Abelson https://mitpress.mit.edu/sicp/full-text/book/book.html

Course Outcomes:

Upon successful completion of the course, students will be able to

16. List out the basic components of a programming language. (L1)
17. Analyze a given programming language for its effectiveness.(L4)
18. Design programs using functional programming languages. (L5)
19. Compare and contrast different types of programming language paradigms. (L4)
20. Build robust and effective software. (L4)

APPROVED IN:
BOS :<< 09-06-2023 >> ACADEMIC COUNCIL: 27 <<06-07-2023>>

SDG No. & Statement:

SDG Justification:

CSEN3351	Building a Modern Computer from First Principles	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	CSEN2011: Computer Organization and Architecture						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course will help the student to build a modern computer system from basic building blocks. It has hands-on projects that will advance the student from constructing basic elementary logic gates to creating a fully functioning general purpose computer.

Course Educational Objectives:

- Building elementary logic gates like And, Or, Not, Multiplexor etc.
- Building a family of adder chips, culminating in the construction of an Arithmetic Logic Unit (ALU)
- Building registers and memory units, culminating in the construction of a Random Access Memory (RAM)
- Learning a machine language and using it to write some illustrative low-level programs.
- Developing an assembler, i.e. a capability to translate programs written in symbolic machine language into binary, executable code.

UNIT 1 Course introduction and overview 8 hours

Introduction of Boolean algebra, and Boolean functions which can be physically implemented using logic gates. Gates and chips using a Hardware Description Language (HDL), simulate the behavior of the resulting chip specifications using a hardware simulator.

UNIT 2 Boolean Arithmetic and the ALU 8 hours

Build a family of adders -- chips designed to add numbers,Build an Arithmetic Logic Unit, The ALU, which is designed to perform a whole set of arithmetic and logical operations, binary numbers and CPU.

UNIT 3 Memory 8 hours

Memory Management, Sequential Logic, FlipFlops, Memory Units, Different Types of Counters, Project

UNIT 4 Machine Language 8 hours

Machine Languages: Overview, Elements, The Hack Computer and Machine language, Language Specifications, Input/ Output, Hack Programming, Project .

UNIT 5 Computer Architecture and Assembler 8 hours

Von Neumann architecture then the fetch and execute cycle CPU, Hack computer project

Assembly language and assemblers, hack assembly language, assembly process instructions, symbols, developing hack assembler, project

References:

1. https://www.coursera.org/learn/build-a-computer
2. Noam Nisan and Shimon Schocken, "The Elements of Computing Systems: Building a Modern Computer from First Principles" , Second Edition.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Specify gates and chips using a Hardware Description Language (HDL) (L1)
2. Build an Arithmetic Logic Unit(L4).
3. Build computer's main memory unit -RAM(L4)
4. Apply machine language applications with input output instructions. (L4)_
5 Understand and apply assembly language to build a new architecture (L4)

APPROVED IN:
BOS :<< 09-06-2023 >> ACADEMIC COUNCIL: 27 <<06-07-2023>>

SDG No. & Statement:

SDG Justification:

CSEN4001	IOT ARCHITECTURES AND PROTOCOLS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**CSEN2021: Computer Networks**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course aims to provide a basic understanding of the current architectures and protocols that make up the Internet of Things (IoT). It first starts with a discussion of two standardized IoT reference models - oneM2M and IoTWF, followed by the introduction of a simplified architectural model. The "things" in IoT are then defined, leading to the introduction of the various access technologies for IoT. Popular network and application layer protocols for IoT are discussed, followed by a brief introduction to IoT data analytics.

Course Educational Objectives:

- To introduce to the student the popular IoT reference models.
- To acquaint the student with the challenges in and solutions for IoT network access.
- To enable the student to examine the feasibility of IP for IoT, leading to a study of optimization of IP for IoT.
- To expose the student to the popular application protocols for IoT with application development in view.
- To familiarize the student with the basics of data and analytics for IoT.

UNIT 1 Introduction to IoT, IoT Network Architecture Architectures 7 hours, P- 2 hours

What is IoT?: Genesis of IoT, IoT and digitization, IoT impact, IoT challenges.
IoT Network Architecture and Design: Drivers behind new network architectures, Comparing IoT architectures, A simplified IoT architecture. OneM2M and IoTWF architectures.

UNIT 2 Smart Objects and Connecting Smart Objects 9 hours, P- 4 hours

Smart Objects: The things in IoT: Sensors, actuators and smart objects, Sensor networks.
Connecting Smart Objects: Communications Criteria, IEEE 802.15.4 - Standardization and Alliances, Physical Layer, MAC Layer, Topology, Security. IEEE 802.15.4g and 802.15.4e - Topology, IEEE 1901.2a - Topology, IEEE 802.11ah - Topology. LoRAWAN - Topology. NB-IoT and other LTE variations.

UNIT 3 IP as the IoT Network Layer 9 hours, P- 4 hours

The business case for IP: The key advantages of IP, Adoption or Adaptation of IP.
The need for optimization: Constrained nodes, Constrained Networks, IP versions.
Optimizing IP for IoT: From 6LoWPAN to 6Lo, Header compression, Fragmentation, Mesh addressing, Mesh-under vs Mesh-over routing. 6TiSCH
RPL: Objective Function, Rank, RPL Headers, Metrics,

UNIT 4 Application Protocols for IoT 9 hours, P - 4 hours

The Transport Layer
IoT Application Transport Methods: Application layer protocol not present, SCADA, Adapting SCADA for IP, Tunneling legacy SCADA over IP networks. Generic Web-based protocols. IoT Application Layer Protocols, CoAP, MQTT.

UNIT 5 Data and Analytics for IoT 10 hours

An introduction to data analytics for IoT: Structured vs Unstructured Data, Data in motion vs data at rest, IoT data analytics overview, IoT data analytics challenges.
Machine Learning: Machine Learning overview, Supervised Learning, Unsupervised learning, Neural Networks, Machine Learning and getting intelligence from Big Data. Predictive analytics.
Big data analytics tools and technology: Massively parallel processing databases, NoSQL databases, HADOOP.
Edge streaming analytics: Comparing Big Data and Edge Analytics, Edge Analytics Core Functions, Distributed Analytics Systems.

Suggested list of experiments:
The following simulation experiments are to be carried out using ns-3, TOSSIM, COOJA or MATLAB.

1) Create a simple network with ten nodes in a linear topology. Plot the average energy spent and packet delivery ratio (PDR, end-to-end) when the simulation is run for 500 seconds for two different transmission radii. Use standard protocols at the different layers.
2) Create a small network with a tree topology (the sink at the root) and static nodes. Run the simulation for 500 seconds and examine the node energy spent and packet delivery ratio spent for transmitting data:
    a) To the sink from the leaf nodes.
    b) To the leaf nodes from the sink.
3) Create a small network with mobile sensor nodes. Any standard mobility pattern can be used. Trigger transmissions with random sources and destinations and plot the average energy spent and PDR. Use standard MAC and routing protocols.

4) Repeat the experiment in (2) using IEEE 802.15.4 at the MAC level.
5) Repeat the experiment in (2) with using 6LoWPAN for routing.
6) Repeat the experiment in (2) using IEEE 802.11 at the MAC and physical level and 6LowPAN and RPL for routing.
7) Repeat the experiment in (2) using the IETF 6TiSCH protocol stack.
8) Create a small network with two end nodes that communicate data via an edge node to a server. The link from the end nodes to the edge node is a wireless link while the link from the edge node to the server is a wired link. Capture the packets at the edge node and the server and report the PDR at these two nodes.

Textbooks:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017

References:

1. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.
2. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016.

Journal(s):

1. X. Vilajosana, T. Watteyne, T. Chang, M. Vučinić, S. Duquennoy and P. Thubert, "IETF 6TiSCH: A Tutorial," in IEEE Communications Surveys & Tutorials, vol. 22, no. 1, pp. 595-615, First quarter 2020, doi: 10.1109/COMST.2019.2939407.

2. RPL: IPv6 routing protocol for low-power and lossy networks. (Accessed on 20/11/2019). [Online] Available: https://tools.ietf.org/html/rfc6550.

Website(s):

1. https://www.ietf.org/proceedings/94/slides/slides-94-rtgarea-2.pdf

2. https://www.thethingsnetwork.org/docs/lorawan/architecture/

3. https://datatracker.ietf.org/doc/html/rfc7252
4. https://mqtt.org/
5. https://www.onem2m.org/

Course Outcomes:

After successful completion of the course the student will be able to:

1. Distinguish between different IoT network architectures.

2. Experiment with various access technologies for IoT.

3. Analyze the difference between protocol design at the network, transport and application layers for IoT and that for the Internet.

4. Select the appropriate IoT protocol at the network and application layers for a given application.

5. Build end-to-end IoT applications that may include IoT data analysis.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2								2		
CO2	2	3	1	1	2								2		
CO3	2	3	1	3	2							3	1		2
CO4	2	2	1	3	2								2		3
CO5	2	2	1	3	2								2		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG7 (Affordable and Clean Energy): This course teaches the protocols and architectures for the Internet of Things (IoT). A crucial application in the IoT is the Smart Grid, which results in efficient usage of energy resources. This results in reduced energy costs and carbon footprint.

SDG11 (Sustainable Cities and Communities): This course deals with the protocols and architectures for development of applications such as Smart Transportation, Smart Water and Waste Management, Smart Infrastructure and Utilities etc. These applications can be leveraged for the development of sustainable cities and communities.

SDG Justification:

CSEN4011	CLOUD-BASED IOT	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	CSEN4001: IoT Architectures and Protocols						
Co-requisite	None						
Preferable exposure	None						

Course Description:

IoT requires several enabling technologies due to the volume of data and diverse application requirements. Distributed computing in the form of cloud, fog or edge computing is one such enabler of IoT. This course provides the basic principles of cloud computing, cloud computing architecture, cloud native application development and deployment, with a focus on IoT applications. It also discusses the importance of fog and edge computing in IoT networks. Example fog and edge middleware and its working are covered, together with the use cases of health monitoring, smart surveillance and smart transportation.

Course Educational Objectives:

- To introduce the basic principles of cloud computing, cloud native application development and deployment, containerization, micro-services and application scaling.
- To equip the students to understand major industry players in the public cloud domain for application development and deployment.
- To establish the importance of the fog, edge and cloud hierarchy.
- To familiarize the student with fog and edge middleware.
- To enable the student to develop IoT applications using fog, edge or cloud computing where appropriate.

UNIT 1 Introduction to Cloud Computing 9 hours, P - 4 hours

Introduction to Cloud Computing: Definition, Characteristics, Components, Introduction to Microsoft Azure, Cloud provider, SAAS, PAAS, IAAS and other Organizational scenarios of clouds. Case Study: Google Cloud.

UNIT 2 Cloud Computing for IoT 9 hours, P - 3 hours

Role of Cloud Computing in IoT – AWS Components – S3 – Lambda – AWS IoT Core - Connecting a web application to AWS IoT using MQTT- AWS IoT Examples.

UNIT 3 IoT and New Computing Paradigms 9hours

Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Advantages of FEC: SCALE, How FEC Achieves These Advantages: SCANC, Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges

UNIT 4 Middleware for Fog and Edge Computing 9 hours, P - 3 hours

Introduction, Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures.

