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
UEECE01: B.Tech. Electronics and Communication Engineering

w.e.f. 2024-25 admitted batch

(Updated on May 2024)

Academic Regulations

Applicable for the Undergraduate Programmes in the School of Technology (except B.Tech.CSBS)

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

GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT

Vision

GITAM will be an exceptional knowledge-driven institution advancing on a culture of honesty and compassion to make a difference to the world.

Mission

- Build a dynamic application-oriented education ecosystem immersed in holistic development.
- Nurture valuable futures with global perspectives for our students by helping them find their ikigai.
- Drive impactful integrated research programmes to generate new knowledge, guided by integrity, collaboration, and entrepreneurial spirit.
- Permeate a culture of kindness within GITAM, fostering passionate contributors.

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.

VISION AND MISSION OF THE SCHOOL

Vision

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VISION AND MISSION OF THE DEPARTMENT

VISION

To excel in Electrical, Electronics and Communication Technologies cultivating innovation with socio-ethical commitment

MISSION

- Empower the students with knowledge to face real-world challenges for holistic development.
- Conduct multidisciplinary research that makes an impact on society, addressing key challenges through innovative solutions.
- Foster a culture emphasizing empathy, respect, commitment upholding the ethical standards.

UEECE01: B.Tech. Electronics and Communication Engineering

(w.e.f. academic year 2024-25 admitted batch)

Programme Educational Objectives (PEOs)

PEO 1	Demonstrate comprehensive knowledge of analytical foundations to Electronics and Communication Engineering in terms of founding principles of circuits, design, computing, signal processing and communication.
PEO 2	Demonstrate critical thinking and problem-solving abilities to handle the real-world problems by applying theoretical foundations and practical skills in different fields of Electronics and Communication Engineering.
PEO 3	Exhibit qualities of teamwork, appreciation of collaboration that entails inter-disciplinary endeavors and the potential impact of technology on society.
PEO 4	Develop creativity, Research related skills, self-learning, entrepreneurial and leadership skills in order to meet the ever-changing needs and challenges in the profession.

PEO Articulation

	PEO1	**PEO2**	**PEO3**	**PEO4**
M1	H	H	M	M
M2	M	H	M	H
M3	L	M	H	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	Demonstrate comprehensive knowledge and practical skills in Electronics and Communication Engineering focusing on subareas of Aerospace and Defence Electronics, Telecommunications, Sensors and IoT, AI and ML Applications and Software Defined Vehicles and apply this knowledge to solve advanced problems.
PSO2	Design and translate abstract concepts in circuits, communications, signal processing, computing and sensing to real-time circuits & systems and analyze their performance.
PSO3	Research and formulate suitable technologies for the implementation of Electronics and Communication Engineering solutions, demonstrating entrepreneurial and research aspects with a commitment to professional ethics and a focus on societal well-being.

Curriculum Structure

(Flexible Credit System)

Minimum Credit Requirements for the Award of Degree

S.No.	Course Category and Category Code	Minimum Credits	% of credits in the Programme
1.	University Core (UC)	19	11.87
2.	Faculty Core (FC)	53	33.13
3.	Programme Core (PC)	49	30.62
4.	Programme Electives (PE)	15	9.38
5.	Open Electives (OE)	24	15.00
	Total	**160**	**100**

University Core (UC) : 19 Credits								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
		Ability Enhancement Courses						
LANG1201	100	Critical Thinking	2	0	0	0	0	2
LANG1241	100	Communicative English - I	0	0	4	0	0	2
LANG1251	100	Communicative English - II	0	0	4	0	0	2
IENT1051	100	Fundamentals of Entrepreneurship	2	0	0	0	0	2
		Skill Enhancement Courses						
CLAD1041	100	Art of Persuasive Communication	0	0	2	0	0	1
CLAD1051	100	Competence in Communication	0	0	2	0	0	1
CLAD1061	100	Life Skills	0	0	2	0	0	1
CLADXXXX	100	Soft Skills - 4	0	0	2	0	0	1
		Value Added Courses						
ENVS1003	100	Environmental Studies	3	0	0	0	0	3
POLS1051	100	The Indian Constitution	1	0	0	0	0	1
		Pass / Fail Courses (Mandatory)						
FINA1081	100	Personal Financial Planning *	1	0	0	0	0	1
PHPY1011	100	Gandhi and the Contemporary World *	1	0	0	0	0	1
		Pass / Fail Courses (Any one course to be chosen)						
DOSP1181	100	Yogasana	0	0	0	2	0	1
MFST1002	100	Health and Wellbeing *	0	0	2	0	0	1
DOSL1081	100	Student Life Activities (Participant)	0	0	0	2	0	1
DOSL1091	100	Student Life Activities (Organizer)	0	0	0	2	0	1
DOSL1101	100	Student Life Activities (Competitor)	0	0	0	2	0	1
DOSL1111	100	Foundations of Student (Leadership)	0	0	0	2	0	1
DOSL1042	100	Community Services – Volunteer	0	0	2	0	0	1
DOSL1052	100	Community Services – Mobilizer	0	0	2	0	0	1
DOSP1003	100	Badminton	0	0	0	2	0	1
DOSP1033	100	Football	0	0	0	2	0	1
DOSP1043	100	Volleyball	0	0	0	2	0	1
DOSP1053	100	Kabaddi	0	0	0	2	0	1
DOSP1073	100	Table Tennis	0	0	0	2	0	1
DOSP1083	100	Handball	0	0	0	2	0	1
DOSP1093	100	Basketball	0	0	0	2	0	1
DOSP1113	100	Throw ball	0	0	0	2	0	1
DOSP1142	100	Cricket	0	0	0	2	0	1
DOSP1132	100	Functional Fitness	0	0	0	2	0	1
DOSP1171	100	Martial Arts/Self Defence	0	0	0	2	0	1

* Massive Open Online Course (MOO

FACULTY CORE (FC) : 53 credits								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH1341	100	Calculus and Differential Equations	3	1	0	0	0	4
MATH1272	100	Linear Algebra	3	1	0	0	0	4
MATH2581	200	Probability theory and Random process	3	1	0	0	0	4
MATH2591	200	Complex variables and transform techniques	3	1	0	0	0	4
PHYS1001	100	Physics	2	1	2	0	0	4
CHEM1111	100	Engineering Chemistry	2	1	2	0	0	4
24CSEN1031	100	Programming for Problem Solving - 1	0	0	6	0	0	3
24CSEN1041	100	Programming for Problem Solving - 2	0	0	6	0	0	3
24xxxxxxxx		Engineering Basket - Choice 1	2	0	2	0	0	3
24xxxxxxxx		Engineering Basket - Choice 2	2	0	2	0	0	3
MECH1011	100	Engineering Visualization and Product Realization	0	0	4	0	0	2
MECH1041	100	Technology Exploration and Product Engineering	0	0	4	0	0	2
24PROJ4777	400	Capstone Project - Introduction	0	0	0	0	2	1
24IENT3777	300	Internship-1	0	0	0	0	2	1
24PROJ4888/ 24IENT4888 / 24RESH4888	400	Capstone Project - Final / Internship-2 / Research	0	0	0	0	16	8
HSMCH102	100	Universal Human Values 2: Understanding Harmony	2	1	0	0	0	3

Engineering Basket 1 & 2
Six credits have to be chosen from the basket other than Parent Department course.

Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
24EECE2221	200	Fundamentals of Sensors and Internet of Things	2	0	2	0	0	3
24EECE2211	200	Fundamentals of Electrical and Electronics Engineering	2	0	2	0	0	3
24EECE2231	200	Foundations of Electrical and Electronics Engineering	3	0	2	0	0	4
24MECH1001	100	Introduction to Mechanical Engineering	2	0	2	0	0	3
24CIVL1001	100	Introduction to Civil Engineering	2	0	2	0	0	3
24BTEN1021	100	Biotechnology and Bioengineering	2	0	2	0	0	3
24BTEN1031	100	Introduction to Biomedical Engineering	2	0	2	0	0	3
24CSEN2261	200	Data Structures and Algorithms	2	0	2	0	0	3

Programme Core (PC) : 49 credits								
49 credits to be earned through programme core courses.								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
24EECE1001	100	Network Theory and Analysis	2	1	0	0	0	3
24EECE2001	200	Electronic Devices and Circuits	3	0	2	0	0	4
24EECE2071	200	Analog Circuits	3	0	2	0	0	4
24EECE3001	300	Introduction to VLSI Design	3	0	2	0	0	4
24EECE2011	200	Signals and Systems	2	1	0	0	0	3
24EECE2111	200	Electromagnetic Waves and Transmission Lines	2	1	0	0	0	3
24EECE3011	300	Antennas Analysis and Design	2	0	2	0	0	3
24EECE3021	300	Analog and Digital Communications	3	0	2	0	0	4
24EECE3031	300	Data Communication and Networking	3	0	0	0	0	3
24EECE3041	300	Control Systems	2	1	0	0	0	3
24EECE2291	200	Digital Logic Design	3	0	2	0	0	4
24EECE3051	300	Computer Organization and Design	3	0	0	0	0	3
24EECE3061	300	Microprocessors and Microcontrollers	3	0	2	0	0	4
24EECE3071	300	Digital Signal Processing	3	0	2	0	0	4

Programme Elective (PE) : 15 credits								
A minimum of 15 credits from any one of the tracks								
Track # **Aerospace & Defence Electronics**								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
24AERO2091	200	Aerospace and Defence Electronics Basics	3	0	0	0	0	3
24AERO3221	300	Avionics Systems and Technologies	3	0	0	0	0	3
24EECE4001	400	Satellite Communications	3	0	0	0	0	3
24EECE3081	300	Radar Systems and Signal Processing	3	0	0	0	0	3
24CSEN2301	200	Fundamentals of Cyber Security	2	0	2	0	0	3
24EECE3091	300	Electromagnetic Compatibility	3	0	0	0	0	3
24EECE3101	300	Digital Image Processing	3	0	0	0	0	3
24EECE3111	300	Command, Control and Communication Systems	3	0	0	0	0	3
24EECE3121	300	Jamming and ECM/ECCM Technologies	3	0	0	0	0	3
24EECE2301	200	Embedded Systems	2	0	2	0	0	3
24EECE4011	400	Unmanned Aerial Vehicles	2	0	2	0	0	3
24EECE3131	300	Electronic Packaging and Testing	3	0	0	0	0	3