UNIT 5 Fog/Edge-based IoT Applications 8 hours, P - 4 hours

Exploiting Fog Computing in Health Monitoring: Introduction, An Architecture of a Health Monitoring IoT-Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, System Implementation Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking: Introduction, Human Object Detection, Object Tracking, Lightweight Human Detection,

Fog Computing Model for Evolving Smart Transportation Applications: Introduction, Data-Driven Intelligent Transportation Systems, Mission-Critical Computing Requirements of Smart Transportation Applications, Fog Computing for Smart Transportation Applications.

Suggested list of experiments:

The following simulation experiments are to be carried out using ns-3, TOSSIM, COOJA or MATLAB.

1) Create a simple network with ten nodes in a linear topology. Plot the average energy spent and packet delivery ratio (PDR, end-to-end) when the simulation is run for 500 seconds for two different transmission radii. Use standard protocols at the different layers.

2) Create a small network with a tree topology (the sink at the root) and static nodes. Run the simulation for 500 seconds and examine the node energy spent and packet delivery ratio spent for transmitting data:

a) To the sink from the leaf nodes.

b) To the leaf nodes from the sink.

3) Create a small network with mobile sensor nodes. Any standard mobility pattern can be used. Trigger transmissions with random sources and destinations and plot the average energy spent and PDR. Use standard MAC and routing protocols.

4) Repeat the experiment in (2) using IEEE 802.15.4 at the MAC level.

5) Repeat the experiment in (2) with using 6LoWPAN for routing.

6) Repeat the experiment in (2) using IEEE 802.11 at the MAC and physical level and 6LowPAN and RPL for routing.

7) Repeat the experiment in (2) using the IETF 6TiSCH protocol stack.

8) Create a small network with two end nodes that communicate data via an edge node to a server. The link from the end nodes to the edge node is a wireless link while the link from the edge node to the server is a wired link. Capture the packets at the edge node and the server and report the PDR at these two nodes.

TextBooks:

1. “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, by Pethuru Raj and Anupama C. Raman, CRC Press.

Fog and Edge Computing: Principles and Paradigms, Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), Wiley Series on Parallel and Distributed Computing. ISBN: 978-1-119-52498-4
Adrian McEwen, Designing the Internet of Things, Wiley, 2013.

References:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things – A Hands on Approach”, Universities Press, 2015.
2. Kevin, Townsend, Carles, Cufí, Akiba and Robert Davidson, “Getting Started with Bluetooth Low Energy” O'Reilly

Journal(s):

1. Sabireen H., Neelanarayanan V., “A Review on Fog Computing: Architecture, Fog with IoT, Algorithms and Research Challenges”, ICT Express, Volume 7, Issue 2, 2021, Pages 162-176, ISSN 2405-9595,

2. Partha Pratim Ray, “A survey of IoT cloud platforms”, Future Computing and Informatics Journal, Volume 1, Issues 1–2, 2016, Pages 35-46, ISSN 2314-7288,

3. Alessio Botta, Walter de Donato, Valerio Persico, and Antonio Pescapé. 2016. Integration of Cloud computing and Internet of Things. Future Gener. Comput. Syst. 56, C (March 2016), 684–700. DOI:https://doi.org/10.1016/j.future.2015.09.021

4. P. Pierleoni, R. Concetti, A. Belli and L. Palma, "Amazon, Google and Microsoft Solutions for IoT: Architectures and a Performance Comparison," in IEEE Access, vol. 8, pp. 5455-5470, 2020, doi: 10.1109/ACCESS.2019.2961511.

Website(s):

1. https://docs.aws.amazon.com/greengrass/index.html
2. https://aws.amazon.com/iot/
3. https://cloud.google.com/docs/get-started
4. https://azure.microsoft.com/en-in/free/iot/
5. https://github.com/Cloudslab/iFogSim

Course Outcomes:

After successful completion of the course the student will be able to:

1. Distinguish between fog, edge and cloud computing.
2. Explain the basics of cloud computing.
3. Develop IoT applications using AWS IoT.
4. Choose the best fog/ edge computing middleware for a given IoT application .
5. Develop IoT applications using fog, edge and cloud computing as necessary.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2											2		
CO2	1	3	2	3	2								2	1	
CO3	1	3	2	3	2							1	1	1	3
CO4	1	2	2	3	2							1	1		3
CO5	1	2	2	3	2							1	1		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG7 (Affordable and Clean Energy): This course teaches creation of cloud-based IoT applications. This has a two-fold effect on energy –

- it enables Smart Grid application development, which results in efficient usage of energy resources and
- cloud computing results in reduced energy costs and carbon footprint compared to on-site computing and storage of data.

SDG11 (Sustainable Cities and Communities): Applications such as Smart Transportation, Smart Water and Waste Management, Smart Infrastructure and Utilities etc. generate a large amount of data, which needs to be stored and/or processed - sometimes in real time. The Cloud-based IoT course teaches how such applications can use the cloud for storing and processing such data, ultimately leading to digital solutions for sustainable cities and communities.

SDG Justification:

CSEN4021	AUGMENTED REALITY - VIRTUAL REALITY- BASIC	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The objective of this course is to mainly establish and cultivate a broad and comprehensive understanding of this rapidly evolving and commercially viable growing field of Computer Science. Augmented Reality and Virtual Reality technologies are really hitting the ground right now and are the buzz words among the technical communities. With these methods, the businesses are trying to get their brands to a whole new level of success and popularity. Integrating AR/VR in Education can increase the experience of learning, in medicine, increases of experience of understanding, in engineering, increases the experience of visualization, in business, increases the In-User Engagement, Boost In Brand Loyalty, Mobility, Better Advertising of products and many more.

Course Educational Objectives:

- To provide an understanding of Mixed reality and the cause for its origins
- To give a practical understanding of Virtual Reality with an immersive Experience
- To provide a practical understanding of Augmented Reality with the available devices
- To make aware of necessary hardware and software to develop AR/VR applications and to enable in attaining skills for using hardware and software.
- To pave a way to analyse the existing AR/VR applications as case studies and create some new applications.

UNIT 1 Introduction to Mixed Reality (MR) 8 hours, P - 8 hours

Introduction: A Glance of Mixed reality technology, use cases of mixed reality technologies that combines Augmented Reality and Virtual Reality

Human factors: Introduction to the eye the ear and somatic senses, human visual system, the human auditory system, the huma vestibular system

Hardware: Introduction to MR Hardware, sensor hardware, head-coupled displays, acoustic hardware, integrated VR Systems

Software: Introduction to Modelling Virtual world, Physical simulation, VR toolkits, working with blender, working with Mesh-room and introduction to Unity

Exercises:

- Assignment and Presentation Regarding Human Factors in VR
- Experience the Working of Hardware with a Prebuild VR and AR Apps
- Make a note on VR Toolkits
- Rendering the virtual object by importing the file created by Meshroom
- Meshing an existing Physical object into a virtual object using Meshing (Chapter – 1) of Text book 1

UNIT 2 Introduction to Virtual Reality (VR) 6 hours, P - 6 hours

Introduction to Virtual Reality: Fundamentals of VR, Types of VR, current VR Technologies, Benefits Disadvantages: VR Health and safety issues, Effects of VR simulations on Users, Cybersickness before and now, Guidelines for proper VR Usage

VR Aspects : Similarities between interactive and passive VR, Demo Sample showcase of VR and 360 Video

Exercise:

- Create a sample 360 degree video for VR on Campus
- Develop a small scene which is Virtual (Photo Gallery)(Chapter – 2) of Text book 1

UNIT 3 Insights into Virtual Reality 6 hours, P - 6 hours

Design Process : UI and UX design for VR

Psychology of VR interaction: Adaptation and artefacts, Ergonomics and ethics

Tracking: Outside-in Vs Inside out tracking

Exercises:

1. Surface-Less Inputs - How deep did the user press? Where in space are they targeting? Do you have fixed or dynamic depth? How far out is the object of interaction?
2. Multiple inputs - visual, track with eye movement, thumb controls, reach-depth, speech recognition, head-tilt gestures, and a whole lot more.
3. Shared Experience
4. Experience Apps for in sensor tracking and experience Kinect and Leap Motion sensors to track from outside (Chapter – 2) of Text book 1

UNIT 4 Introduction to Augmented Reality 6 hours, P - 6 hours

Introduction to Augmented Reality: AR Standards, Libraries and Middleware, Limitations, Similarities and differences between Augmented Reality and Mixed Reality

AR Aspects: Types of AR, Marker Based AR, Marker-less based AR and QR based AR tracking. Chapter 3) for Text Book 2

UNIT 5 Mixed Reality in Education - Applications 4 hours, P - 4hours

Virtual Reality in Education-VR Applications for Primary schools high schools, in-service professional training, Augmented Reality in Education-AR Applications for Primary schools high schools, in-service professional training. (Chapter 4) of Text Book 1

Textbooks:

1. Zeynep Tacgin, Virtual and Augmented Reality: An Educational Handbook , Cambridge Scholars, 2020, ISBN (10): 1-5275-4813-9

2. Pangilinan, Erin, Steve Lukas, and Vasanth Mohan. Creating augmented and virtual realities: theory and practice for next-generation spatial computing. " O'Reilly Media, Inc.", 2019.

References:

1. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley 2016

2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

Course Outcomes:

1. know how AR/VR systems work and the applications of VR

2. understand the design and implementation of the hardware that enables AR/VR systems to be built

3. understand the system of human vision and its implication on perception and rendering

4. apply the concepts of motion and tracking in AR/VR systems

5. build applications based on understanding the importance of interaction and audio in AR/VR systems

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN4031	BLOCKCHAIN TECHNOLOGY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**CSEN2071: Cryptography and Network Security**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

The course enables learners to grasp the concepts of Blockchain Technologies underlying cryptocurrency creation, smart contracts, transactions, storage, verification mechanisms. Cryptography foundation and consensus algorithms for creation of blockchains are elaborated in the course. Bitcoin, Etherium protocols are introduced with practice. Transformation of traditional businesses with blockchains is illustrated through examples.

Course Educational Objectives:

- Understand concepts of blockchain technology
- Acquire knowledge of bitcoin, Etherium protocols
- Learn to program and implement Blockchain
- Develop blockchain applications
- Analyse blockchain use cases

UNIT 1 Blockchain Fundamentals 9hours

Tracing blockchain Origin: The Double Spend problem, Byzantine Generals' Computing Problems.Blockchain concepts: How Blockchain works, Centralization vs. Decentralization, Distributed Consensus, Consensus without identity using a blockchain, Incentives and proof of work, Cryptocurrency, NFTs, Mining.

Types of blockchains: Public Blockchain, Private Blockchain, Semi-Private Blockchain, Sidechains. Blockchain Vulnerabilities.

Lab: Blockchain Case study analysis (identification and learning of tools for blockchain implementation) Creation of sample blocks to understand blockchain concepts.

- How Blockchain Works: https://andersbrownworth.com/blockchain/
- Build a Blockchain in Python: https://www.activestate.com/blog/how-to-build-ablockchain-in-python

UNIT 2 Cryptography and types of consensus algorithms for Blockchain 9 hours

Cryptographic Hash Functions, SHA256, Hash Pointers and Data Structures, Merkle tree, Distributed Ledger.

Types of Consensus Algorithms: Proof of Stake, Proof of Work, Delegated Proof of Stake, Proof of Elapsed Time.

Lab: Generate Hash Using Hash function, Working of Distributed Ledger, Working of Blockchain Transaction, Create Blockchain Network. Explore consensus mechanisms Using the Basic Blockchain, students can implement some projects on top of it. https://www.activestate.com/blog/how-to-build-a-blockchain-in-python/

UNIT 3 Bitcoin Blockchain 9 hours

Bitcoin Blockchain: Structure, Operations, Features, Consensus Model, Incentive Model: How does Bitcoin work? What makes Bitcoin different? How secure are Bitcoins? Mechanics of Bitcoin: Bitcoin transactions, Bitcoin Scripts, Bitcoin network, Bitcoin Mining, Bitcoin Wallets.

Cryptocurrency Regulations

Lab: Understand/ Install a Software Wallet, Generate a Paper Wallet/Web Wallet, Review and Analyse a Bitcoin Block on Explorer, Analyse a Bitcoin Transaction, Understand/ conduct a Transaction Using Electrum Wallet

UNIT 4 Ethereum Blockchain and DApps 9 hours

Etherium Blockchain: Smart Contracts: Definition and Need, Features of Smart Contracts, Life Cycle of a Smart Contract; Ethereum Structure, Operations, Consensus Model, Incentive Model Introduction to Ethereum Higher-Level Languages, DApps: Distributed Application development.

Lab: Building A Simple Smart Contract with Solidity, Solc-Compiler, Ethereum Contract ABI, RemixIDE for Smart Contract Development.

(Or using Viper - Smart Contracts in Vyper: https://vyper.readthedocs.io/en/stable/

Learn Vyper: https://learnxinyminutes.com/docs/vyper/

Vyper Examples: https://github.com/vyperlang/vyper/tree/master/examples)

UNIT 5 Open source Blockchains, Use cases of Blockchain 9 hours

Traditional Blockchain Challenges: Security, Performance perspectives.

Introduction to Hyperledger (Linux Foundation), NFTs New generation blockchain platforms: Solana, Flow, Avalanche, Cosmos, Polkadot, Corda, Openchain, Multichain blockchains

Block Chain Use cases in Healthcare, Government, Finance, Supply Chain, Food traceability, Water Management

Lab: Decentralized app creation: Creating a Hospital Smart Contract / Banking application/ any other domain specific smart contract

TextBooks:

1. Manav Gupta, BlockChain for dummies, 2nd IBM Limited Edition, Published by John Wiley & Sons, Inc, 2018.

2. Andreas M. Antonopoulos, Mastering Bitcoin: Programming the Open Blockchain, O'Reilly Media, 2/e, 2017.

3. Andreas Antonopoulos and Gavin Wood Mastering Ethereum: Building Smart Contracts and Dapps Shroff Publisher/O’Reilly Publisher, 2018

4. Imran Bashir, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, Packt Publishing (2017).

References:

1. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 1/e, 2015.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, 2016.
3. Kirankalyan Kulkarni, Essentials of Bitcoin and Blockchain, Packt Publishing. 2018
4. Tiana Laurence, Blockchain for Dummies, 2nd Edition, John Wiley & Sons, 2019
5. Anshul Kaushik, Block Chain & Crypto Currencies, Khanna Publishing House, 2018

Coursera Courses:

1. https://www.coursera.org/learn/blockchain-evolution-and-technology-concepts/home/info
2. https://www.coursera.org/learn/introduction-blockchain-technologies/home/week/1
3. https://www.coursera.org/learn/blockchain-basics/home/week/1
4. https://www.coursera.org/learn/decentralized-apps-on-blockchain/home/week/1
5. https://www.coursera.org/learn/blockchain-platforms/home/week/1
6. https://www.coursera.org/learn/smarter-contracts/home/week/1
7. https://www.coursera.org/learn/blockchain-basics/home/week/3

Website(s):

1. https://nptel.ac.in/courses/106105184/
2. Introduction to Blockchain Technology and Applications,
3. https://swayam.gov.in/nd1_noc20_cs01/preview
4. https://www.edx.org/course/blockchain-and-fintech-basics-applications-andlimitations

Course Outcomes:

After successful completion of the course the student will be able to:

1. Distinguish between different types of blockchain platforms.
2. Understand the working and importance of smart contracts.
3. Develop blockchain based application.
4. Apply blockchain technology to provide solutions to some real-life problems.
5. Understand the security and performance perspective of blockchain technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3	1	2	1	1	1	1	2	2	1	1
CO2	3	3	3	2	3	1	1	1	2	1	1	2	2	2	3
CO3	3	3	3	3	3	3	2	2	1	1	1	3	3	3	1
CO4	3	3	3	2	3	3	2	1	2	1	1	2	1	2	3
CO5	2	2	1	2	3	3	1	1	2	1	1	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN4041	CLOUD SECURITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**CSEN2121: Cloud Computing**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course will provide a foundational understanding of what is required to secure a cloud ecosystem, regardless of the vendor. The concepts and principles discussed will help bridge the gaps between traditional and cloud security architectures while accounting for the shifting thought patterns involving enterprise risk management.

Course Educational Objectives:

- Understand fundamental cloud computing concepts and deployment models.
- Understand the foundational security practices that are required to secure modern cloud computing infrastructures.
- Understand the security risks involved in the cloud environment.
- Learn how attempt is made to resolve the challenges in the cloud environment.
- Understand the Cloud Security Architecture and Design patterns.

UNIT 1 Introduction to Cloud 9 hours

Introduction to Cloud: Cloud Delivery Models, Cloud Deployment Models, Cloud Computing Software Security Fundamentals: Cloud Information Security, Objectives, Cloud Security Service

UNIT 2 Cloud Security Principles in all steps 9 hours

Cloud Security Principles in all steps: Cloud Security Design Principles, Secure Cloud, Software Requirements, Approaches to Cloud Software Requirements Engineering,Cloud Security Policy Implementation and Decomposition, Secure Cloud Software Testing, Cloud Penetration Testing

UNIT 3 Dielectric and Magnetic Materials 9 hours

Cloud Computing Risk Issues: The CIA Triad, Privacy and Compliance Risks, Common Threats and Vulnerabilities, Cloud Access Control Issues, Cloud Service Provider Risks

UNIT 4 Cloud Computing Security Challenges 9 hours

Cloud Computing Security Challenges: Security Policy Implementation, Policy Types, Computer Security Incident Response Team (CSIRT), VM Security Recommendations

UNIT 5 Cloud Computing Security Architecture and Design patterns 9 hours

Cloud Computing Security Architecture and Design patterns, Architectural Considerations, Trusted Cloud Computing, Secure Execution Environments and Communications, Identity Management and Access Control, Autonomic Security, Introduction to Design Patterns, Security Patterns for Cloud Computing

Textbooks:

1. Ronald L. Krutz Russell Dean Vines , Cloud Security - A Comprehensive Guide to Secure Cloud Computing Published by Wiley Publishing, Inc.

2. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler (Syngress/Elsevier)

References:

1. Chris Dotson, Practical Cloud Security: A Guide for Security Design and Deployment, Published by O'Reilly, 1st Edition.
2. John Vacca, Cloud Computing Security: Foundations and Challenges, 2nd Edition CRC Press.
3. Cloud Computing Design Patterns by Thomas Erl (Prentice Hall)

Coursera Courses:

1. https://www.coursera.org/programs/gitam-coursera-program-for-faculty-p4k5n/browse?authProvider=gitam&productId=QIr8oto9EeeMQhJSb7VrRg&productType=s12n&query=cloud+security&showMiniModal=true&source=search

2. https://www.coursera.org/programs/gitam-coursera-program-for-faculty-p4k5n/browse?authProvider=gitam&productId=QNj1YNo9EeeH8g6KA-0xng&productType=course&query=cloud+security&showMiniModal=true&source=search

Journal(s):

1. https://www.sciencedirect.com/science/article/abs/pii/S1084804516302983

2. https://ieeexplore.ieee.org/abstract/document/5283911?casa_token=7GPyS-RR8h0AAAAA:qRujNSSEyTQiqoFKYyCSz9DHYsB_l-_6Zo6o99X4FREr04eR9YxdpGK4hwjAXttdyQOM3P6wfA

3. https://ieeexplore.ieee.org/abstract/document/6141247?casa_token=KZF3akfvovIAAAAA:xUQUuYnpCNOAECJ_V-G3zvpXx6rHZHOi-10EKTiXdGWT9zBmhAup93LDaScQX9uUDsmUdCthig

4. https://www.ibm.com/in-en/topics/cloud-

security#:~:text=Cloud%20security%20is%20a%20collection,as%20part%20of%20their%20infrastructure

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the basic principles and deployment models of cloud.
2. Understand how to protect data-at-rest, data-in-transit, and data-in-use within a cloud environment.
3. Understand standard cloud security network designs and architecture models.
4. Understand the complexity of cloud threat actors and techniques used to attack a cloud computing infrastructure
5. Understand the regulatory requirements needed to secure data in the cloud and the difficulties in meeting those requirements.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1									2		1
CO2	3	2	1	1	1	1	1	2		1	2	2	2	1	2
CO3	2	2		1	1	1		1				2	1		
CO4	3	3	1	3	1	2	1	2	1		2	2	2	2	3
CO5	3	2	1		1						1	2	1		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 9: Building a better security infrastructure provides resilient networks and promotes inclusive and sustainable industrialization

SDG Justification:

CSEN4051	EDGE COMPUTING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Computer Networks						
Co-requisite	None						
Preferable exposure	IoT and Cloud Computing						

Course Description:

This course is to provide students with a strong foundation in the Edge Computing and enabling them to become proficient in designing, implementing, and securing edge computing solutions. The course aims to equip students with the necessary skills to address the challenges and opportunities presented by edge computing and contribute to the development of innovative and efficient computing systems for various applications and industries.

Course Educational Objectives:

1. To Understand the Fundamentals of Edge Computing.
2. To familiarize with Edge Devices and Infrastructure.
3. To explore Edge Computing Technologies.
4. To understand Security and Privacy in Edge Computing.
5. To identify Edge Computing Applications and Future Trends.

UNIT 1 Introduction to Edge Computing 9 hours

Understanding Edge Computing: Definition and concept of edge computing, Evolution and history of edge computing, Benefits and advantages of edge computing over traditional cloud-based architectures

Comparison with Cloud Computing: Contrasting edge computing and cloud computing models, Use cases for edge computing and cloud computing, Complementary role of edge and cloud computing in distributed systems

UNIT 2 Edge Devices and Infrastructure 9 hours

Edge Devices: Internet of Things (IoT) devices and sensors, Edge servers and gateways

Mobile edge computing (MEC) devices

Edge Infrastructure: Edge data centers and micro data centers, Fog computing and its relation to edge computing, Edge network topologies and architectures

Designing Edge Computing Systems: Factors to consider in edge infrastructure design, Scalability, reliability, and redundancy in edge deployments, Edge orchestration and management platforms

UNIT 3 Edge Computing Technologies 9 hours

Communication Protocols for Edge Computing: MQTT, CoAP, AMQP, and other messaging protocols, HTTP/HTTPS and RESTful APIs in edge environments, 5G and its impact on edge computing

Edge Analytics and Machine Learning: Data processing and analytics at the edge, Real-time analytics and decision-making, Edge machine learning models and applications

Low-Latency Processing and Real-Time Applications: Importance of low-latency processing in time-critical applications, Edge computing for augmented reality (AR), virtual reality (VR), and gaming, Real-time data analysis in autonomous vehicles and robotics

UNIT 4 Security and Privacy in Edge Computing 9 hours

Security Challenges in Edge Computing: Edge devices as potential entry points for attacks, Securing communication between edge devices and data centers, Data integrity and confidentiality concerns.