Track # : Telecommunications								
24EECE4021	400	Software Defined Radio and Networks	3	0	0	0	0	3
24EECE4001	400	Satellite Communications	3	0	0	0	0	3
24EECE4031	400	Optical Communications and Networks	3	0	0	0	0	3
24EECE3141	300	Principles of Radar Systems	3	0	0	0	0	3
24EECE3151	300	Information Theory and Coding	3	0	0	0	0	3
24EECE3161	300	Fundamentals of Wireless Communications	3	0	0	0	0	3
24EECE3171	300	Mobile Communication System with Optimization	3	0	0	0	0	3
24EECE2021	200	Applied Linear Algebra with Machine Learning, Wireless Communication and Data Analytics	2	0	2	0	0	3
24EECE4041	400	LTE and Advanced LTE Technologies for Mobile Communications	3	0	0	0	0	3
24EECE4051	400	5G Technologies and Its Applications	3	0	0	0	0	3
Track # : Sensors and IoT								
24EECE2031	200	Introduction to IoT and its Applications	3	0	0	0	0	3
24EECE2041	200	IoT Sensors and Actuators	3	0	0	0	0	3
24EECE3181	300	IoT Architecture and Protocols	3	0	0	0	0	3
24CSEN3261	300	IoT Security and Privacy	3	0	0	0	0	3
24CSEN3271	300	Cloud Computing for IoT	3	0	0	0	0	3
24EECE2051	200	Embedded Systems for IoT	2	0	2	0	0	3
24EECE4061	400	Wireless Sensor Networks	3	0	0	0	0	3
24EECE3191	300	IoT Device Design and Development	3	0	0	0	0	3
24EECE3201	300	Industrial IoT and Automation	3	0	0	0	0	3
24EECE3211	300	IoT for Transportation	3	0	0	0	0	3
Track # : AI and ML Applications								
24CSEN2311	200	Machine Learning Techniques	2	0	2	0	0	3
24CSEN2321	200	Fundamentals of Neural Networks	2	0	2	0	0	3
24CSEN2331	200	Fundamentals of Deep Learning	2	0	2	0	0	3
24CSEN3281	300	Fundamentals of Natural Language Processing	3	0	0	0	0	3
24EECE4071	400	Machine Learning for Audio, Image, and Video Analysis	3	0	0	0	0	3
24EECE4081	400	Machine Learning for Antenna Array Applications	3	0	0	0	0	3
24EECE4091	400	Applications of Artificial Intelligence in VLSI Design	3	0	0	0	0	3

24EECE4101	400	Wireless Communications with Artificial Intelligence	3	0	0	0	0	3
24EECE4111	400	Embedded Systems with Artificial Intelligence	3	0	0	0	0	3
Track # : Software Defined Vehicles								
24MECH2081	200	Fundamentals of Automotive Engineering	3	0	0	0	0	3
24EECE3221	300	Introduction to Automotive Electronics and Vehicle Architecture	3	0	0	0	0	3
24CSEN2341	200	Software Engineering for Automotive Applications	3	0	0	0	0	3
24EECE3231	300	Vehicle Networks and Communication Protocols	3	0	0	0	0	3
24EECE3241	300	Automotive Embedded Systems and Operating Systems	3	0	0	0	0	3
24EECE3251	300	Model Based System Design	3	0	0	0	0	3
24CSEN3291	300	Automotive Cyber Security	3	0	0	0	0	3
24EECE4121	400	Advanced Driver Assistance Systems (ADAS) System Design	3	0	0	0	0	3
24EECE3261	300	Introduction to AUTOSAR	3	0	0	0	0	3
24EECE4131	400	Vehicle-to-Everything (V2X) Communications	3	0	0	0	0	3
24EECE2061	200	Introduction to Electric Vehicle Technologies	3	0	0	0	0	3

Open Electives (OE)

A minimum of 24 credits are to be earned under this category of courses, out of which 9 credits are from other departments from the School of Technology and the remaining 15 credits are from schools other than the School of Technology.

The current list of courses offered under OE will be available through the registration portal. Refer here for the tentative list of courses offered under OE category

University Core (UC)

LANG1201	**CRITICAL THINKING**	**L**	**T**	**P**	**S**	**J**	**C**
		2	0	0	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

Critical thinking lies at the heart of scholarship in a university and is an important practice for us moderns to cultivate as members of civil society. This course begins with the historical significance of and motivations behind critical thinking in modernity. We introduce 'argumentation' as the key technique in the practice of critical thinking. First, we look at the distinction between the truth value of an opinion and the force of evidence and reasoning in arguments. We examine arguments and argumentation as instrument and practice of exercising critical thinking. Starting with simple arguments, we learn the distinction between a good and a bad argument. Next, we study the types and causes of bad or fallacious arguments. Finally, we examine longer arguments, developing practical ways of evaluating, critiquing and constructing arguments. Argumentation is central to the Socratic method, a key practice throughout the history of university education. This course prepares students to read and have a deep, original engagement with complex texts which they will encounter in various courses in the humanities and social sciences. Furthermore, this course also trains students to become public intellectuals, who can take on, address and construct complex arguments for consumption beyond academia.

Course Educational Objectives:

- Understand the historical significance and motivations behind critical thinking, fostering an appreciation for its role in modern society.
- Develop the ability to identify and evaluate arguments, distinguishing between opinions and evidence-based reasoning.
- Acquire skills in constructing and assessing well-formed arguments, both in terms of plausibility and intended purpose.
- Recognize and analyze common fallacies, enabling the identification and critique of flawed reasoning in arguments.
- Engage in advanced argumentation, demonstrating the capacity to construct effective arguments and engage with complex texts.

MODULE 1 AN INTRODUCTION TO CRITICAL THINKING 5 Hrs

Critical thinking as a practice of freedom – reconciling duty and critique-Opinion and arguments-Identifying arguments in LSD.-How to spot an argument – structure

MODULE 2 ARGUENTATION BASICS **5 Hrs**

Interpreting arguments in LSD-The evaluation of arguments – 'good' arguments vs 'bad' arguments – Acceptability, Relevance and Sufficiency-Fundamentals of Constructing arguments - Plausibility and Purpose

MODULE 3 'BAD' ARGUMENTS – FALLACIES **6 Hrs**

Fundamentals of Argument Construction and Evaluation in LSD. What is wrong with bad arguments? (A typology of fallacies)-The causes of fallacious reasoning.

MODULE 4 ADVANCED ARGUMENTATION **6 Hrs**

Dialectical character of arguments-Steps to construct arguments-Constructing arguments in LSD.

MODULE 5 EXTENDED ARGUMENTS **8 Hrs**

Analyzing longer arguments-Evaluation and Critique of arguments-Analyzing extended arguments in LSD

Texbook(s):

1. Johnson, Ralph H. and J. Anthony Blair., Logical Self-Defence, International Debate Education Association,New York, 2006

Reference(s):

1. Kant, Immanuel., What is enlightenment?, http://www.columbia.edu/acis/ets/CCREAD/etscc/kant.html
2. Vaughn, Lewis, The Power of Critical Thinking: Effective Reasoning About Ordinary and Extraordinary Claims, Oxford,New York, 2019
3. Epstein, Richard L, Critical Thinking. Ontario, 2006

Course Outcomes:

1. Demonstrate a comprehensive understanding of the historical context and importance of critical thinking, applying it to contemporary issues.
2. Identify and analyze arguments, differentiating between opinions and well-supported claims based on evidence and reasoning.
3. Construct coherent and persuasive arguments, employing appropriate techniques and evidence to support claims effectively.
4. Identify and critique fallacious reasoning, employing critical thinking skills to evaluate the strength and validity of arguments.
5. Engage in the analysis and evaluation of complex texts, demonstrating the ability to read deeply and engage in original and thoughtful discussions.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	2							2		2			
2	1	2	2							2		2			
3	1	2	2							2		2			
4	1	2	2							2		2			
5	1	2	2							2		2			

3 – High, 2 – Medium & 1 – Low Correlation

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LANG1241	COMMUNICATIVE ENGLISH - I	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

The course is designed to enhance students' English proficiency through various interactive and practical modules. The course focuses on developing effective oral and written communication skills in diverse situations. It includes modules on self-introduction, situational conversations, formal and informal greetings, telephonic conversations, and writing tasks such as formal emails, essays, and descriptive stories. The course aims to improve listening and comprehension, enhance public speaking and presentation skills, and encourage literary analysis and creative expression. Through continuous assessment and term-end examinations, students will gain confidence and competence in using English effectively in academic and professional contexts.

Course Educational Objectives:

- Enable students to articulate their thoughts clearly and confidently in various situations, including self-introduction, situational conversations, and formal greetings.
- Improve students' ability to listen for specific information, comprehend spoken and written content, and engage in note-making and note-taking activities.
- Equip students with the skills to write formal emails, applications, and essays and create descriptive and story-writing pieces.
- Enhance the ability to deliver speeches, participate in elocution, and create video blogs, enhancing students' public speaking and presentation capabilities.
- Promote an appreciation for literature by analyzing prose, poetry, and plays while encouraging creative expression through various writing genres and video blogging.

List of Experiments

1. About Oneself and Others (*A1, Module 1)
2. Situational Conversation (*B1, Module 1-)
3. Expressional Greeting: Formal Vs Informal Greeting (*A1, Module 2)

4. Telephonic Conversation (*A2, Module 2)
5. Instructions & Announcements - All (*A1, Module 5)
6. Bus Terminals (*A2, Module 4)
7. Notes and Messages - All (*A1, Module 6)
8. Application Form (*A1, Module 7)
9. Formal Email/Paragraph Writing (*B1, Module 7)
10. Video Blogs (*C1, Module 5)
11. Speech & Elocution (*A2, Module 5)
12. Time Expressions (*B1, Module 6)
13. Prose and Poems (*A1, Module 4)
14. Plays – Macbeth (*C2, Module 4)
15. Descriptive & Story Writing (*A1, Module 7)
16. Story Genres - Literary Fiction (*B2, Module 3)
17. Situational Conversations – ALL – essay writing (*A2, Module 1)
18. Situational Conversations – Scientific Developments (*C2, Module 1)

Textbook(s):

1. Dutt, P. K., & Rajeevan, G. , Basic Communication Skills. , Foundation Books., 2007

Reference(s):

1. Hewings, M., & McCarthy, M., Cambridge Academic English B2 Upper Intermediate Student's Book (Vol. 1)., Cambridge University Press., 2012
2. Bohlke, D., & Richards, J. C., Four corners., Cambridge University Press., 2012
3. Philpot, S., & Curnick, L., New Headway-academic skills: reading, writing, and study skills.Level 2: student's book. Oxford, UK.:, Oxford University Press., 2007
4. Latham-Koenig, C., Oxenden, C., & Lambert, J., American English File 3E Level 5 Student Book., Oxford University Press., 2020
5. McCarthy, M., & O'dell, F., Academic vocabulary in use edition with answers., Cambridge University Press., 2016 6. Zemach, D. E., & Islam, C., Writing paragraphs: from sentence to paragraph., 2006
7. Bradbury, A. J. ., Successful presentation skills (Vol. 111)., 2006

Course Outcomes:

1. Develop and apply active listening strategies to understand and analyze spoken content in diverse contexts, improving comprehension and retention.
2. Utilize different writing techniques to produce varied written forms, including persuasive essays, research papers, and creative stories, demonstrating versatility in writing.
3. Conduct detailed analyses of written texts, identifying nuanced arguments and rhetorical strategies, enhancing interpretive and evaluative reading skills.
4. Develop communication skills to articulate complex ideas clearly and persuasively in spoken interactions.
5. Apply integrated language skills in practical settings, demonstrating the ability to use listening, speaking, reading, and writing comprehensively.

Course Articulation Matrix:

	POs												**PSOs**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1					2				2	2		2			
2					2				2	2		2			
3					2				2	2		2			
4					2				2	2		2			
5					2				2	2		2			

3 – High, 2 – Medium & 1 – Low Correlation

LANG1251	COMMUNICATIVE ENGLISH - II	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

The course focuses on enhancing students' written and oral English communication proficiency. It encompasses a variety of practical skills, such as conducting effective phone conversations, engaging in situational dialogues, and excelling in public speaking. Students will participate in numerous writing exercises, including the creation of posters, brochures, journal articles, and book reviews. Additionally, the course focuses on enhancing listening and comprehension abilities in various real-world contexts. Through interactive activities like debates, presentations, and collaborative projects, students will build their capability to communicate clearly and confidently in various situations.

Course Educational Objectives:

- Enhance students' ability to handle conversations in various real-life contexts.
- Equip students with the skills to write posters, travel brochures, journal articles, and book reviews.
- Enable students' abilities in public speaking, including delivering presentations and speeches and engaging in debates.
- Strengthen students' listening and reading skills through comprehension exercises, particularly in diverse real-world contexts.
- Promote teamwork and creativity through group activities like collaborative journal writing and creating various written materials.

List of Experiments

1. Customer Service - Inquiry (*C1, Module 3)
2. Taking and Making a Call (*C2, Module 2)
3. Telephonic Conversation – Ordering Food Online (*B2, Module 2)
4. Situational Conversations – Marine Species (*C1, Module 1)
5. Telephonic Expressions – Thoughtful Present (*B1, Module 2)
6. Theatre /Movies - Life of Pi (*B1, Module 4)
7. Poster writing/Notice Board Writing (*A1, Module 7)

8. The Art of Writing – Travel Brochure (*C2, Module 7)
9. Elements of Journal Article (*B2, Module 7)
10. Presentation Skills (*C1, Module 4)
11. Speech & Elocution (*B2, Module 6)
12. Steps to write a book review (*C1, Module 3)
13. Steps to write a summary (*C2, Module 5)
14. Debate - How does debating work? (*B2, Module 4)
15. Story Genre – Literary Fiction (*B2, Module 3)
16. The Critic – Steps to write a book review (*C1, Module 3)

Textbook(s):

1. Kumar, S., & Lata, P., Communication skills., Oxford University Press., 2011

Reference(s):

1. Hewings, M., Thaine, C., & McCarthy, M., Cambridge academic English C1 advanced student's book: An integrated skills course for EAP., Cambridge University Press., 2012
2. Berlin, A., 50 Conversation Classes., Createspace Independent Publishing Platform., 2022
3. McCarthy, M., English idioms in use advanced–Cambridge., 2010
4. Hollihan, T. A., & Baaske, K. T., Arguments and arguing: The products and process of human decision making., Waveland Press., 2022
5. Seo, B., Good Arguments: What can the art of debating teach us about listening better and disagreeing well? Simon and Schuster., 2022
6. Philpot, S., & Curnick, L., New Headway-academic skills: reading, writing, and study skills. Level 3: student's book. Oxford, UK.:, Oxford University Press., 2007
7. Hahn, F. E., Do-it-yourself advertising and promotion: how to produce great ads, brochures, catalogs, direct mail, websites, and more!, John Wiley & Sons., 2003

Course Outcomes:

1. Students will be able to confidently engage in conversations across a variety of real-life scenarios, demonstrating appropriate conversational strategies and cultural awareness.
2. Students can create clear, persuasive, and visually appealing posters, travel brochures, journal articles, and book reviews tailored to specific audiences and purposes.
3. Students will be able to deliver well-organized and impactful presentations and speeches and participate effectively in debates, using appropriate rhetorical techniques and presentation aids.
4. Students can accurately comprehend and critically analyze spoken and written texts from

diverse real-world contexts, demonstrating improved listening and reading skills.

5. Students can work collaboratively in groups to produce creative written materials, such as collaborative journals and other projects, showcasing their ability to integrate ideas and engage in constructive teamwork.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1					2				2	2		2			
2					2				2	2		2			
3					2				2	2		2			
4					2				2	2		2			
5					2				2	2		2			

3 – High, 2 – Medium & 1 – Low Correlation

IENT1051	FUNDAMENTALS OF ENTREPRENEURSHIP	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

Entrepreneurship is a vital life skill that fosters curiosity, creativity, and a focus on seizing opportunities. By embracing entrepreneurship, individuals can achieve professional independence, tackle complex challenges with innovative solutions, and take calculated risks. This course, "Introduction to Entrepreneurship," is designed to provide students with essential knowledge and practical skills for their entrepreneurial journey. Contrary to popular belief, entrepreneurship can indeed be learned, and this course dispels those myths. It offers a comprehensive understanding of the entire entrepreneurial process, from generating ideas to launching a minimum viable product (MVP). Through a combination of theory and hands-on activities, students will explore various aspects of entrepreneurship, such as identifying opportunities, discovering customers, designing solutions, and employing lean startup methods. To succeed, students must demonstrate self-direction and a genuine enthusiasm for learning, whether independently or in collaboration with peers.

Course Educational Objectives:

- Understand the fundamental concepts and processes of entrepreneurship.
- Identify and evaluate business ideas and opportunities.
- Know the techniques for effective problem-solving.
- Understand the customer and the customer discovery process and how to develop market insights.
- Effectively pitch your Venture Idea

MODULE 1 ENTREPRENEURIAL PROCESS AND MINDSET **6 Hrs**

Introduction to Entrepreneurship, Pilot Your Purpose, Innovation, Risk-Taking and Value Creation, Myths around Entrepreneurship, Distinct Types of Entrepreneurship, Entrepreneurial vs. Managerial Mindset.

MODULE 2 PROBLEM IDENTIFICATION AND IDEATION **6 Hrs**

Entrepreneurship Opportunity identification, Market and Need Analysis, Problem Discovery, Problem Statement Identification and definition, Evaluating and Selecting Ideas

MODULE 3 CUSTOMER DISCOVERY & MARKET INSIGHTS **6 Hrs**

Users and Buyers, Target Group and Persona, Customer Research Methods (People Shadowing, laddering etc.), Use Cases, Market Sizing & Segmentation, Customer Value Proposition

MODULE 4 SOLUTION DESIGN **6 Hrs**

Principles of Effective Solution Design, Prototyping Methods and Tools, Building and Testing Prototypes, Gathering Feedback on Prototypes, Iterating and Refining Solutions, Building Minimum Viable solution.

MODULE 5 CRAFTING YOUR VENTURE NARRATIVE **6 Hrs**

How you can launch a successful venture. Tell your venture story

Textbook(s):

1. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses,

Reference(s):

1. Blank, S. and Dorf, B., The Startup Owner’s Manual: The Step-by-Step Guide for Building a Great Company., BookBaby, Pennsauken., 2012
2. Neck, Heidi & Greene, Patricia & Brush, Candida., Teaching entrepreneurship: A practice-based approach., 2014

Course Outcomes:

1. To discover skills and competencies needed for entrepreneurial career
2. Effectively utilize frameworks for business planning and development.
3. Implement customer research methods such as shadowing, laddering etc to gather insightful data.
4. Build and refine a minimum viable product (MVP) based on real customer feedback.
5. Present a process pitch that integrates learnings across all units to propose a viable entrepreneurial venture.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1			2	2	1	2	2		2	3	1	2	1	1	
2			2	2	1	2	2		2	3	1	2	1	1	
3			2	2	1	2	2		2	3	1	2	1	1	
4			2	2	1	2	2		2	3	1	2	1	1	
5			2	2	1	2	2		2	3	1	2	1	1	

3 – High, 2 – Medium & 1 – Low Correlation

CLAD1041	ART OF PERSUASIVE COMMUNICATION	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

The first of the four graded Soft Skills courses covers foundational aspects crucial for early career development. It will enable learners to understand how to communicate effectively, master the art of expression and impactful presentations using context appropriate audio-visual aids. This course is more than just lessons; it is a guide to becoming a well-rounded and successful individual in a world where soft skills matter significantly.

Course Educational Objectives:

- Enable learners develop a foundational understanding of effective verbal and non-verbal communication concepts and familiarize students with basic technical and business communication skills.
- .Enable learners pick basic presentation skills, context appropriate strategies for organizing content in presentations and explore using audio visual aids and advanced verbal communication strategies, including persuasive techniques and non-verbal communication skills.
- .Enhance learners' understanding of interpersonal and cross cultural communication.
- .Introduce learners to context appropriate dress code and social norms.
- Enable learners to master the essentials of business writing, encompassing letters, emails, etiquette, and the creation of impactful memos, notices, and circulars, fostering effective communication and professional writing

List of Experiments

1. Foundations of Communication: Importance of communication in the professional world, overview of verbal and non-verbal communication skills, enhancing vocal delivery and articulation, utilizing body language for effective communication and relevant activities.
2. Interpersonal Communication: Building and maintaining professional relationships, conflict resolution in the workplace, role play and relevant activities.

3. Cross Cultural Communication: Understanding and navigating cultural differences, communication in the workplace - standards
4. Presentation Skills: Basics of effective presentations, understanding the importance of presentation skills, overcoming stage fear and building confidence
5. Structuring your presentation: Developing a clear introduction, body, and conclusion; organizing content for maximum impact
6. Visual Aids and Technology in Presentations: Creating impactful slides and visual aids, Incorporating technology for engaging presentations
7. Audience Engagement Strategies: Techniques to capture and maintain audience interest, Encouraging interaction and participation, relevant activitiesExercise Adapting to Different Presentation Contexts: Tailoring presentations for various audiences
8. (technical vs. non-technical), adjusting presentation style for different settings (academic, industry, conferences)
9. Effective Use of Data and Statistics in Presentations: Presenting technical information with clarity, Interpreting and visualizing data effectively
10. Dress Code Standards and Presentation: Understanding dress code standards, dressing for success, navigating dress codes in professional environments
11. Basics of Business Writing: Letters and Emails, etiquette, drafting effective memos, notices, and circularsExercise

Textbook(s):

1. Gupta, S., Soft Skill - Interpersonal & Intrapersonal Skills Development, 2020

2. Chauhan, G. S., & Sharma, S., Soft Skills: An Integrated Approach to Maximise Personality, Wiley, 2016

Reference(s):

1. Rizvi, M. A., Effective Technical Communication., 2005

2. Nawal, M., Business Communication., 2012

3. Raman, M. S., Technical Communication Principles and Practice., 2020

Course Outcomes:

1. Communicate effectively using verbal and non-verbal skills and put to use basic technical and business communication skills.
2. Demonstrate basic presentation skills, choose context appropriate strategies for organizing content and use audio visual aids, employ advanced verbal communication strategies, including persuasive techniques and non-verbal communication skills.
3. Exhibit understanding of interpersonal communication and cross cultural communication.

4. .Exhibit understanding of context, appropriate dress code and social norms in day to day lives.
5. Proficiently craft professional business communication, including letters, emails, memos, notices, and circulars, while adhering to etiquette norms for effective and impactful correspondence.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1									2	2		1			
2									2	2		1			
3									2	2		1			
4									2	2		1			
5									2	2		1			

3 – High, 2 – Medium & 1 – Low Correlation

CLAD1051	COMPETENCE IN COMMUNICATION	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

The second of the four graded Soft Skills courses delve deeper into advanced communication and presentation skills with nuanced time management skills. Facilitating the learners in applying the principles of social etiquette and professionalism, this course emphasizes a collaborative and supportive environment that helps learners prepare for success in both personal and professional spheres. It also builds upon the foundational knowledge acquired in the previous course.

Course Educational Objectives:

- Enhance learners' professional reputation in the workplace by developing professional communication skills. • Enable learners to explore technology tools for presentations using advanced verbal communication strategies, including strategies to overcome challenges on virtual platforms.
- Enable learners to collaborate with team members in practising and applying strategies for maintaining consistency and cohesion in team interactions.
- Enable learners to prepare technical documents and reports following advanced techniques and ethical norms. • Equip the learner to draft the CV/Resume addressing industry demands and to face interviews confidently.