Privacy and Compliance in Edge Computing: GDPR and data protection in edge environments, Balancing data collection and privacy requirements, Edge computing implications on data sovereignty

Encryption and Authentication in Edge Systems: Secure boot and device authentication,

Data encryption and decryption mechanisms, Identity and access management for edge devices

UNIT 5 Edge Computing Applications and Future Trends 9 hours

Real-World Use Cases of Edge Computing: Edge computing in industrial IoT and Industry 4.0, Healthcare applications and remote patient monitoring, Smart cities and edge-enabled urban infrastructure

Emerging Trends in Edge Computing: Edge-native applications and services, Edge computing in edge-cloud hybrid architectures, Serverless computing at the edge.

Challenges and Future of Edge Computing: Future of edge computing, Scalability and interoperability challenges, Edge computing as an enabler of emerging technologies.

Textbooks:

1. “Edge Computing: A Primer" by Nathan G. Evans and Limor Fix
2. Fog and Edge Computing: Principles and Paradigms" edited by Rajkumar Buyya, Satish Narayana Srirama, and Shadi Aljawarneh

References:

1. Perry Lea,” IoT and Edge Computing for Architects”-second edition, Packt, March,2020.
2. Mohiuddin Ahmed (Editor), Paul Haskell-Dowland (Editor), “Secure Edge Computing: Applications, Techniques and Challenges”, CRC press, first edition, August 2021.
3. Practical Industrial Internet of Things Security: A practitioner's guide to securing connected industries" by Sravani Bhattacharjee

Online Resources:

1. The OpenFog Consortium (https://www.openfogconsortium.org/) offers whitepapers and resources on fog and edge computing concepts and architectures.
2. IEEE Edge Computing Community (https://edgecomputing.ieee.org/) provides various resources, including articles, webinars, and technical papers on edge computing.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Demonstrate a clear understanding of the fundamental principles, concepts and importance of edge computing.
2. Design and deploy effective edge computing systems, considering factors such as edge devices, network topologies, scalability, reliability, and redundancy.
3. Apply edge computing technologies to process and analyze data at the edge, including implementing basic edge analytics and machine learning models for real-time applications.
4. Demonstrate proficiency in identifying security risks in edge computing environments and proposing appropriate security measures to protect edge devices and data.
5. Apply their knowledge to real-world use cases and industries, proposing innovative edge computing solutions to address specific challenges and requirements.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2			2												
CO3					3										
CO4								1							
CO5														3	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

SDG 9: Industry, Innovation, and Infrastructure

SDG Justification:

Edge computing can improve infrastructure and enable innovative solutions in various industries, such as manufacturing, transportation, and healthcare.

SDG No. & Statement:

SDG 11: Sustainable Cities and Communities

SDG Justification:

Edge computing can help in creating smart cities by enabling real-time data processing for traffic management, public safety, and resource utilization, contributing to more sustainable urban development.

SDG No. & Statement:

SDG 7: Affordable and Clean Energy

SDG Justification:

Edge computing can optimize energy consumption by processing data locally and reducing the need for data transmission to centralized data centers. This can contribute to energy efficiency and the use of clean energy sources.

CSEN4071	FUNDAMENTALS OF IOS SECURITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**CSEN1101: Operating Systems**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course will provide a foundational understanding of iOS security. The concepts discussed will help in understanding the vulnerabilities and ways to mitigate those vulnerabilities. This will help in designing secure iOS applications with minimal vulnerabilities.

Course Educational Objectives:

- Understand the security model of the iOS Applications.
- Understand the foundational security practices that are required to secure iOS Application.
- Understand the ways in which the iOS applications can be abused.
- Understand the techniques needed to mitigate the vulnerabilities in iOS Applications.

UNIT 1 The Ios Security Model 9 hours

IOS Security Model, Secure Boot, Limiting Access with the App Sandbox, Data Protection and Full-Disk Encryption, Native Code Exploit Mitigations: ASLR, XN, and Friends, Jailbreak Detection, How Effective Is App Store Review?, Key iOS Programming Terminology, Dissecting an Objective-C Program, How Objective-C Manages Memory

UNIT 2 Ios Application Anatomy 9 hours

IOS Application Anatomy, Dealing with plist Files, The Bundle Directory, The Data Directory, The Shared Directory. Building your test platform, Network and Proxy Setup, Xcode and Build Setup

UNIT 3 Debugging With Lldb And Friends 9 hours

Debugging With Lldb And Friends, Useful Features in lldb, Using lldb for Security Analysis, BLACK- BOX Testing, Installing Third-Party Apps, Reverse Engineering from Decrypted Binaries, Defeating Certificate Pinning, Hooking with Cydia Substrate, Automating Hooking with Introspy

UNIT 4 Ios-Targeted Web Apps 9 hours

IOS-Targeted Web Apps, Using (and Abusing) UIWebViews, Rewards and Risks of JavaScript-Cocoa Bridges, Enter WKWebView, DATA LEAKAGE, The Truth About NSLog and the Apple System Log, How Sensitive Data Leaks Through Pasteboards, Keylogging and the Autocorrection Database, Dealing with Sensitive Data in Snapshots, Leaks Due to State Preservation

UNIT 5 Legacy Issues And Baggage From C 9 hours

Format Strings, Buffer Overflows and the Stack, Integer Overflows and the Heap, INJECTION ATTACKS, Client-Side Cross-Site Scripting, SQL Injection, XML Injection

TextBooks:

1. David Thiel, iOS Application Security-The Definitive Guide for Hackers and Developers, No Starch Press,2016.

References:

1. Kunal Relan, iOS Penetration Testing-A Definitive Guide to iOS Security, Apress Publications,2017

2. Jonathan Zdziarski, Hacking and Securing IOS Applications, O'Reilly Media,2012

Course Outcomes:

After successful completion of the course the student will be able to:

1. Learn the fundamental security model of iOS.

2. Learn the basic structure and testbed of iOS.

3. Understand different kind of testing and debugging methodologies.

4. Understand the application abuses and data leakages by applications running on iOS.

5. Analyse the vulnerabilities through different kinds of injection attacks.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1								1		
CO2	2	1	1	1	1								1		
CO3	2	2	1	1	3								1		
CO4	3	2	1	1	2								1		
CO5	3	3	2	2	3								2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SGD 12: Cyber defense mechanisms ensure that no effect will be made to the industrial patterns

SDG Justification:

CSEN4081	GAME PROGRAMMING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**CSEN1011: Problem Solving and Programming with C**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

The main theme of the course on "Game Programming" is to provide an opportunity to obtain knowledge skills on foundations of basic needs of the graphic systems through different transformations and projections, understand the simulation and animation mechanisms, game engine architectures and support systems, Resources and file management systems, interface environments and then learn to build the logic of 2D and 3D gaming using different game programming tools such as DirectX, OpenGL, Python, Unity, Java 2D and 3D, C#, JavaScript and/or any other functional programming tool. At the end of this course, the team of student can develop 2D and/or 3D game using any of the game programming tools in an interactive environment for the development of Puzzle, AI based games by considering single, two-player or multi-player game agents.

Course Educational Objectives:

- Understand the game engine architecture and geometric modelling
- Understand the game development platforms and frameworks
- Use many software development tools for best practices
- Apply game logic and interface design, layout and event management
- Work on teams to develop 2D and 3D games using current game programming tools

UNIT 1 The Graphics System for Game Programming 9 hours

The Foundation, Transformations, Quaternion's, Geometry for 3D Engines, Ray Tracing, Lightening and Shading, Camera And Projections, Culling And Clipping, Character Animation, Physics-Based Simulation, Scene Graphs.

UNIT 2 Game Engine Design 9 hours

Game Engine Architecture- Introduction, Tools, Software Engineering for Games, Parallelism and Concurrent Programming, Engine Support Systems, Resources and File Systems, Game Loop And Real- Time Simulation, Human Interface Devices, Collision And Rigid Body Dynamics, Game Profiling.

UNIT 3 Game Programming 9 hours

Application Layer, Game Logic, Game Views, Managing Memory, Controlling The Main Loop, Loading And Ca Data, User Interface Management, Game Event Management.

UNIT 4 Game Platforms and Frameworks 9 hours

2D and 3D Game Development Using Flash, DirectX, Java, Python, Game Engines-DX Studio, Unity

UNIT 5 Game Development 9 hours

Developing 2D and 3D Interactive games using DirectX or Python-Isometric and Tile Based Games, Puzzle Games, Single Player Games, Multi Player Games.

Textbooks:

1. David J.Griffiths,“IntroductiontoElectrodynamics”,4/e, Pearson Education, 2014

2. Charles Kittel, “Introduction to Solid State Physics”, Wiley Publications, 2011.

3. Jason Gregory, “ Game Engine Architecture” , CRC Press/ A K Peters, 2009

4. Mike Mc Shaffrfy and David Rez Graham, “Game Coding Complete”, Fourth Edition, Cengage Learning, PTR, 2013

References:

1. Ernest Adam and Andrew Rollings, “Fundamentals of Game Design”, 2nd Edition Prentice Hall/ New Riders, 2009
2. Steve Rabin, Introduction to Game Development, Cenage Technology, 2009
3. David M Bourg & Glenn

Coursera Courses:

1. https://www.coursera.org/learn/game-design-and-development-1

Journal(s):

1. Saiqa Aleem, Luiz Fernando Capretz , Faheem Ahmed , 2016, “Game development software engineering process life cycle: a systematic review”, Journal of Software Engineering Research and Development volume 4, Article number: 6

Website(s):

1. https://jserd.springeropen.com/articles/10.1186/s40411-016-0032-7

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the graphics systems for game programming
2. Understand the Game design architecture, tools and Interface environments
3. Design game programming using different layers and interface environments
4. Apply game platforms and frameworks
5. Develop 2D and 3D interactive games using various functional programming tools

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					1							2		
CO2				2										2	
CO3		3	2												
CO4		2											2		
CO5			3									1		2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSEN4091	HUMAN COMPUTER INTERACTION	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides an introduction to the field of human-computer interaction (HCI).This course is an interdisciplinary field that integrates theories and methodologies from computer science, cognitive psychology, design, and many other areas. Students will work on both individual and team projects to design, implement and evaluate computer interfaces. The course is open to students from all disciplines, providing them with experience working in interdisciplinary design teams.Teams will be incrementally led through the phases of ethnographic study and requirements analysis, scenario-based design, paper prototyping, computer prototyping, and several methods of usability analysis and evaluation. This course involves exposure to current research in HCI, in order to provide students with an understanding of the range of issues to provide them with practice reading, presenting and critiquing HCI research, and to provide ideas for team projects and real time applications.