List of Experiments

1. Foundations of Communication: Importance of communication in the professional world, overview of verbal and non-verbal communication skills, enhancing vocal delivery and articulation, utilizing body language for effective communication and relevant activities.
2. Interpersonal Communication: Building and maintaining professional relationships, conflict resolution in the workplace, role play and relevant activities.
3. Cross Cultural Communication: Understanding and navigating cultural differences, communication in the workplace - standardsExercise
4. Presentation Skills: Basics of effective presentations, understanding the importance of

presentation skills, overcoming stage fear and building confidence

5. Structuring your presentation: Developing a clear introduction, body, and conclusion; organizing content for maximum impact
6. Visual Aids and Technology in Presentations: Creating impactful slides and visual aids, Incorporating technology for engaging presentations
7. Audience Engagement Strategies: Techniques to capture and maintain audience interest, Encouraging interaction and participation, relevant activities
8. Adapting to Different Presentation Contexts: Tailoring presentations for various audiences (technical vs. non-technical), adjusting presentation style for different settings (academic, industry, conferences)
9. Effective Use of Data and Statistics in Presentations: Presenting technical information with clarity, Interpreting and visualizing data effectively
10. Dress Code Standards and Presentation: Understanding dress code standards, dressing for success, navigating dress codes in professional environments
11. Basics of Business Writing: Letters and Emails, etiquette, drafting effective memos, notices, and circularsExercise

Textbook(s):

1. Gupta, S., Soft Skill - Interpersonal & Intrapersonal Skills Development., V&S Publishers., 2020 2. Chauhan, G. S., & Sharma, S., Soft Skills: An Integrated Approach to Maximise Personality., Wiley, 2016

Reference(s):

1. Rizvi, M. A., Effective Technical Communication., 2005
2. Nawal, M., Business Communication., 2012
3. Raman, M. S., Technical Communication Principles and Practice., 2020

Course Outcomes:

1. Deduce the skills required for developing a professional reputation in the workplace by using effective communication strategies.
2. Apply advanced technological tools and techniques in presentation and to overcome the challenges on the virtual platform.
3. Deliver presentations by collaborating with team members maintaining consistency and cohesion.
4. Compile technical documents and reports applying advanced techniques and adhering to ethical norms.
5. Draft winning CV / Resume addressing industry demands and face interviews confidently.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1									2	2		1			
2									2	2		1			
3									2	2		1			
4									2	2		1			
5									2	2		1			

3 – High, 2 – Medium & 1 – Low Correlation

CLAD1061	LIFE SKILLS	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 is designed to help students enhance self-awareness with a focus on managing physical and mental health, emotions and stress. As a life skill course, it helps the learners deal with adversity, develop resilience and build coping skills. In addition to helping students develop empathy, the course augments interpersonal sensitivity and enables students to improve the quality of their interpersonal relationships.

Course Educational Objectives:

- To develop an enhanced awareness of self
- To promote a focus on physical and mental health
- To facilitate an understanding of the sources of stress and reactions to stress
- To discuss the significance of emotional intelligence
- To help appreciate the role of empathy in enhancing interpersonal sensitivity

List of Experiments

1. Self Awareness
2. Staying Well: Connectedness between Physical and Mental Health
3. Stress and Coping
4. Emotional Intelligence
5. Empathy

Textbook(s):

1. Feldman, R.S., Adjustment: Applying Psychology in a Complex World., McGraw-Hill,Newyork, 1989

Reference(s):

1. Linden, W., Stress Management: From Basic Science to Better Practice., Sage,Newyork, 2004
2. Goleman, D., Working with Emotional Intelligence., Bantam,London, 2000

Course Outcomes:

1. Have an enhanced understanding of self
2. Appreciate the importance of maintaining physical and mental health
3. Identify stressors and develop coping mechanisms
4. Develop an ability to manage emotions intelligently
5. Appreciate diversity through empathy

Course Articulation Matrix:

	POs												**PSOs**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1									2	2		1			
2									2	2		1			
3									2	2		1			
4									2	2		1			
5									2	2		1			

3 – High, 2 – Medium & 1 – Low Correlation

ENVS1003	ENVIRONMENTAL STUDIES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

The National Education Policy (NEP) 2020 underlines the importance of making environmental education an integral part of curricula and encouraging environmental awareness and sensitivity towards its conservation and sustainable development. Environmental studies include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development.

Course Educational Objectives:

• To developed expertise relevant to the historical context of human interactions with the environment • To make student aware about the concept of natural resources and its need for protection

• To make student aware of role of environmental legislations to protect environment

• To make student aware of a comprehensive knowledge of climate change and sustainable development goals

MODULE 1: HUMANS AND THE ENVIRONMENT, ENVIRONMENTAL ISSUES: LOCAL, REGIONAL AND GLOBAL **12 Hrs**

The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowelege and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. Environmental Ethics and emergence of environmentalism: Anthropocentric and ecocentric perspectives; The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.

MODULE 2 : NATURAL RESOURCES AND SUSTAINABLE DEVELOPMENT 8 Hrs

Overview of natural resources: Definition of resource; Classification of natural resources; Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic; Microbes as a resource; Status and challenges.Water resources: Types - fresh water and marine resources; Environmental impact of over-exploitation, issues and challenges. Mineral resources: Importance of mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation.

Energy resources: Sources and their classification (renewable - coal, oil, natural gas, nuclear energy and non-renewable - solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen); Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.

MODULE 3 :CONSERVATION OF BIODIVERSITY AND ECOSYSTEMS, ENVIRONMENTAL POLLUTION AND HEALTH 8 Hrs

Biodiversity: Biodiversity as a natural resource and its distribution; Levels and types of biodiversity; Biodiversity hotspots; Threats to biodiversity and ecosystems.

Biodiversity conservation. Ecosystems and their services: Major ecosystem types in India and their basic characteristics - forests, wetlands, grasslands, agriculture, coastal and marine. Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Causes, effects and control measures of air, water, soil and noise pollution: Principles and need of Solid and hazardous waste management. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

MODULE 4: CLIMATE CHANGE: IMPACTS, ADAPTATION MITIGATION, AND ENVIRONMENTAL MANAGEMENT 8 Hrs

Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Impacts, vulnerability and adaptation to climate change; Mitigation of climate change: Synergies between adaptation and mitigation measures; GHG reduction vs. sink enhancement; Concept of carbon intensity; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Carbon capture and storage, National climate action plan; Climate justice.

Environmental management system: Concept of ISO 14001 and Circular Economy, Life cycle analysis; Environmental audit and impact assessment; Concept of 3R and sustainability; Ecolabeling /Ecomark scheme

MODULE 5: ENVIRONMENTAL TREATIES, LEGISLATION CASE STUDIES AND FIELD WORK

9 Hrs

An overview of instruments of international cooperation; conventions and protocols; COP Major International Environmental Agreements: CITES; Ramsar Convention; UNCCD; Vienna Convention; Montreal Protocol ; Basel Convention; Rotterdam Convention; Stockholm Convention; UNFCCC; Kyoto Protocol; Paris Agreement; Major Indian Environmental Legislations: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; Waste management rules; Field visits to identify local/regional environmental issues; Participation in plantation drive and nature camps; Documentation of campus biodiversity; Campus environmental management activities such as solid waste disposal, water management and sanitation and sewage treatment

Textbook(s):

1. Fisher, Michael H., An Environmental History of India- From Earliest Times to the Twenty-First Century, , Cambridge University Press., 2018
2. Perman, R., Ma, Y., McGilvray, J., and Common, M., Natural Resource and Environmental Economics. Pearson Education., Pearson Education., 2003
3. William P.Cunningham and Mary A., Cunningham Environmental Science: A Global Concern, Mc-Graw Hill, USA), 2015 4. Bawa, K.S., Oomen, M.A. and Primack, R., Conservation Biology: A Primer for South Asia. Universities Press., Universities Press.,
5. Jackson, A. R., & Jackson, J. M. , . Environmental Science: The Natural Environment and Human Impact. Pearson Education, Pearson Education, 2000
6. Ahluwalia, V. K., . Environmental Pollution, and Health. The Energy and Resources Institute (TERI), 2015 7. Tiefenbacher, J, Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, , London, 8. Theodore, M. K. and Theodore, Louis , Introduction to Environmental Management, , 2nd , CRC Press,

Reference(s):

1. Hughes, J. Donald, An Environmental History of the World- Humankind’s Changing Role in the Community of Life,, 2nd , Routledge. , 2009
2. John W. Twidell and Anthony D., Renewable Energy Sources, Weir Publisher, 2015
3. Singh, J.S., Singh, S.P. & Gupta, S.R., Ecology, Environment and Resource Conservation. , Anamaya Publications , 4. Manahan, S.E., Environmental Chemistry, 11th, CRC Press., 2022
5. Central Pollution Control Board Web page for various pollution standards.,
6. Pittock, Barrie, Climate Change: The Science, Impacts and Solutions. , 2nd , Routledge., 2009

Course Outcomes:

1. Gain insights into the international efforts to safeguard the Earth's environment and resources,ecosystems, biodiversity and conservation
2. Identify types of natural resources, their distribution and use with special reference to India.
3. Discuss the factors affecting the availability of natural resources, their conservation.
4. An overview of national and global efforts to address climate change adaptation and mitigation efforts
5. Understand different approaches of assessing environmental quality and associated risks

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	3	2				2			
2						2	3	2				2			
3						2	3	2				2			
4						2	3	2				2			
5						2	3	2				2			

3 – High, 2 – Medium & 1 – Low Correlation

POLS1051	THE INDIAN CONSTITUTION	L	T	P	S	J	C
		1	0	0	0	0	1
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.
- To inculcate constitutional morality.

MODULE 1 INTRODUCTION TO INDIAN CONSTITUTION 3 Hrs

Introduction to constitutions, Purpose of a constitution, How should a society make a constitution? Constituent Assembly and the making of India's constitution

MODULE 2 FUNDAMENTALS OF INDIAN CONSTITUTION 3 Hrs

Preamble: origin and significance, Fundamental rights and its significance, Directive principles of state policy and philosophical principles, Basic structure, case studies.

MODULE 3 CITIZENSHIP 3 Hrs

Citizenship: basic concepts, citizenship in Indian constitution, changes in citizenship law, challenges and future.

MODULE 4 ORGANS OF THE STATE 3 Hrs

The executive: The President, Prime Minister and the Council of Ministers, the legislature: Parliament, Lok Sabha and Rajya Sabha, Collective responsibility, the judiciary: the Supreme Court, changing nature of relationship between the three organs.

MODULE 5 DISTRIBUTION OF POWERS 3 Hrs

Separation of powers at state level: executive, legislature and judiciary; changing nature of union and state relations; 73rd and 74th constitutional amendments, rural and urban local governments: challenges and future.

Texbook(s):

1. Granville Austin, The Indian Constitution: Cornerstone of a Nation, 1966
2. Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, The Oxford Handbook of the Indian Constitution, 2016

Course Outcomes:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance is carried out in India
2. Become aware of the fundamental rights and duties of the citizens as well as the obligation of the state towards its citizens.
3. Familiarize with key political developments that have shaped the Constitution and amended it from time to time.
4. Imbibe the values enshrined in the constitution and follow the constitutional morality.
5. Equip themselves to take up other courses in law after having done a foundation course on Indian Constitution.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2		2							
2						2		2							
3						2		2							
4						2		2							
5						2		2							

3 – High, 2 – Medium & 1 – Low Correlation

FINA1081	PERSONAL FINANCIAL PLANNING	L	T	P	S	J	C
		1	0	0	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course provides a comprehensive understanding of the foundations of finance, with a focus on the behavioral aspects of decision-making. Students explore topics such as risk attitudes, decision-making under uncertainty, biases, and heuristics. They learn about investment products, measuring returns, portfolio diversification, and asset allocation. The course emphasizes personal financial goal-setting and planning, including the development of financial statements and balance sheets. Additionally, students gain knowledge of tax planning and its impact on financial decisions. By the end of the course, students are equipped with the skills to make informed financial decisions and effectively plan for their personal financial goals.

Course Educational Objectives:

- To Understand the financial behaviour and Personal Financial planning process and application of time value of money
- To know applications of the financial decisions making beliefs , biases to take informed decision for better financial planning.
- Understand the investment products and measuring risk return analysis
- To know and prepare the Personal Finance Goals and analyses the factors influencing personal financial planning.
- To Understand the tax rules and to make better financial decision making and analysis the Tax Planning.

MODULE 1: INTRODUCTION TO BEHAVIORAL ECONOMICS AND FINANCE 3 Hrs

Foundation of Finance – Equity – bond , debenture - – Behavioural aspects of finance decisions - investment decisions – financing decisions and other decisions- economics of decision making – risk attitude and decision making – decision making under risk – certainty equivalent and risk premium.

MODULE 2 : BELIEFS, BIASES AND HEURISTICS FINANCIAL DECISION-MAKING 3 Hrs

Beliefs, Biases and Heuristics Financial Decision-Making Beliefs - Biases – information overload and decision constraints – Overconfidence and Investor Behavior - ease of processing information – familiarity Heuristics – behavioural investing – loss of aversion – and investor Behaviour – sunk cost fallacy - financial decision making – home bias – representativeness (good companies vs. good investments) – return chasers - availability of heuristics – availability and attention grabbing - anchoring – anchor to informed decision making - overconfidence bias – sample model of overconfident trader.

MODULE 3: INVESTMENT PRODUCTS AND MEASURING INVESTMENT RETURNS: 3 Hrs

Financial Assets and valuation – present value of financial commitments (time value of money) - Investment Portfolio risk and return – return and biases and relationship – portfolio diversification - Portfolios for Individual Investors – assets allocation – return maximization and risk minimizations (L28)- Portfolio Return and Risk

MODULE 4: PERSONAL FINANCIAL GOAL - PLANNING PERSONAL FINANCES - PERSONAL FINANCIAL STATEMENTS 3 Hrs

Personal financial goals – time based financial goals – need based financial goals – setting and basic guideline for developing financial goals -common financial goals for individuals – factors influencing financial goals - life situations and personal value – economic factors - financial planning process – personal financial settlement – cash flow personal balance sheet

MODULE 5: TAX PLANNING - TAXES AND FINANCIAL PLANNING - TAXES AND FINANCIAL PLANNING 3 Hrs

Income tax basics – taxes and financial planning – implications of taxes on returns – before and after tax rate of returns – calculating taxable income and tax liability – tax planning for personal finance – purchase decisions – investment decisions – incorporating taxes into financial plan – tax saving guidelines

Texbook(s):

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

Reference(s):

1. S Murali and K R Subbakrishna, Personal Financial Planning (Wealth Management) ,

Course Outcomes:

1. Explain the financial planning process and how time value of money is used.
2. Financial planning with informed decision making by considering different dimensions of beliefs and biases.

3. Recognize the various investment options and do an investment return analysis.
4. Recognize and set up a personal financial for goals.
5. Explain tax rules and effects on financial planning and examine the Tax Planning strategies

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						1		1			2				
2						1		1			2				
3						1		1			2				
4						1		1			2				
5						1		1			2				

3 – High, 2 – Medium & 1 – Low Correlation

PHPY1011	GANDHI AND THE CONTEMPORARY WORLD	L	T	P	S	J	C
		1	0	0	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course provides the students with basic knowledge on Gandhi's life, his philosophies and his relevance in the contemporary world.

Course Educational Objectives:

- To provide the students with the basic knowledge on Gandhi's life and his philosophies
- To understand his role in the Indian national movement
- To apply Gandhian Ethics while analysing the contemporary social/political issues

MODULE 1 GANDHI'S LIFE AND HIS PHILOSOPHIES 3 Hrs

Gandhi's Life and major contributions- Gandhi and Indian National Movement

MODULE 2 ELEVEN VOWS OF MAHATMA GANDHI 3 Hrs

Ashram Vows/Eleven Vows of Gandhi and its implications

MODULE 3 GANDHI AND SARVODAYA 3 Hrs

Sarvodaya as a Social Philosophy- Its Implications - Gandhian Socialism – Jayaprakash Narayan and Total Revolution- Vinoba Bhave and Bhoodan movement

MODULE 4 NEW EDUCATION/BASIC EDUCATION 3 Hrs

Gandhi's views on Education-His experiments at Phoenix settlement and Tolstoy Farm-Educational Policies in independent India

MODULE 5 RELEVANCE OF GANDHI IN THE CONTEMPORARY TIMES 3 Hrs

Contemporary challenges-moral-social-political and environmental challenges-Insights from Gandhi-Gandhi and Gandhism after Gandhi

Texbook(s):

1. Gandhi, M. K. , The Story of My Experiments with Truth., Navjivan Publishing House,Ahmadabad, 1948
2. Gandhi, M K, Satyagraha in South Africa, Navjivan Publishing House,Ahmadabad, 1968

3. Kripalani, J.B, Gandhi: His Life and Thought. , Publications Division,New Delhi, 1970

Course Outcomes:

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. Critically evaluate the relevance of Gandhi's ideas and principles in addressing contemporary moral, social, political, and environmental challenges.
5. Articulate Gandhi's views on education, particularly his concept of Basic Education

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2	2	2							
2						2	2	2							
3						2	2	2							
4						2	2	2							
5						2	2	2							

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1181	YOGASANA	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

Yoga course also helps to learn about healthy practices like regulating breathing through various techniques, performing physical exercises, and relaxation habits for long-term well- being. Students will mainly focus on the subjects like philosophy, yoga and health, and motivation.

Course Educational Objectives:

- To attain a high level of consciousness
- To enable the students to lead a healthy lifestyle
- To practice mental hygiene
- To increase concentration and self control
- To improve the immune system

List of Topics

1. Pranasanchalana (Preparatory postures) - Tadasana , Parshwa Tadasana , TiryakTadasana , Vrukshasan , Trikonasana , Utkatasana
2. Supine Postures - Uthanupadasana , Pawanamukthasana , Sethubandhasana , Sarvangasana , Matsyasana
3. Prone Asanas - Salabasana, Sarpasana , Dhanurasana
4. Sitting Asanas - Vajrasana , Shashankasana, Supthavajrasana , Ustrasana , Sarala Vakrasana Surya Namaskara, Pranayama and Relaxation
5. Surya Namasakara , Anuloma Viloma-Brahmari Relaxation technique

Textbook(s):

1. Yoga Sutras of Patanjali, Swami Satchidananda,

Reference(s):

1. The Heart of Yoga: Personal Practice,
2. Sun Salutations,

3. Complete Book of Yoga: Harmony of Body and Mind,

Course Outcomes:

1. Yoga improves mental & physical strength, balance and flexibility
2. Yoga benefits heart health
3. Yoga develops core strength
4. Yoga connects you with a supportive community
5. Yoga usually involves paying attention to your breath, which can help you relax

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

MFST1002	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 to exercise, 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

List of Experiments

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

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
5. knowing to maintain emotional and physical balance

Course Articulation Matrix:

CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSL1081	STUDENT LIFE ACTIVITIES - PARTICIPANT	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

This course recognizes student participation in co-curricular and extra-curricular activities organised by student organisations and/or institutional departments to explore their interests. It will enable students to identify, involve, and pursue avocational interests through experiential learning opportunities.

Course Educational Objectives:

- Encourage participation across a spectrum of co-curricular and extracurricular offerings
- Foster hands-on engagement to cultivate interpersonal social competencies
- Empower learners to explore their passions and skills outside/beyond the classroom
- Inspire students to give back to society through welfare and community activities

List of Topics

1. Art & Culture (Music, Dance, Theatre, Crafts, Cinema, Cuisine, Quiz, Debate, Photography, Literature, Heritage, Creative Writing, Fashion, Social Media, Travel, Comedy, and Gaming)
2. Self-Development (Oratory, Entrepreneurship, Leadership, Language, Design, Student Mobility, Higher Education, and Career Guidance)
3. Wellness (Physical Health & Hygiene, Mental Health, Mindfulness, Community Building, and Socio-Cultural Inclusion)
4. Technical (Coding, Cybersecurity, Animation, Innovation, Astronomy, Robotics, Consulting, Business, Aeronautics, Automotive, and Research)
5. Social Cause (Community Service, Allyship, Women Empowerment, Sustainability and Animal Welfare)

Textbook(s):

1. Jayshree Nair-Misra., TAGORE- A LIFE OF LEARNING, Azim Premji University, 2012

Reference(s):

1. Newport, Cal., How to Win at College: Surprising Secrets for Success from the Country's Top Students., 2005
2. Light, Richard J., Making the Most of College., 2004
3. TEDx Talks., "TEDxToronto - Drew Dudley "Leading with Lollipops.", 2010
4. TED., "How to Start a Movement | Derek Sivers." ,, 2010
5. "Randy Pausch Last Lecture: Achieving Your Childhood Dreams." ,, YouTube,Carnegie Mellon University., 2007 6. "Dead Poets Society.", 1989
7. J. Cohan, Deborah., "10 Benefits of Extracurricular Activities in College." Psychology Today,, Psychology Today,, 2023
8. Christison, Claudette., "The Benefits of Participating in Extracurricular Activities." BU Journal of Graduate Studies in Education,, BU Journal of Graduate Studies in Education,, 2013

Course Outcomes:

1. Broaden Experiential Horizons
2. Enhance Self-Discovery
3. Cultivate Diversity Awareness
4. Effective Communication Skills
5. Enhance Problem-Solving Skills

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSL1091	STUDENT LIFE ACTIVITIES - ORGANIZER	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

This course promotes and acknowledges students' efforts towards organising various co-curricular and extra-curricular activities as part of various student organisations and/or institutional departments in their area of interest. It will provide students with opportunities for experiential learning through end-to-end planning and execution of versatile events as part of a team.