Course Educational Objectives:

- To learn the foundations of Human Computer Interaction.
- To become familiar with the design technologies for individuals and persons with disabilities.
- To be aware of software process and mobile HCI.
- To learn the guidelines for user interface.

UNIT 1 Importance of user Interface 9 hours

Definition, importance and Benefits of good design, brief history of Screen design, about interaction design: makeup of interaction design, working together as multidisciplinary team. The Human: I/O channels, Memory, Reasoning and problem solving; The Computer: Devices – Memory, processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements.

UNIT 2 Design and software process 9 hours

Interactive Design: Basics – process – scenarios – navigation – screen design, HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design Visually pleasing composition, presentation in formation simply and meaningfully, information retrievalon web, Technological consideration in interface design

UNIT 3 Models and Theories 9 hours

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT 4 HCI in the software process and mobile: 9 hours

The software lifecycle: Usability engineering, Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules .Evaluation techniques,Goals of evaluation.

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. – Case Studies

UNIT 5 Web interface design 9 hours

Designing Web Interfaces- Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow, Dynamaic web content and static web connect – Case Studies

TextBooks:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, —Human Computer Interaction, 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)

2. Brian Fling, —Mobile Design and Development, First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)

3. Bill Scott and Theresa Neil, —Designing Web Interfaces, First Edition, O'Reilly, 2009. (UNIT-V)

References:

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.
4. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
5. Human –Computer Interaction, Smith - Atakan, Cengage Learning

Coursera Courses:

6. Interaction Design (10% syllabus covered)
7. https://www.coursera.org/specializations/interaction-design
8. Design principals (10% syllabus covered)

Website(s):

9. https://www.tutorialspoint.com/human_computer_interface/human_computer_interface_introduction.htm
10. https://www.educative.io/blog/intro-human-computer-interaction

Course Outcomes:

After successful completion of the course the student will be able to:

1. Design effective dialog for HCI in software process
2. Design effective HCI for individuals and persons and Teams with disabilities.
3. Assess the importance of user feedback for different designs
4. Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.
5. Develop meaningful user interface as per the requirements

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3	3	3				3	3		3			
CO2	2	3		2	2				3	3		3			
CO3			3		2				3				3		
CO4			3	3					2			3			
CO5	3		3	3	2				3	3		2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGs: 10
Reduced inequality
Human Computer Interaction(HCI) a multidisciplinary research area focused on interaction modalities between humans and computers. An interdisciplinary field that integrates theories and methodologies from computer science, cognitive psychology, design, and many other areas.
HCI provide a quality of experience by ensuring that an interface is: useful, usable, desirable, findable, accessible, credible, and valuable.

SDG Justification:

CSEN4101	INFORMATION SECURITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course aims to present Information Security concepts to the students. This course offers a good understanding of the basics of information security and the security model. It provides knowledge about various Threats, Attacks, Legal, Ethical and Professional Issues. The course will present an overview of the risks encountered in information systems security, and the tools used for resolving these risks. This course also provides a few case studies of information security.

Course Educational Objectives:

- To know the concepts of Security services, threats, mechanisms, and attacks.
- To understand the role of security in the systems development life cycle.
- To know the aspects of risk management
- To know the technical aspects of information security
- To analyze security in cloud environment.

UNIT 1 Introduction to Information Security 9 hours

History, What is Information Security? Critical Characteristics of Information, CNSS Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, Approaches to Information Security Implementation, The Security in the SDLC, Security Principles, Security Services.

UNIT 2 The Need For Security 9 hours

Introduction, Business Needs, Threats-categories of Threat: Compromise to Intellectual property, Deviations in quality of services, Espionage or Trespass, Forces of nature, human error or failure, information extortion, Sabotage or Vandalism, Software attacks, Technical Hardware and Software failures, Technical obsolescence, Theft.
Deadly sins in software Security. Attacks-types of Attacks: Malware Infection, Theft, Bots, Insider abuse, Insider attack, unauthorized privilege escalation, password sniffing. Categories of attacks: Website defacement, financial fraud, exploit wireless networks, unauthorized Intellectual Property access, exploiting user social network profile.

UNIT 3 Security analysis 9 hours

Risk Management: An overview of Risk management, Identifying and Assessing Risk, Assessing and Controlling Risk – Systems: Access Control Mechanisms, Information Flow and Confinement Problem.

UNIT 4 Network Access Control and Cloud Security 9 hours

Network Access Control, Extensible Authentication Protocol, Cloud Computing and architecture, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service.

UNIT 5 Security Technologies 9 hours

Firewall and VPNs: Access Control, Firewalls, Protecting Remote Connections, Intrusion Detection and Prevention Systems-Security tools.

TextBooks:

1. Michael E Whitman and Herbert J Mattord, —Principles of Information Security, Cengage Learning, 6/e,2018.

2. William Stallings. Cryptography and Network Security – Principles and Practice, Pearson Education, 7/e, 2017.

References:

1. Micki Krause, Harold F. Tipton, "Handbook of Information Security Management", CRC Press LLC, 6e, 2012.
2. Atul Kahate, Cryptography and Network Security, Mc Graw Hill, 3/e, 2013.
3. Forouzan and Mukhopadhyay. Cryptography and Network Security, Mc Graw Hill, 3/e, 2015

Website(s):

4. 300+ Terrifying Cybercrime & Cybersecurity Statistics (2022) (comparitech.com)
5. https://www.comparitech.com/vpn/cybersecurity-cyber-crime-statistics-facts-trends/

Course Outcomes:

After successful completion of the course the student will be able to:

1. Identify the need of security mechanisms in an organization.
2. Illustrate various Threats and Attacks
3. Identify, manage, and control Risks
4. Demonstrate the functionalities of Security as a Service in Cloud
5. Apply access control mechanism and protect connections in a system.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1												
CO2	1	2	2	2											
CO3	2	1	2	1											
CO4	2	1	1	1											
CO5	1	1	2	2											

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 8: Cyber Security to society and industries will build up sustained economic growth with better profits for the industry and fewer losses to the humanity

SDG Justification:

CSEN4111	INTRUSION DETECTION AND PREVENTION SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	CSEN2021: Computer Networks						
Co-requisite	None						
Preferable exposure	None						

Course Description:

An Intrusion Detection System (IDS) is a system that monitors network traffic for suspicious activity and issues an alert when such activity is discovered. It is a software application that scans a network or a system for harmful activity or policy breaching. Any malicious venture or violation is normally reported either to an administrator or collected centrally using a security information and event management (SIEM) system. An Intrusion Prevention System is a network security application that monitors network or system activities for malicious activity. Major functions of intrusion prevention systems are to identify malicious activity, collect information about this activity, report it and attempt to block or stop it.

Course Educational Objectives:

- Provide knowledge on how to monitor networks from harmful sources.
- Learn different Intrusion Detection Systems for hosts and networks.
- Design a strong Intrusion Prevention system.
- Understand the different Intrusion Detection Systems architectures.
- Analyse the alerts and predict future attacks.

UNIT 1 Introduction to Intrusion 9 hours

Attack taxonomies – Probes – Privilege Escalation Attacks – DoS and DDoS Attacks – Active attacks – Passive attacks - Malicious Attacks – Insider Attacks – Sniffer Attacks – Side-Channel Attacks – Worm Attacks - Distributed Attacks - IDS types.

UNIT 2 Intrusion Detection Approaches and Systems 9 hours

Detection approaches – Misuse detection – anomaly detection – specification-based detection – hybrid detection Theoretical Foundations of Detection: Taxonomy of anomaly detection system – fuzzy logic – Bayes theory – Artificial Neural networks – Support vector machine – Evolutionary computation – Association rules – Clustering Learning Outcomes.

UNIT 3 Intrusion Detection and Prevention Technologies 9 hours

Host-based intrusion detection system (HIDS), Network-based IDS, Information Sources for IDS, Host and Network Vulnerabilities and Countermeasures. Intrusion detection techniques, misuse detection: pattern matching, rule-based and state-based anomaly detection: statistical-based, machine learning based, data mining-based hybrid detection.

UNIT 4 Intrusion Detection and Prevention Systems Architecture 9 hours

Tiered architectures, Single-tiered, Multi-tiered, Peer-to-Peer. Sensor: sensor functions, sensor deployment, and security. Agents: agent functions, agent deployment, and security. Manager component: manager functions, manager deployment, and security. Information flow in IDS and IPS, defending IDS/IPS, Case study on commercial and open-source IDS.

UNIT 5 Alert Management and Correlation Data fusion 9 hours

Alert correlation, Pre-process, Correlation Techniques, Post-process, and Alert Correlation architectures. Cooperative Intrusion Detection, Cooperative Discovery of Intrusion chain, Abstraction-based Intrusion Detection, Interest-based communication and cooperation, agent-based cooperation

Textbooks:

1. Ali A. Ghorbani, Wei Lu, “Network Intrusion Detection and Prevention: Concepts and Techniques”, Springer, 2010.

2. Earl Carter, Jonathan Hogue, “Intrusion Prevention Fundamentals”, Pearson Education, 2006.

References:

1. Carl Enrolf, Eugene Schultz, Jim Mellander, “Intrusion Detection and Prevention”, McGraw Hill, 2004.
2. Paul E. Proctor, “The Practical Intrusion Detection Handbook “,Prentice-Hall , 2001.
3. Ankit Fadia and Mnu Zacharia, “Intrusion Alert”, Vikas Publishing, Ltd, 2007.

Journal(s):

1. Denning, Dorothy E. "An intrusion-detection model." IEEE Transactions on software engineering 2 (1987): 222-232.
2. Azeez, Nureni Ayofe, et al. "Intrusion detection and prevention systems: an updated review." Data management, analytics and innovation (2020): 685-696.
3. Quincozes, Silvio E., et al. "A survey on intrusion detection and prevention systems in digital substations." Computer Networks 184 (2021): 107679.
4. Bace, Rebecca Gurley. Intrusion detection. Sam’s Publishing, 2000.
5. Wang, Zongjian, and Xiaobo Li. "Intrusion prevention system design." Proceedings of the International Conference on Information Engineering and Applications (IEA) 2012. Springer, London, 2013.

Website(s):

1. https://www.imperva.com/learn/application-security/intrusion-detection-prevention/
2. https://www.clearnetwork.com/top-intrusion-detection-and-prevention-systems/
3. https://www.vmware.com/topics/glossary/content/intrusion-prevention-system.html
4. https://www.gartner.com/reviews/market/intrusion-prevention-systems

Course Outcomes:

After successful completion of the course the student will be able to:

1. Interpret different types of attacks and Intrusion Detection Systems.
2. Analyse and apply data mining and machine learning approaches for detecting attacks.
3. Apply different intrusion detection techniques for host and network systems.
4. Determine IDPS architecture and deploy agent and manager components.
5. Predict the upfront attack by correlating the alerts.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3						1					1		
CO2			3	1		2		1					1		
CO3		3	2										2	2	
CO4	3		1			2		1					2	2	
CO5		2	3					1					3	2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG 8: Cyber Security to society and industries will build up sustained economic growth with better profits for the industry and fewer losses to the humanity

SDG Justification:

		L	T	P	S	J	C
CSEN4121	**IOT FOR INDUSTRIES**	**3**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	CSEN2021:Computer Networks						
Co-requisite	None						
Preferable exposure	None						

Course Description:

IoT for Industries course concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. The objective of this course is to make students aware of these latest technologies, their applications and to identify the future scope for a better manufacturing system.