Course Educational Objectives:

- Enable learners to organise a wide variety of co-curricular and extracurricular activities
- Foster hands-on engagement to cultivate interpersonal social competencies
- Inculcate the ability to effectively work with a group of diverse individuals
- Enhance managerial and administrative skills essential for professional development

List of Topics

1. Art & Culture (Music, Dance, Theatre, Crafts, Cinema, Cuisine, Quiz, Debate, Photography, Literature, Heritage, Creative Writing, Fashion, Social Media, Travel, Comedy, and Gaming)
2. Self-Development (Oratory, Entrepreneurship, Leadership, Language, Design, Student Mobility, Higher Education, and Career Guidance)
3. Wellness (Physical Health & Hygiene, Mental Health, Mindfulness, Community Building, and Socio-Cultural Inclusion)
4. Technical (Coding, Cybersecurity, Animation, Innovation, Astronomy, Robotics, Consulting, Business, Aeronautics, Automotive, and Research)
5. Social Cause (Community Service, Allyship, Women Empowerment, Sustainability and Animal Welfare)

Textbook(s):

1. Jayshree Nair-Misra., Nair-Misra. "Tagore - A Life of Learning." Azim Premji University,, Azim Premji University,, 2012

Reference(s):

1. Newport, Cal., How to Win at College: Surprising Secrets for Success from the Country's Top Students., 2005
2. Light, Richard J., Making the Most of College., 2004
3. TEDx Talks., "TEDxToronto - Drew Dudley "Leading with Lollipops.", 2010
4. TED., "How to Start a Movement | Derek Sivers." ,, 2010
5. "Randy Pausch Last Lecture: Achieving Your Childhood Dreams." ,, YouTube,Carnegie Mellon University., 2007 6. "Dead Poets Society.", 1989
7. J. Cohan, Deborah., "10 Benefits of Extracurricular Activities in College." Psychology Today,, Psychology Today,, 2023
8. Christison, Claudette., "The Benefits of Participating in Extracurricular Activities." BU Journal of Graduate Studies in Education,, BU Journal of Graduate Studies in Education,, 2013

Course Outcomes:

1. Enhance Management Skills Development:
2. Effective Teamwork:
3. Cultivate Leadership Readiness:
4. Critical Thinking Proficiency:
5. Enhance Problem-Solving Skills:

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSL1101	STUDENT LIFE ACTIVITIES - COMPETITOR	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

This course encourages student participation in co-curricular and extra-curricular competitions organised at local, national and international levels. It will allow students to make use of various creative opportunities and benchmark themselves within their peer group on recognised platforms.

Course Educational Objectives:

- Encourage competitive participation in both co-curricular and extracurricular offerings
- Foster hands-on engagement to cultivate interpersonal social competencies
- Empower learners to explore their passions and skills outside/beyond the classroom
- Inculcate a healthy paradigm of self-awareness, commitment, and honour

List of Topics

1. Art & Culture (Music, Dance, Theatre, Crafts, Cinema, Cuisine, Quiz, Debate, Photography, Literature, Heritage, Creative Writing, Fashion, Social Media, Travel, Comedy, and Gaming)
2. Self-Development (Oratory, Entrepreneurship, Leadership, Language, Design, Student Mobility, Higher Education, and Career Guidance)
3. Wellness (Physical Health & Hygiene, Mental Health, Mindfulness, Community Building, and Socio-Cultural Inclusion)
4. Technical (Coding, Cybersecurity, Animation, Innovation, Astronomy, Robotics, Consulting, Business, Aeronautics, Automotive, and Research)
5. Social Cause (Community Service, Allyship, Women Empowerment, Sustainability and Animal Welfare)

Textbook(s):

1. Jayshree Nair-Misra., Nair-Misra. “Tagore - A Life of Learning.” Azim Premji University,, Azim Premji University,, 2012

Reference(s):

1. Newport, Cal., How to Win at College: Surprising Secrets for Success from the Country's Top Students., 2005
2. Light, Richard J., Making the Most of College., 2004
3. TEDx Talks., "TEDxToronto - Drew Dudley "Leading with Lollipops.", 2010
4. TED., "How to Start a Movement | Derek Sivers." ,, 2010
5. "Randy Pausch Last Lecture: Achieving Your Childhood Dreams." ,, YouTube,Carnegie Mellon University., 2007 6. "Dead Poets Society.", 1989
7. J. Cohan, Deborah., "10 Benefits of Extracurricular Activities in College." Psychology Today,, Psychology Today,, 2023
8. Christison, Claudette., "The Benefits of Participating in Extracurricular Activities." BU Journal of Graduate Studies in Education,, BU Journal of Graduate Studies in Education,, 2013

Course Outcomes:

1. Enhanced Expertise:
2. Cultivate Social Competencies:
3. Critical Thinking Proficiency:
4. Effective Communication Skills:
5. Effective Teamwork:

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSL1111	FOUNDATIONS OF STUDENT LEADERSHIP	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

This course aims to provide a foundation for student leadership through opportunities to discover their strengths and identify areas for further development. Participants will delve deeper into understanding leadership through a research-driven framework provided by Kouzes and Posner's Five Practices of Exemplary Leadership (6th ed.) which consists of five key practices: Model the Way, Inspire a Shared Vision, Challenge the Process, Enable Others to Act, and Encourage the Heart.

Course Educational Objectives:

- Unlearn preconceived notions of what makes for an effective student leader
- Identify leadership fundamentals and develop strategies to enhance them
- Inculcate the ability to effectively work with a group of diverse individuals
- Encourage the practice of consensus building and feedback for growing as a leader

List of Topics

1. Model the Way: Leaders establish principles concerning the way people (constituents, peers, colleagues, and customers alike) should be treated and the way they should pursue goals. Leaders create standards of excellence and set an example for others to follow. They put up signposts when people feel unsure of where to go or how to get there. Leaders create opportunities for victory.
2. Inspire a Shared Vision: Leaders passionately believe they can make a difference. They envision the future and create an ideal and unique image of what the organization can become. Through their magnetism and persuasion, leaders enlist others in their dreams. They breathe life into their visions and get people to see exciting possibilities for the future.
3. Challenge the Process: Leaders search for opportunities to change the status quo. They look for innovative ways to improve the organization. In doing so, they experiment and take risks. Since complex change threatens to overwhelm people and stifle action, leaders set interim goals so that people can achieve small wins as they work toward larger objectives. Effective leaders unravel bureaucracy when it impedes action. And, because leaders know that taking

risks involves mistakes and failures, they accept occasional disappointments as opportunities to learn.

4. Enable Others to Act: Leaders foster collaboration and build spirited teams. They actively involve others. Leaders understand that mutual respect sustains extraordinary efforts. They strive to create an atmosphere of trust and human dignity. They strengthen others, making each person feel capable and powerful.
5. Encourage the Heart: Accomplishing extraordinary things in organizations is hard work. To keep hope and determination alive, leaders recognize the contributions that individuals make. In every winning team, the members need to share in the rewards of their efforts, so leaders celebrate accomplishments. They make people feel like heroes.

Textbook(s):

1. Kouzes, J. M., Posner, B. Z., High, B., & Morgan, G. M., The student leadership challenge: Five Practices for Becoming an Exemplary Leader ., (4th Ed), John Wiley & Sons., 2024

Reference(s):

1. Kouzes, J.M. & Posner, B.Z., The Leadership Challenge Workshop: Participant Workbook., (5th ed.), 2017
2. Kouzes, J. M., & Posner, B. Z., The Leadership Challenge: How to Make Extraordinary Things Happen In Organizations, (7th ed.), 2023
3. 42 FRESH IDEAS, 2018
4. THE LEADERSHIP CHALLENGE [VIDEO}.,

Course Outcomes:

1. Critical Self-Reflection
2. Leadership Fundamentals
3. Diverse Team Collaboration
4. Consensus Building and Feedback Integration
5. Communication skills

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1			2	2	1	2	2		2	3	1	2	1	1	
2			2	2	1	2	2		2	3	1	2	1	1	
3			2	2	1	2	2		2	3	1	2	1	1	
4			2	2	1	2	2		2	3	1	2	1	1	
5			2	2	1	2	2		2	3	1	2	1	1	

3 – High, 2 – Medium & 1 – Low Correlation

DOSL1042	COMMUNITY SERVICES - VOLUNTEER	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 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 Experiments

1 Community Health Services Exercise

2 Swachh Bharat Abhiyan and other Cleanliness drives management)

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

16 Participation in various community service activities

17 Weekly reflection paper

18 Portfolio (on social media using an Instagram account)

19 Two learning papers (one per semester)

Texbook(s):

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

Reference(s):

1. Nicholas Kristof and Sheryl Wu Dunn, A path appears: Transforming lives, creating opportunities, 2. M. K. Gandhi, The story of My Experiments with Truth,

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSL1052	COMMUNITY SERVICES - MOBILIZER	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 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 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 Experiments

1. Community Health Services
2. "Swachh Bharat Abhiyan and other Cleanliness drives management)"
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
16. Organizing and leading teams in various community service activities
17. Fortnightly reflection paper
18. Portfolio (on social media using an instagram account)
19. Two learning papers (one per semester)

Texbook(s):

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

Reference(s):

1. Nicholas Kristof and Sheryl Wu Dunn, A path appears: Transforming lives, creating opportunities,
2. M. K. Gandhi, The story of My Experiments with Truth,
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 fellow students
3. Understanding the process of mobilizing cash, kind and volunteer support
4. Building leadership and management skills
5. Building empathy and citizenship behavior

Course Articulation Matrix:

	POs												**PSOs**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1003	BADMINTON	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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.

List of Topics

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

Textbook(s):

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1033	FOOTBALL	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1043	VOLLEYBALL	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1053	KABADDI	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

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

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1073	TABLE TENNIS	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1083	HANDBALL	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1093	BASKETBALL	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1113	THROWBALL	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

1. World Throw ball Federation - Rules of the Game ,

Course Outcomes:

1. Learn to play Throw ball
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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1142	CRICKET	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

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 Topics

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

Textbook(s):

1. Law of Cricket -MCC ,

Course Outcomes:

1. Learn to play Cricket
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

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1132	FUNCTIONAL FITNESS	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

This course provides instruction and the opportunity for participation in physical fitness activities. Injury Prevention, Weight Management, Food and Nutrition, Resistance Training strategies, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physical and physiological functions of the human body.

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 Topics

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

Textbook(s):

1. National Institute of Health,
2. World Health Organization,
3. JC Santana, author of Functional Training ,

Course Outcomes:

1. Learn to how to do Physical fitness Activities
2. Understanding of the fundamental concepts such as Physical Activates, variations of training .
3. Understanding of the governing structure and administration training
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

DOSP1171	MARTIAL ARTS/SELF DEFENCE	L	T	P	S	J	C
		0	0	0	2	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	NO						

Course Description:

The fundamental objective of self defence training is to prepare and empower the students with techniques to handle an attack. Self defence course not only enables students to defend themselves against physical attack, it also has diverse benefit for the students in their everyday lives.

Course Educational Objectives:

- To enhance the ability to defend and protect
- To enhance confidence building
- To enhance the value of self-discipline
- To inculcate the knowledge of life skills.
- To enhance the employment opportunities.
- To facilities the students in improving physical and mental health.

List of Topics

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

Textbook(s):

1. Self Defence Make Simple ,
2. Phil Pierce 2. Self Defence : Janathan Kellerman,
3. Right of Private and Self Defence : Ramachandra,

Course Outcomes:

1. Learn to how to do Martial Arts and Self defence
2. Understanding of the fundamental concepts such as Physical Activates, variations type of training
3. Understanding of the governing structure and administration training
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1						2	2	2	2	2					
2						2	2	2	2	2					
3						2	2	2	2	2					
4						2	2	2	2	2					
5						2	2	2	2	2					

3 – High, 2 – Medium & 1 – Low Correlation

Faculty Core (FC)

MATH1341	CALCULUS AND DIFFERENTIAL EQUATIONS	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	Single Variable Calculus and Ordinary Differential Equations						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course is designed to impart knowledge on calculus and ordinary differential equations of functions of one or more variables taught in this course are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters as basic concepts for modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Course Educational Objectives:

- Understand the differentiation of a functions of several variables and the extreme values.
- To explain evaluation of multiple integrals over various regions and their applications in engineering.
- To explain calculus over vectors and their physical interpretations in engineering.
- To impart knowledge on ordinary differential equations and some applications in engineering.