Course objectives:

To provide students with basic knowledge on Industrial IoT systems.
To get an overview of Industry 4.0.
To understand various communication, connectivity, networking, data management challenges in industries.
To analyze industrial data using machine learning techniques.
To apply the IoT concepts in building solutions to Industrial problems.

Unit -1 **9 hours**

Overview of Internet of Things: Introduction, IoT Architecture, Application-based IoT Protocols, Cloud Computing, Fog Computing, Sensor Cloud, Big Data.

Learning Outcomes:
After completion of this module, the student will be able to:
Acquire the basic knowledge of the Internet of Things (IoT), architecture, and its protocols (L1).
Compare and analyze various protocols of IoT, which will help them to grasp the concepts of the Industrial Internet of Things (IIoT) (L3).
Describe the reasons for the shift of technology from the traditional methods to cloud, mobile cloud, fog computing and big data (L2).

Unit- 2 **9 hours**

Overview of Industry 4.0 and Industrial Internet of Things: Introduction to Industry 4.0: Industrial revolution: Phases of development, Evolution of Industry 4.0, Environmental impacts of Industrial revolution, Industrial Internet, Applications of Industry 4.0. **IIoT:** Prerequisites of IIoT, Basics of CPS, CPS and IIoT, Applications of IIoT, IIC, Industrial Internet Systems, Industrial Sensing, Industrial Processes.

Learning Outcomes:
After completion of this module, the student will be able to:
Understand the basic features of industry 4.0 and Industrial Internet of Things (IIoT) (L1).
Acquire knowledge of the Industrial Internet, Cyber-Physical system, and the interlink of IoT, CPS, and IIoT (L2).
Describe the application areas of IIoT and Industry 4.0 (L2).

Unit : 3 **9 hours**

Industrial Data Transmission: Introduction, Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modbus, Batibus, DigitalSTROM, Controller Area Network, DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and LoRaWAN, NB-IoT, IEEE 802.11AH. **Industrial Data Acquisition:** Introduction, Distributed Control System, PLC, SCADA.

Learning Outcomes:
After completion of this module, the student will be able to:
Explain various data transmission technologies in industrial environments (L2).
Explore the features of various industrial communication protocols (L3).
Acquire knowledge of industrial data acquisition systems (L2).

Unit : 4 **9 hours**

Introduction to IIoT Analytics: Introduction, IIoT Analytics: Categorization of analytics: IIoT and Industry 4.0 context, Usefulness of IIoT analytics, Challenges of analytics in industries, Mapping of analytics with the IIRA architecture, Deployment of analytics, Artificial intelligence, Applications of analytics across value chain. **Machine Learning and Data Science in Industries:** Introduction to Machine Learning, Categorization of ML, Applications of ML in Industries, Data Science in Industries, Deep Learning, Application of Deep Learning in Industries.

Learning Outcomes:
After completion of this module, the student will be able to:

1. Analyze the challenges in the implementation of analytics in industries (L3).
2. Understand the role of machine learning algorithms in industrial data analysis & management (L1).
3. Explore the applications of deep learning in industries (L3).

Unit : 5 **9 hours**

Application of IIoT: Healthcare Applications in Industries, Inventory Management and Quality Control, Plant Safety and Security, Case Studies: Manufacturing Industry, Automotive Industry, Mining Industry.

Learning Outcomes:
After completion of this module, the student will be able to:
Understand various IIoT-based healthcare systems, and smart devices used to monitor the health of a patient (L1).
Describe various types of inventories, types of inventory management methods, and applications of the IIoT-based technologies for inventory management. (L2).
Explore the necessity of safety of workers at different locations in the workplace, and various IIoT applications applied to adopt safety measures (L3)

Textbooks:

Introduction to Industrial Internet of Things and Industry 4.0 by Anandarup Misra Sudip, Roy Chandana, Mukherjee December 2020.
Introduction to IoT By Sudip Misra, Anandarup Mukherjee, Arijit Roy, 2021.

Reference book:

1.INTERNET OF THINGS WITH RASPBERRY PI AND ARDUINO by Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, and Mahendra Swain. CRC Press, Taylor and Francis group. 2020.

Suggested exercises:

Raspberry Pi Installation & Configuration Process.
Linux Commands for Application Execution.
Python Essentials.
Understanding and using GPIO pins.
LED Control.
Remote Login Methods.
Web server Creation.
PWM Generation.
Serial Communication & RFID Interfacing.
I2C Protocol ADC.
USB Camera Interfacing.
2 x 16 LCD Interfacing.
Course Outcomes:

CO-1: Describe the working of various IoT technologies (L2)

CO-2: Understand the overview of Industry 4.0 and Industrial IoT Systems (L1).
CO-3: Compare and assess the features of various industrial communication protocols (L3).
CO-4: Explore the importance of machine learning algorithms, cloud & fog computing in industrial
data analysis & management (L2).
CO-5: Explain the applications of IIoT in various industries (L2).

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**1**	**1**							**2**		**1**	**1**	**1**	**1**	**1**
CO2	**2**	**2**	**3**	**2**	**1**				**2**		**1**	**1**	**2**	**3**	**2**
CO3	**3**	**2**	**3**	**2**	**2**				**2**		**2**	**1**	**3**	**2**	**1**
CO4	**3**	**2**	**2**	**2**	**2**				**2**		**1**	**1**	**3**	**2**	**2**
CO5	**2**	**2**	**3**	**2**	**3**				**2**		**3**	**3**	**2**	**3**	**2**

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

SDG 9 (Industry, Innovation and Infrastructure): Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG Justification:

This course teaches the basic technology to design and operate Industrial IoT systems, which are the backbone of Industry 4.0. The techniques covered in this course help build resilient and sustainable industries with good performance and sustainability in areas such as healthcare, mining, automotives etc.

<table>
<tr><td rowspan="2">CSEN4131</td><td rowspan="2">IOT SECURITY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN2101: Internet of Things</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The purpose of this course is to expose students to new developments in the area of cyber security for the Internet of Things (IoT). In this course, the topics to be covered include security management and Cryptology, IoT Attacks and Threat management, Protocols to provide IoT security. IoT case studies and security concerns related to the applications are discussed.

Course Educational Objectives:

- Introduce the IoT security issues and countermeasures.
- Introduce the IoT Security testing methodology.
- Introduce the hardware security attacks
- Introduce the radio hacking and their methodologies
- Provide the details of selective IoT case study and their security challenges.

UNIT 1 The Iot Security World 9 hours

Why Is IoT Security Important? How Is IoT Security Different than Traditional IT Security?, Case Study: Finding, Reporting, and Disclosing an IoT Security Issue, Threat Modelling for IoT, Rating Threats with the DREAD Classification Scheme, Other Types of Threat Modelling, Frameworks, and Tools, Common IoT Threats

UNIT 2 A Security Testing Methodology 9 hours

Passive Reconnaissance, The Physical or Hardware Layer, The Network Layer, Web Application Assessment, Host Configuration Review,

NETWORK ASSESSMENTS

Hopping into the IoT Network, Identifying IoT Devices on the Network, Attacking MQTT

UNIT 3 Hardware Hacking 9 hours

UART, JTAG and SWD, Hacking a Device Through UART and SWD, Hardware for Communicating with SPI and I2C, SPI,I2C

UNIT 4 Radio Hacking 9 hours

How RFID Works, Attacking RFID Systems with Proxmark3, How BLE Works, Working with BLE, Discovering Devices and Listing Characteristics, BLE Hacking

UNIT 5 Targeting The Iot Ecosystem 9 hours

Threats in IoT Mobile Apps, Analyzing Android Applications, Avoid Root Detection Using Static Patching HACKING THE SMART HOME Gaining Physical Entry to a Building, Playing Back an IP Camera Stream, Attacking a Smart Treadmill

Textbooks:

1. Fotios Chantzis, Ioannis Stais, Paulino Calderon, Evangelos Deirmentzoglou, and Beau Woods, Practical IoT Hacking: The definitive guide to attacking the Internet of Things, No Starch Press,2021

References:

1. Aditya Gupta, The IoT Hacker's Handbook: A Practical Guide to Hacking the Internet of Things, Apress Publications ,2019
2. Fei Hu,Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, CRC Press,2016
3. Brian Russell & D. Van Duren, Practical Internet of Things Security, Packt Publishing,2016.
4. Internet of Things: Privacy & Security in a Connected World, Federal Trade Commission, 2015

Course Outcomes:

After successful completion of the course the student will be able to:

1. Introduce the IoT security issues and countermeasures.
2. Introduce the IoT Security testing methodology.
3. Introduce the hardware security attacks
4. Introduce the radio hacking and their methodologies
5. Provide the details of selective IoT case study and their security challenges

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2	2	2	1								2	1	2
CO3	2	2	2	1	1								2	2	
CO4	2	2	2	2	1								2	2	2
CO5	2		3										2	2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 11: Sustainable Cities and Communities require safe ways to communicate between them, which can be provided by cyber security mechanisms

SDG Justification:

CSEN4141	NATURAL LANGUAGE PROCESSING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	CSEN2031: Artificial Intelligence						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to learn Natural language processing at different levels like Morphological Level, Syntactic Level, Semantic Level, Discourse Level and Pragmatic Level and creates an ability to understand and interpret complex language utterances which is a crucial part in design of intelligent agents. Natural language processing is the sub-field of linguistics and computer science which helps in interpreting the human language by a machine. More specifically, natural language processing is the computer understanding, analysis, manipulation, and/or generation of natural language.

Course Educational Objectives:

- To understand the architecture and design of Natural language processing
- To analyse various tagging techniques
- To adopt concepts of Context free grammars for NLP
- To provide knowledge on semantic properties of embeddings
- To implement and learn the applications like sentiment analysis

UNIT 1 **6 hours, P - 4 hours**

Introduction to Natural Language Processing, Ambiguities in language, Regular expression, Words, Morphology, Morphology parsing, Word tokenization, Lemmatization & stemming, Edit distance. N-grams language models, Smoothing-Laplace smoothing, Good-Turing discounting, Interpolation Backoff, and Perplexity

UNIT 2 **6 hours, P - 4 hours**

Introduction, English word classes, Tagsets in English, Rule-based part of speech tagging, HMM part of speech tagging, Transformation-based part of speech tagging, Evaluation and error analysis, Issues- Tag indeterminacy and tokenization, Unknown words

UNIT 3 **6 hours, P - 4 hours**

Syntactic Parsing, Ambiguity, CKY parsing, Early parsing, Probabilistic context free grammar, PCGFS for language modelling, Probabilistic CKY parsing of PCFGs, Ways to learn rule probability, Problems with PCFGs

UNIT 4 **6 hours, P - 4 hours**

Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Word2Vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and embeddings, Evaluating vector models.

UNIT 5 **6 hours, P - 4 hours**

Coherence Resolution - Text Coherence - Discourse Structure, word sense disambiguation, semantic role labelling. Machine Translation -Transfer Metaphor–Interlingua- Statistical Approaches- IBM1 model. Application of NLP: Sentiment classification, Text summarization and Factoid Question Answering

Textbooks:

1. Daniel Jurafsky, James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2/e, Prentice Hall, 2008.

2. C. Manning, H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA, 1999.

3. Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019**.**

References:

1. Jalaj Thanaki, Python Natural Language Processing: Explore NLP with machine Learning and deep learning Techniques, Packt, 2017.