MODULE1 PARTIAL DERIVATIVES 12 Hrs

Partial derivatives, The chain rule, extreme values and saddle points, Taylor's series of quadratic and cubic approximations.

MODULE 2 MULTIPLE INTEGRALS -DOUBLE INTEGRALS-APPLICATIONS 12 Hrs

Double and Iterated Integrals over rectangular regions, double Integrals over general regions, Reversing the order, Area by double Integration, double Integrals in Polar form

MODULE 3 TRIPLE INTEGRALS 12 Hrs

Double and Iterated Integrals over rectangular regions, double Integrals over general regions, Reversing the order, Area by double Integration, double Integrals in Polar form.

MODULE 4 VECTOR CALCULUS: 12 Hrs

Vector Differential Calculus. Grad, Div, Curl, Line, Vector Fields and Line Integrals: Work, Circulation, and Flux, Path Independence. Green's Theorem in the Plane, Surfaces for Surface Integrals

MODULE 5 DIFFERENTIAL EQUATIONS **12 Hrs**

Homogeneous Linear ODEs with Constant Coefficients, Euler–Cauchy Equations, Nonhomogeneous ordinary differential equations, Modeling-Forced oscillations, Resonance, Electric circuits,Solution by Variation of Parameters,

Textbook(s):

1. Joel Hass, Christopher Heil, Maurice D. Weir, Pearson Addison Wesley 2018) -(Modules 1-4), 4,
2. Erwin Kreys, Adavanced Engineering Mathematics, 10, JOHN WILEY & sons.inc,

Reference(s):

1. B.S. Grewal, Engineering Mathematics , 44,
2. Dennis G. Zill, "Differential Equations with Boundary-Value Problems" ,

Course Outcomes (COs)

1. Compute partial derivatives, apply the chain rule, and analyze extreme values.
2. Evaluate double integrals, reverse order, and apply them to area calculations.
3. Compute triple integrals, change order, and apply them to volume calculations.
4. Use Grad, Div, Curl, evaluate line/surface integrals, and apply Green's theorem.
5. Solve ODEs, apply Euler–Cauchy equations, and model real-world systems.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1									2	2	
2	2	2	1	1									2	2	
3	2	2	1	1									2	2	
4	2	2	1	1									2	2	
5	2	2	1	1									2	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 08-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

MATH1272	LINEAR ALGEBRA	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 to gain knowledge in the concepts of Linear Algebra focusing on basics of matrices, matrix decomposition, 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:

- To familiarize with theory of matrices and tools for solving system of linear equations
- To impart knowledge on Eigen values and Eigen vectors.
- To teach the concepts of vector spaces (Linear Combination, Linear Span, Basis, dimension) and their properties.
- To explain the concepts of inner product spaces (Length, distance and angle between vectors).
- To familiarize with the concept of singular value decomposition.

MODULE 1 INTRODUCTION TO MATRICES: 12 Hrs

Introduction to Matrices (Matrix multiplication) and Determinants, Cramer's rule, inverse of a matrix, Echelon form, rank of a matrix, solving system of linear equations (Non-Homogeneous and Homogeneous), LU-decomposition method.

MODULE 2 VECTOR SPACES: 12 Hrs

Field, vector space, Linear dependence, Linear Independence, linear combination of vectors, linear span, basis, dimension and linear transformations (Definition and examples)

MODULE 3 EIGEN VALUES AND EIGEN VECTORS 12 Hrs

Eigen values and Eigen vectors, Cayley-Hamilton theorem (without proof), calculating powers of a matrix, Diagonalization, Quadratic forms and their definiteness.

MODULE 4 INNER PRODUCT SPACES: **12 Hrs**

Inner product spaces, length, distance, angle between vectors, cauchy-schwarz's inequality (Triangle Inequality and Parallelogram law), orthogonality, and orthonormal sets.

MODULE 5 SINGULAR VALUE DECOMPOSITION **12 Hrs**

Gram Schmidt orthogonalization process, singular values, singular value decomposition.

Textbook(s):

1. Erwin kreyszig, Advanced Engineering Mathematics, Tenth Edition,
2. David Lay, Steven Lay, Judi McDonald, Linear , Algebra and Its Applications, 5th Edition , Pearson , 2021

Reference(s):

1. S. Friedberg, A. Insel L. Spence, Linear Algebra , 4th Edition, 2013
2. S. Kumaresan, Linear algebra ,
3. Seymour Lipchutz, Linear Algebra , 4th edition, Schaum's Outline,Marc Lipson,

Course Outcomes:

1. solve the system of linear equations
2. understand the properties of rank and identifying solutions of system of linear equations.
3. calculate Eigen values and Eigen vectors, Cayley-Hamilton theorem, calculating powers of a matrix
4. construct ortho normal basis
5. learn and decompose a rectangular matrix. (Singular value decomposition)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2								2	2	1
2	3	2	2	2	2								2	2	1
3	3	2	2	2	2								2	2	1
4	3	2	2	2	2								2	2	1
5	3	2	2	2	2								2	2	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 28-06-2023 Academic Council Number: 27 Academic Council : 06-07-2023

MATH2581	**PROBABILITY THEORY AND RANDOM PROCESS**	**L**	**T**	**P**	**S**	**J**	**C**
		3	1	0	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	Basics of Probability						

Course Description:

This course provides a comprehensive introduction to probability theory and its applications in various fields. Through a combination of theoretical concepts and practical examples, students will develop a solid understanding of fundamental probability principles, random variables, and random processes. The course explores various probability distributions, their properties, and their applications in analyzing real-world phenomena. Additionally, students will learn about random processes and their temporal and spectral characteristics, preparing them for advanced studies in stochastic processes and related fields.

Course Educational Objectives:

- Understand the fundamental concepts of probability theory and its application in analyzing uncertain events and phenomena.
- Develop proficiency in mathematical techniques for modeling and analyzing random variables and their distributions.
- Gain insights into the behavior of multiple random variables, including joint distributions, conditional distributions, and statistical independence.
- Gain insights into the behavior of multiple random variables, including joint distributions, conditional distributions, and statistical independence.
- Apply probability theory and random processes to solve real-world problems in fields such as engineering, finance, and data science.

MODULE 1 PROBABILITY **12 Hrs**

Probability introduced through sets and relative frequency, joint and conditional probability, independent events, combined experiments, Bernoulli trials.

MODULE 2 RANDOM VARIABLE **12 Hrs**

Introduction, random variable concept, distribution function, density function, the Gaussian random variable, other distribution and density examples, conditional distribution and density functions. Operation on One Random Variable: Introduction, expectation, moments, functions that give moments, transformations of a random variable.

MODULE 3 MULTIPLE RANDOM VARIABLES **12 Hrs**

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. Expected Value of a Function of Random Variables: Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

MODULE 4 RANDOM PROCESS-I **12 Hrs**

Temporal characteristics - the random process concept, stationary and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

MODULE 5 RANDOM PROCESS-II **12 Hrs**

Spectral characteristics, the power spectrum: Properties, relationship between power spectrum and autocorrelation function, the cross-power density spectrum: Properties, relationship between crosspower spectrum and cross-correlation function.

Textbook(s):

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, , 4/e, Tata McGraw Hill, 2002 2. Athanasios Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002

Reference(s):

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, 2002

Course Outcomes:

1. Demonstrate proficiency in calculating probabilities using set theory, relative frequency, and various probability distributions.
2. Analyze the properties and behavior of random variables, including expectation, moments, and transformations. 3. Evaluate joint distributions and conditional distributions of multiple random variables, and assess their statistical independence.
4. Understand the concept of random processes, including stationary processes and correlation

functions.

5. Apply spectral analysis techniques to characterize the frequency content of random processes and interpret their spectral properties in practical contexts.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	2									2	2	
2	3	2	1	2									2	2	
3	3	2	1	2									2	2	
4	3	2	1	2									2	2	
5	3	2	1	2									2	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 08-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

MATH2591	COMPLEX VARIABLES & TRANSFORM TECHNIQUES	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

The objective of this course is to introduce the complex differentiation, harmonic functions, complex integration which helps in finding harmonic conjugates, finding winding number, to evaluate integrals over paths and waves. This course also deals with the transform techniques of Laplace and Fourier has wide range of applications in Signal processing, control systems and so on, Expansions of functions as an infinite Fourier series which are used in data transmission and modulation.

Course Educational Objectives:

- To explain the concepts of complex analysis and their applications.
- To demonstrate the concept of Laplace and inverse Laplace transforms, application to Ordinary differential equations.
- To impart the knowledge of Fourier series
- To explain the evaluation of Fourier transforms of various functions

MODULE 1 COMPLEX NUMBERS AND COMPLEX FUNCTIONS **12 Hrs**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugates, applications to flow problems.

MODULE 2 COMPLEX INTEGRATION – CONTOUR INTEGRALS **12 Hrs**

Integration of complex functions, Cauchy's theorem, Cauchy's integral formula, Singularities of analytic functions, Residue Cauchy's Residue theorem, Computation of Residues- application to Contour integrals.

MODULE 3 LAPLACE TRANSFORMS **12 Hrs**

Definition, Existence conditions, Properties of Laplace transforms, Inverse Laplace transforms, transform of- Derivative and integrals, multiplication by tn, division by t, convolution theorem, periodic functions, Unit - Step function, Unit Impulse function, applications to Ordinary differential equations

MODULE 4 FOURIER SERIES **12 Hrs**

Definition, Dirichlet's conditions, Fourier series – functions of any period, Odd and Even functions, Fourier half range series

MODULE 5 FOURIER TRANSFORMS **12 Hrs**

Fourier integrals, Fourier Cosine and Sine integrals, Fourier transform, Sine and Cosine transforms Properties, convolution theorem

Textbook(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, , Khanna Publishers, 2017

Reference(s):

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, 2004
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics , Narosa Publishing House,New Delhi, 2014
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e,
4. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, 2014

Course Outcomes:

1. Apply the C-R equations to check the analyticity , find the complex potential or velocity of flow problems.
2. Calculate residues and use of Cauchy Residue theorem to evaluate certain real definite integrals.
3. Evaluate the Laplace transforms of special functions and apply Laplace transform to solve the linear differential equations of continuous systems.
4. Develop the Fourier series expansion for different periodic functions and analyze the nature of Fourier series of even and odd functions.
5. Compute the Fourier transform of different functions along with properties..

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1									2	2	
2	2	2	1	1									2	2	
3	2	2	1	1									2	2	
4	2	2	1	1									2	2	
5	2	2	1	1									2	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 28-06-2023 Academic Council Number: 27 Academic Council : 06-07-2023

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:

- To introduce mathematical principles to estimate forces, fields and waves.
- To familiarize students with electromagnetics in modern communication systems.
- To impart knowledge concerning the electrical behaviour of dielectric materials.
- To demonstrate the properties of magnets.
- To introduce semiconductor physics and devices.

MODULE 1 BASICS OF ELECTROMAGNETICS 12 Hrs

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.

MODULE 2 FIBER OPTICS 12 Hrs

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numericalaperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

MODULE 3 DIELECTRIC, MAGNETIC AND SUPERCONDUCTING MATERIALS 12 Hrs

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.

MODULE 4 SEMICONDUCTOR PHYSICS 12 Hrs

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.

MODULE 5 SEMICONDUCTOR DEVICES 12 Hrs

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.