Coursera Courses:

2. https://www.coursera.org/learn/sequence-models-in-nlp
3. https://www.coursera.org/specializations/natural-language-processing
4. https://www.coursera.org/learn/attention-models-in-nlp
5. https://www.coursera.org/learn/classification-vector-spaces-in-nlp
6. https://www.coursera.org/learn/probabilistic-models-in-nlp
7. https://www.coursera.org/specializations/tensorflow-advanced-techniques
8. https://www.coursera.org/learn/natural-language-processing-tensorflow3

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the morphology, morphology parsing, word tokenization, lemmatization & stemming.

2. Understand the concepts tag indeterminacy and tokenization.

3. Apply various parsing techniques for natural language processing processors.

4. Distinguish and apply lexical and vector semantics to design word embeddings.

5. Design a statistical model for IBM1 and sentimental analysis.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	1	2	1			1						
CO2	1	2	1	1	1				1						
CO3	1	1	1	1	1	1			1						
CO4	1	1	1	1	2	2			1						
CO5	1	1	1	1	1	1			1						

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGc: 10
Reduced inequality
Natural language processing helps computers communicate with humans in their own language and scales other language-related tasks. Because of NLP, it is possible for computers to read text, hear speech, interpret it, measure sentiment and determine which parts are important. Applications like Language Translator, Chatbots, Autocomplete in Search Engines, Voice Assistants are some of the applications to reduce inequality among people.

SDG Justification:

<table>
<tr><td rowspan="2">CSEN4151</td><td rowspan="2">OPERATING SYSTEMS SECURITY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN1101: Operating Systems</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course deals with security concepts and procedures applied in operating systems. Students will examine security concepts that are uniquely implemented into operating systems. Also, this course will enable practical hands-on approach when testing operating system security techniques and apply these concepts in real time. It makes us understand the significance of Security Kernels, Secure Communications, and examine secure capability systems

Course Educational Objectives:

- Design trusted computing base that defines a trust model, define a threat model for the trusted computing base, and ensure protection of the trusted computing base under that model.
- Examine the UNIX and Windows operating systems and show why they are fundamentally not secure operating systems.
- Analyze the concept for expressing secrecy and integrity goals, information flows, and then describe models for expressing these goals in mandatory access control policies
- Identify the security features to an existing operating system, with its existing customer base and applications to building secure systems.
- Construct the secure operating systems from capability systems

UNIT 1 Introduction 9 hours

Introduction

Introduction - Security goals, Trust model, Threat model Access Control Fundamentals – Protection system – Lampson's Access Matrix, Mandatory protection systems, Reference monitor, Secure Operating System Definition, Assessment Criteria

UNIT 2 9 hours

Multics- Multics History, The Multics System, Multics Fundamentals, Multics Security Fundamentals, Multics Protection System Models, Multics Protection System, Multics Reference Monitor, Multics Security, Multics Vulnerability Analysis.
Security in Ordinary OS: System Histories-UNIX History, Windows History.

UNIX Security - UNIX Protection System, UNIX Authorization, UNIX Security Analysis, UNIX Vulnerabilities. WINDOWS Security - WINDOWS Protection System, WINDOWS Authorization, WINDOWS Security Analysis, WINDOWS Vulnerabilities.

UNIT 3 **Security Goals** **9 hours**

Verifiable Security Goals-Information Flow-Information Flow Secrecy Models, Information Flow Integrity Models, Covert Channels. Security Kernels, Secure Communications processor-Scomp Architecture, Scomp Hardware, Scomp Trusted Operating Program, Scomp Kernel Interface Package, Scomp Applications, Scomp Evaluation

UNIT 4 **Linux** **9 hours**

Building a Secure Operating System for Linux -Linux Security Modules, LSM History, LSM Implementation, Security-Enhanced Linux SE Linux Reference Monitor, SE Linux Protection State, SELinux Labeling State, SELinux Transition State, SE Linux Administration, SE Linux Trusted Programs, SE Linux Security Evaluation.

UNIT 5 **Solaris Trusted Extensions** **9 hours**

Solaris Trusted Extensions - Trusted Extensions Access Control, Solaris Compatibility, Trusted Extensions Mediation ,Process Rights Management (Privileges), Privilege Bracketing and Relinquishing ,Controlling Privilege Escalation, Assigned Privileges and Safeguards, Role-based Access Control (RBAC),RBAC
Authorizations ,Rights Profiles ,Users and Roles ,Converting the Super user to a Role, Trusted Extensions Networking , Trusted Extensions Multilevel Services, Trusted Extensions Administration Secure Capability Systems-Capability System Fundamentals, Capability Security, Challenges in Secure Capability Systems

Textbooks:

1. Trent Jaeger,” Operating System Security”, Morgan and Claypool, 2008

References:

1. Andrew S. Tanenbaum, “Modern Operating Systems”, Third Edition, Prentice Hall, 2009.

2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts with Java”, Ninth Edition, Wiley, 2012

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the challenges of building a secure operating system
2. Compare and illustrate security in Unix and Windows operating systems.
3. Illustrate Verifiable Security Goals
4. Understand the significance of Security Kernels and Secure Communications processor
5. Examine the challenges in secure capability systems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1											1		
CO2	2	1	3	2									2	2	
CO3	2	2		2									2	2	
CO4	2	2	3	2									2	2	
CO5	2	2											2	3	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SGD 12: Cyber defense mechanisms ensure that no effect will be made to the industrial patterns

SDG Justification:

CSEN4161	SECURITY FOR CYBER PHYSICAL SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	CSEN4131: IoT Security						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course aspires to create organized systematic practices and approaches that are made from continuous assimilation of physical systems and cyber systems. The course will facilitate engineers through essential expertise in enterprise software-hardware design. The course similarly teaches awareness of various software's to design physical systems and tools for constructing cyber modules. The course will make experts who can model predictable and secure Cyber-Physical Systems (CPS)

Course Educational Objectives:

- Ability to analyse overall specifications of CPS and translate it to the different subsystems design requirements.
- Adequate competency to model overall CPS using Hybrid system and other approaches and validate the model.
- Capability to co-design hardware-software architecture in distributed environment and methods to embedded security in the overall design of CPS.
- Ability to understand applications like smart grid, mobile networks, IoT, and different systems of a smart city.

UNIT 1 Overview of Security and Privacy in Cyber-Physical Systems 9 hours

Overview of Security and Privacy in Cyber-Physical Systems: Introduction, Defining Security and Privacy, Defining Cyber-Physical Systems, Examples of Security and Privacy in Action, Approaches to Secure Cyber- Physical Systems, Ongoing Security and Privacy Challenges for CPSs Network Security and Privacy for Cyber-Physical Systems, Security and Privacy Issues in CPSs, Local Network Security for CPSs, Internet-Wide Secure Communication, Security and Privacy for Cloud-Interconnected CPSs

UNIT 2 9 hours

Cyber-Physical Systems and National Security Concerns National Security Concerns Arising from Cyber- Physical Systems, National Security Implications of Attacks on Cyber-Physical Systems Legal Considerations of Cyber-Physical Systems and the Internet of Things Privacy and Technology in Recent History, The Current State of Privacy Law, Meeting Future

Challenges Context Awareness for Adaptive Access Control Management in IoT Environments Security Challenges in IoT Environments, Surveying Access Control Models and Solutions for IoT, Access Control Adaptation: Motivations and Design Guidelines, Our Adaptive Context-Aware Access Control Solution for Smart Objects, Open Technical Challenges

UNIT 3 Key Management in CPSs 9 hours

Key Management Security Goals and Threat Model, CPS Key Management Design Principles, CPS Key Management, CPS Key Management Challenges, and Open Research Issues Data Privacy Issues in Distributed Security Monitoring Systems
Information Security in Distributed Data Collection Systems, Technical Approaches for Assuring Information Security, Approaches for Building Trust in Data Collection Systems Privacy Protection for Cloud-Based Robotic Networks
Cloud Robot Network: Use Case, Challenges, and Security Requirements, Establishment of Cloud Robot Networks, Communication Security, Security Management of Cloud Robot Networks

UNIT 4 Toward Network Coding for Cyber-Physical Systems 9 hours

Toward Network Coding for Cyber-Physical Systems: Security Challenges and Applications Introduction, Background on Network Coding and Its Applications, Security Challenges, Secure Network Coding, Applications of Network Coding in Providing Security Lightweight Crypto and Security Lightweight Cryptography Implementations for Security and Privacy in CPSs, Opportunities, and Challenges Cyber-Physical Vulnerabilities of Wireless Sensor Networks in Smart Cities WSN Applications in Smart Cities, Cyber-Physical Vulnerabilities, Solution Approaches.

UNIT 5 9 hours

Detecting Data Integrity Attacks in Smart Grid, Data Security and Privacy in Cyber-Physical Systems for Healthcare Medical Cyber-Physical Systems, Data Security and Privacy Issues and Challenges in Wireless Body Area Networks (WBANs), Existing Security and Privacy Solutions in(WBAN) Cyber Security of Smart Buildings
What Is a Smart Building? Communication Protocols for Smart Buildings, Attacks, Solutions to Protect Smart Buildings, Recent Trends in Smart Building Security Research

Textbooks:

1. Houbing Song, Glenn A. Fink, Sabina Jeschke, "Security and Privacy in Cyber-Physical Systems", Wiley- IEEE Press, 1st edition, 2017

2. Sajal Das, Krishna Kant, and Nan Zhang, "Handbook on Securing Cyber-Physical Critical Infrastructure – Foundations & Challenges", Morgan Kaufmann, 2012.

References:

1. Eric D. Knapp and Raj Samani, "Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure, Syngress,1st Edition, 2013

2. Ali Ismail Awad, Steven Furnell, Marcin Paprzycki, Sudhir Kumar Sharma, Security in CyberPhysical Systems Foundations and Applications, Springer, 2021

3. F. Pasqualetti, F. Dörfler and F. Bullo, "Attack Detection and Identification in Cyber-Physical Systems," in IEEE Transactions on Automatic Control, vol. 58, no. 11, pp. 2715-2729, Nov.2013

4. H. Fawzi, P. Tabuada and S. Diggavi, "Secure Estimation and Control for Cyber-Physical Systems Under Adversarial Attacks," in IEEE Transactions on Automatic Control, vol. 59, no.6, pp. 1454-1467, June 2014

5. Yilin Mo, Rohan Chabukswar and Bruno Sinopoli "Detecting Integrity Attacks on SCADA Systems" in IEEE Transactions on Control System Technology, Vol. 22, No. 4, 2014

Course Outcomes:

After successful completion of the course the student will be able to:

1. The general nature of distributed cyber-physical systems, how they can be modelled and the role of modelling to ensure system quality and timeliness in development processes.

2. Analyse privacy and security of cyber physical systems

3. Adapt the latest data security and privacy preserving techniques in various domains

4. Validate and assess security and privacy of CPSs regulations and ethical constraints.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			1									1		
CO2	2	2	3	2		1							1	2	
CO3	2		3	2		1							1	2	
CO4	2	2	3	2		1							1	2	
CO5	2			3									1	2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 11: Sustainable Cities and Communities require safe ways to communicate between them, which can be provided by cyber security mechanisms

SDG Justification:

CSEN4171	SOCIAL NETWORK ANALYSIS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	**CSEN3261: Machine Learning**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course enables the students to gain knowledge on various aspects of different key concepts of social science data, how this data is produced, the underlying networks, and what type of analysis can be done. This course also provides different measures of social network analysis by using Social Network Analysis(SNA) tools for network analysis and visualization.

Course Educational Objectives:

- To learn development of Social Network Analysis.
- To understand the basic mathematical concept of social networks.
- To impart knowledge, concerning the Ontological representation of social relationships.
- To learn building Semantic Web applications.
- To understand the Evaluation of web-based social network extraction

UNIT 1 Social Network Analysis 9 hours

Social Network Analysis: Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis.
Electronic sources for network analysis: Electronic discussion networks, Blogs, and online communities, and Web-based networks.

UNIT 2 Mathematical Representation of Social Network 10 hours

Mathematical Representation of Social Network: Networks and Graphs, Degree, Average Degree, and Degree Distribution, Adjacency Matrix, Real Networks are Sparse, Weighted Networks, Bipartite Networks, Paths and Distances, Connectedness, Clustering Coefficient.

UNIT 3 Aggregation Social Network Data 10 hours

Aggregation Social Network Data: State-of-the-art in-network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data.

UNIT 4 Social Semantic Applications 9 hours

Social Semantic Applications: Building Semantic Web applications with social network features, Flink: the social networks of the Semantic Web community, open academia: distributed, semantic-based publication management.

UNIT 5 Evaluation Of Web-Based Social Network Extraction 12 hours

Evaluation Of Web-Based Social Network Extraction: Differences between survey methods and electronic data extraction, Context of the empirical study, Data collection, Preparing the data, optimizing goodness of fit, Comparison across methods and networks, Predicting the goodness of fit, Evaluation through analysis, Discussion.

Textbooks:

1. Peter Mika, "Social Networks and the Semantic Web", 1/e, Springer 2007.

2. ALBERT-LÁSZLÓ BARABÁSI," Network Science", 1/e, Cambridge university press, 2016.

References:

1. BorkoFurht, —Handbook of Social Network Technologies and Applications, 1/e, Springer, 2010
2. GuandongXu,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, 1/e, Springer, 2011.

Coursera Courses:

1. https://www.coursera.org/learn/python-social-network-analysis

Website(s):

2. https://www.sciencedirect.com/topics/social-sciences/social-network-analysis

Course Outcomes:

After successful completion of the course the student will be able to:

1. define Social Network analysis and narrate its related applications.

2. demonstrate social networks using graph theory.

3. illustrate Modeling and Aggregation of Social network data.

4. analyze human behavior in social web and related communities.

5. classify, create and visualize social networks using tools.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	3		3							3	2	
CO2	1	2	2	3	3								3	2	
CO3	1	1	2	3	3				1		1		3	2	
CO4	1	3	2	2	1	3			1				1	2	3
CO5	1	2	2	3	3	1			1	1		1	3	2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN4181</td><td rowspan="2">SOFTWARE DEFINED NETWORKS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN2021: Computer Networks</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Software Defined Networks (SDNs) represent an emerging network architecture that facilitates dynamic, cost-effective and adaptable management of networks. They are especially suitable for the current day applications that are dynamic and have a high bandwidth demand. This course introduces SDNs and how they decouple the network control and forwarding functions. It then studies the OpenFlow protocol, which is the basic component of SDNs. Network control in SDNs is introduced using the Mininet tool.

Course Educational Objectives:

- To establish the advantages of Software Defined Networks (SDNs).
- To familiarize the student with the components in and working of SDNs.
- To expose the student to the OpenFlow protocol for SDNs.
- To introduce Network Function Virtualization.
- To enable the student to perform network control using the Mininet tool.

UNIT 1 Introduction to and Motivation for SDNs 7 hours

Introduction to SDNs, Traditional Switch Architecture, Evolution of Switches and Control Planes, Data Center Innovation, Data Center Needs, Forerunners of SDNs, Emergence of OpenFlow, Network Virtualization.

UNIT 2 Genesis and Working of SDNs 9 hours

Characteristics of SDNs, SDN Operation, SDN Devices, SDN Controller, SDN Applications, SDN via APIs, SDN via Hypervisor based Overlay Networks.

UNIT 3 The OpenFlow Specification and SDN Control 9 hours

Openflow Overview, OpenFlow 1.0 and OpenFlow Basics.
SDN Design and Development: Mininet- Applications, Control Plane, SDN Controllers (Floodlight, Opendaylight), Customizing SDN Control (Switching and Firewalls).

UNIT 4 Network Function Virtualization (NFV) and SDNs 9 hours

Network Functions Virtualization (NFV) and SDN: Concepts, Implementation and Applications, Network Virtualization with Mininet, Network Control Slicing, Virtualization in Multi Tenant Data Centers, Docker and Containerization.

UNIT 5 Applications of SDN 8 hours

Network Management, Resource Utilization, Network Service Chaining, Bandwidth Calendaring and Network Programmability, Network Virtual Machines, , Applicability of OpenFlow Protocols in SDN Controllers, A Simple Reactive Java Application.

TextBooks:

1. Goransson P., Black C., Software Defined Networks: A Comprehensive Approach, (2e), Morgan Kaufmann, 2016.

References:

1. F. Hu, Network Innovation through Open Flow and SDN: Principles and Design, (1e), CRC Press, 2014.
2. Nadeau T. D., Gray K., SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, (1e), Shroff Publishers, 2013.

Journal(s):

1. D. Kreutz, F. M. V. Ramos, P. E. Veríssimo, C. E. Rothenberg, S. Azodolmolky and S. Uhlig, "Software-Defined Networking: A Comprehensive Survey," in Proceedings of the IEEE, vol. 103, no. 1, pp. 14-76, Jan. 2015, doi: 10.1109/JPROC.2014.2371999.

Website(s):

1. https://www.cse.wustl.edu/~jain/tutorials/ftp/sd_hs14.pdf
2. https://opennetworking.org/wp-content/uploads/2013/04/openflow-spec-v1.0.0.pdf
3. http://mininet.org/

Course Outcomes:

After successful completion of the course the student will be able to:

1. Analyze the benefits of SDNs.
2. Identify the functions of various components in an SDN.
3. Compare SDN and NFV and examine their interaction.
4. Interpret the working of the OpenFlow protocol.
5. Create SDN prototypes using Mininet.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2											1	2	
CO2	1	1	2	1									1	3	
CO3	1	1	2	1	3								1	3	
CO4	1	2	2	1	3								1	3	
CO5	1	2	2	3	3								1	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG9 (Industry, Innovation and Infrastructure): This course teaches the fundamentals of Software Defined Networks (SDNs). The usage of SDNs enables massive Machine Type Communications (mMTC) and Ultra-Reliable Low Latency Communications (URLLC). This can help foster innovation by connecting scientific communities better and enabling growth in industries that require digital connectivity.

SDG13 (Climate Action) SDNs can be used in the Internet of Things (IoT), which has applications that can be deployed to monitor environmental pollution and the effects of climate change (such as melting of the polar icecaps and forest fires) in real time.

SDG Justification:

<table>
<tr><td rowspan="2">CSEN4191</td><td rowspan="2">WEB APPLICATION SECURITY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">CSEN3071: Web Application Development and Software Frameworks</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course is designed to provide an opportunity for students to obtain knowledge on foundations to design a web application in a secure manner. This course covers the basics of web technologies and the vulnerabilities in web application design, handling the errors, auditing logs, alert and reacting to the attacks. It also deals with authentication technologies and their flaws, the tools to capture the passwords and access control mechanisms, learn the basics related SQL injection attacks and how to prevent these kinds of attacks

Course Educational Objectives:

- Expertise in web application security core mechanisms.
- Learn various web technologies and their security.
- To provide awareness on web application mapping.
- To provide practical and hands on experience on attacking authentication and data stores

UNIT 1 Web Application (In)security 9 hours

The Evolution of Web Applications, Common Web Application Functions, Benefits of Web Applications, Web Application Security. Core Defence Mechanisms: Handling User Access Authentication, Session Management, Access Control, Handling User Input, Varieties of Input Approaches to Input Handling, Boundary Validation. Multistep Validation and Canonicalization: Handling Attackers, Handling Errors, Maintaining Audit Logs, Alerting Administrators, Reacting to Attacks.

UNIT 2 Attacking Authentication 9 hours

Authentication Technologies, Design Flaws in Authentication Mechanisms, Bad Passwords, Brute Forcible Login, Verbose Failure Messages, Vulnerable Transmission of Credentials, Password Change, Functionality, Forgotten Password Functionality, “Remember Me” Functionality, User Impersonation, Functionality Incomplete, Validation of Credentials, Nonunique Usernames, Predictable Usernames, Predictable Initial Passwords, Insecure Distribution of Credentials. Attacking Access Controls: Common Vulnerabilities, Completely Unprotected, Functionality Identifier-Based Functions, Multistage Functions, Static Files, Platform Misconfiguration, Insecure Access Control Methods

UNIT 3 Attacking Data Stores 9 hours

Injecting into Interpreted Contexts, bypassing a Login, injecting into SQL, exploiting a Basic Vulnerability Injecting into Different Statement Types, Finding SQL Injection Bugs, Fingerprinting the Database, The UNION Operator, Extracting Useful Data, Extracting Data with UNION, Bypassing Filters, Second-Order SQL Injection, Advanced Exploitation Beyond SQL Injection: Escalating the Database Attack, Using SQL Exploitation Tools,
SQL Syntax and Error Reference, Preventing SQL Injection

UNIT 4 Attacking Back-End Components 9 hours

Injecting OS Commands, Manipulating File Paths, Injecting into XML Interpreter, Injecting into Back-end HTTP Requests, Injecting into Mail Services

UNIT 5 Attacking Users: Cross-Site Scripting 9 hours

Varieties of XSS, XSS Attacks in Action, Finding and Exploiting XSS Vulnerabilities, Preventing XSS Attacks

Textbooks:

1. The Web Application Hacker's Handbook: Finding and Exploiting Security Defydd Stuttard, Marcus Pinto Wiley Publishing, Second Edition.

References:

1. Professional Pen Testing for Web application, Andres Andreu, Wrox Press

2. Carlos Serrao, Vicente Aguilera, Fabio Cerullo, “Web Application Security” Springer; 1st Edition

Course Outcomes:

After successful completion of the course the student will be able to:

1. Explore security in web applications

2. Explore various web application technologies

3. Discuss how to map web applications and analysing them

4. Explore various techniques for attacking authentication.

5. Simulate various data stores attacking techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	1	2	2	1									2	2	
CO3	2	2	2										2	2	
CO4	2	2	2	1									2	2	
CO5	3			1									3	2	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 8: Cyber Security to society and industries will build up sustained economic growth with better profits for the industry and fewer losses to the humanity

SDG Justification:

GITAM School of Technology

GITAM (Deemed to be Universtiy)

Visakhapatnam | Hyderabad | Bengaluru