List of Experiments

Experiment 1 To determine the magnetic field along the axis of a circular coil carrying current.
Experiment 2To determine the numerical aperture of a given optical fiber and hence to find its acceptance
Experiment 3 To determine magnetic susceptibility by Quincke's tube method
Experiment 4 To determine the Hall coefficient using Hall effect experiment
Experiment 5 To determine the resistivity of semiconductor by Four probe method
Experiment 6 To determine the energy gap of a semiconductor.
Experiment 7 To study the characteristics of PN Junction diode.
Experiment 8 To study magnetic hysteresis loop (B-H curve).
Experiment 9 To determine the dielectric constant of a substance by resonance method.
Experiment 10 To determine hysteresis loss by CRO.
Experiment 11 To study the characteristics of Photodiode
Experiment 12 To study the characteristics of Solar Cell
Experiment 13 To study the characteristics of Zener diode
Experiment 14 To study the resonance of LCR circuit Experiment

Textbook(s):

1. David J.Griffiths, Introduction to Electrodynamics, 4, Pearson Education, 2014
2. Charles Kittel, Introduction to Solid State Physics, Wiley Publications, 2011
3. M. N. Avadhanulu, P.G. Kshirsaga, A Text book of Engineering Physics, 11, Chand Publications, 2019 4. S. Balasubramanian, M.N. Srinivasan, A Text book of Practical Physics , S Chand Publishers, 2017

Reference(s):

1. Jearl Walker, David Halliday, Robert Resnick, Principles of Physics, 10, Wiley India, 2015
2. Gerd Keiser, Optical Fiber Communications, 4, Tata Mc Graw Hill, 2008
3. S.O.Pillai , Solid StatePhysics, 8, New Age International, 2018
4. S.M. Sze , Semiconductor Devices-Physics and Technology, Wiley, 2008

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

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1		2				2	2			2	2	
2	2	2	1		2				2	2			2	2	
3	2	2	1		2				2	2			2	2	
4	2	2	1		2				2	2			2	2	
5	2	2	1		2				2	2			2	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 02-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

CHEM1111	ENGINEERING CHEMISTRY	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 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:

- To impart knowledge on various aspects of water and its treatment.
- To study about electrochemical energy systems, renewable energy sources, solar cells, and their applications.
- To gain knowledge on materials such as steel, cement, and polymers
- To create awareness on corrosion and its control.
- To introduce different types of nanomaterials and instrumental techniques

MODULE 1 WATER AND ITS TREATMENT 12 Hrs

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.

MODULE 2 CHEMICAL BONDING AND ELECTROCHEMICAL ENERGY SYSTEMS 12 Hrs

Valence Bond theory, Orbital Hybridization, Molecular Orbital (MO) diagram, Highest Occupied Molecular Orbital (HOMO)-Lowest Unoccupied Molecular Orbital (LUMO), Bond order, Band structure, 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.

MODULE 3 ENGINEERING MATERIALS AND POLYMER CHEMISTRY 12 Hrs

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, Conducting polymers:– Examples and applications. Geopolymers – Introduction, synthesis, geopolymerization with oligomers, geopolymer 3-D frameworks, applications.

MODULE 4 CORROSION AND ITS CONTROL 12 Hrs

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.

MODULE 5 NANOMATERIALS AND ANALYTICAL INSTRUMENTAL TECHNIQUES 12 Hrs

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 Principle and applications of pH metry, potentiometry, conductometry

List of Experiments

Experiment 1 Determination of Mohr’s salt by potentiometric method
Experiment 2 Determination of strength of an acid by pH metric method
Experiment 3 Determination of conductance by conductometric method
Experiment 4 Determination of viscosity of a liquid
Experiment 5 Determination of surface tension of a liquid
Experiment 6 Determination of sulphuric acid in lead-acid storage cell
Experiment 7 Determination of chromium (VI) in potassium dichromate
Experiment 8 Determination of copper in a copper ore
Experiment 9 Determination of Zinc by EDTA method.

Experiment 10 Estimation of active chlorine content in Bleaching powder

Experiment 11 Preparation of Phenol-Formaldehyde resin

Experiment 12 Preparation of Urea-Formaldehyde resin

Experiment 13 Thin layer chromatography

Experiment 14 Preparation of TiO2/ZnO nano particles

Experiment 15 SEM analysis of nano materials

Textbook(s):

1. Jain PC, Jain M, Engineering Chemistry, 16, 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
4. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's , Quantitative Chemical Analysis , 6, Pearson publishers , 2000
5. N.K Bhasin and Sudha Rani , Laboratory Manual on Engineering Chemistry , 3, Dhanpat Rai Publishing Company , 2007

Reference(s):

1. Sashi chawla, A Textbook of Engineering Chemistry, 2003
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, , 2013
3. S.S. Dara, A T, A Textbook of Engineering Chemistry, 2010
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, 2014
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, 2016

Course Outcomes:

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.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1				2		2	1					
2	2	1	1				2		2	1					
3	2	1	1				2		2	1					
4	2	1	1				2		2	1					
5	2	1	1				2		2	1					

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 08-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN1031	PROGRAMMING FOR PROBLEM SOLVING - 1	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course introduces the fundamentals of programming for problem solving using C language for coding. It starts with the basics of the stored program model and data representation in computers and general problem-solving strategies. Then it introduces the program design using flowcharts and pseudocode. After a brief overview of compilation, it introduces C language constructs for operators and expressions and control flow. Program modularity, documentation, debugging and testing are introduced as general concepts, followed by functions, the standard library, arrays, dynamic memory allocation, pointers and structures in C. The course also covers the basics of AI-assisted coding and analyzing code generated by AI coding assistants.

Course Educational Objectives:

- To teach the student how to design algorithmic solutions in the form of flowcharts and pseudocode.
- To teach the student how to convert algorithms to high-level programs.
- To enable the student to code, test and debug using C language.
- To expose the student to efficient AI-assisted coding practices.

List of Experiments

S.no	Topic	Type
1	Basic components of a computer, the Von Neumann architecture and the stored program model, binary and hexadecimal number systems, conversion from decimal to binary to hexadecimal systems and vise versa, representation of data in a computer (numbers - integers and floating point, text - ASCII and UniCode, images - black and white, grayscale and RGB, audio and video).	Experiment
2	Flowcharts/Pseudo codes, Introduction to Problem-solving (Textbook 2, Chapter1, Sections 1.1 and 1.2): Problem definition, Getting started on a problem, The use of specific examples, Similarities among problems,Working backwards from a solution, General problem-solving strategies; C language: The compilation process, Syntax and Semantic errors.	Experiment
3	Variable Names, Data Types and Sizes, Constants, Declarations, Arithmetic Operators, Relational and Logical Operators, Type Conversions, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Conditional Expressions, Precedence and Order of Evaluation	Experiment
4	Statements and Blocks, If-Else and Else-If , Switch; Top-down Design (Textbook 2, Chapter1, Section 1.3): Breaking a problem into sub-problems, Choice of a suitable data structure, Construction of loops- establishing the initial conditions, finding the iterative construct, termination of loops; C language: Loops - While and For, Loops - Do-While, Break and Continue, Goto and labels.	Experiment
5	Implementation of Algorithms (Textbook 2, Chapter1, Section 1.4): Use of procedures to emphasize modularity, Choice of variable names, Documentation of programs, Debugging programs, Program testing; C language: Basics of Functions, Functions Returning Non-integers, External Variables.	Experiment
6	Scope Rules, Header Files, Static Variables, Register Variables, Block Structure, Initialization	Experiment

7	Input and Output: <stdio.h> , Formatted Output, Formatted Input, Character Input and Output Functions, Direct Input and Output Functions, Character Class Tests: <ctype.h> , String Functions: <string.h>, Mathematical Functions: <math.h>, Utility Functions: <stdlib.h>	Experiment
8	Recursion, The C Preprocessor, File Inclusion, Macro Substitution, Conditional Inclusion	Experiment
9	Pointers and Addresses, Pointers and Function Arguments, Pointers and Arrays , Address Arithmetic, Character Pointers and Functions	Experiment
10	Pointer Arrays (Pointers to Pointers), Multi-dimensional Arrays, Initialization of Pointer Arrays, Pointers vs. Multi-dimensional Arrays, Command-line Arguments, Pointers to Functions	Experiment
11	Basics of Structures, Structures and Functions, Arrays of Structures, Pointers to Structures	Experiment
12	Table Lookup, Typedef , Unions, Bit-fields	Experiment
13	Basics of AI-assisted coding using GitHub Copilot / CodiumAI	Experiment
14	Code comprehension - analyzing AI-generated Code	Experiment
15	Mini Project	Project

Textbook(s):

1. Brian W. Kernighan / Dennis Ritchie, The C Programming Language, 2nd Edition, Pearson Education India, 2015 ,978-9332549449
2. R.G. Dromey, How to Solve it by Computer, 1st Edition, Pearson Education India, 2008 ,978-8120303881
3. arold Abelson , Gerald Jay Sussman with Julie Sussman, Structure and Interpretation of Computer Programs,, 2nd Eition, The MIT Press, 1996 ,978-0262510875.

Reference(s):

1. Byron Gottfried, Schaum's, Schaum's Outline of Programming with C, 2nd Edition,, 1996 ,978-0070240353
2. Ron White, How Computers Work, Tenth Edition, 2014 ,978-0789749840
3. SWAYAM, “Problem Solving Through Programming In C", ,https://onlinecourses.nptel.ac.in/noc23_cs53/preview
4. SWAYAM, “Introduction To Programming In C”, , https://onlinecourses.nptel.ac.in/noc22_cs40/preview
5. GitHub Copilot in VS Code, ,https://code.visualstudio.com/docs/editor/github-copilot
6. The modern coding, ,https://codieum.com/GitHub Copilot overview

Course Outcomes:

1. Describe the representation of data in a computer. (L1)
2. Devise algorithms for problem-solving using flowcharts or pseudocode. (L6)
3. Apply C language constructs to convert algorithms to code. (L3)
4. Discover bugs in code and debug it. (L6)
5. Critique code produced by AI-coding assistants. (L5)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	2	2	2				2	2			2	2	1
2	2	3	2	2	2				2	2			2	2	1
3	2	3	2	2	2				2	2			2	2	1
4	2	3	2	2	2				2	2			2	2	1
5	2	3	2	2	2				2	2			2	2	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN1041	PROGRAMMING FOR PROBLEM SOLVING - 2	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course introduces the fundamentals of programming for problem solving using Python language for coding. It reiterates the concepts of problem solving using programming and introduces the built-in data types in Python. Package creation and usage, exception handling and file I/O are introduced , along with exemplary Python packages.

Course Educational Objectives:

- To teach the student how to convert algorithms to high-level programs.
- To enable the student to code, test and debug using Python language.
- To familiarize the student with exception handling and high level file I/O.
- To introduce the concept of modularity using packages.
- To expose the student to efficient AI-assisted coding practices.

List of Experiments

Experiment 1 Problem solving with computers, Definition of a Problem, Program design, Debugging, Types of errors in programming, Documentation.

Experiment 2 Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies -. top-down and bottom-up programming.

Experiment 3 Structure of a Python Program, Elements of Python, Python Interpreter, Input-Output: Printing on screen , Reading data from keyboard, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings and Operators.

Experiment 4 Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass. Using in-built functions in Python, importing and using functions from existing packages,

Experiment 5 Initialization of strings, Accessing Strings, Basic Operations, String slices, String Function and Methods.

Experiment 6 Introduction to lists, Accessing list, list operations, Working with lists, List Function and Methods.

Experiment 7 Introduction to tuples and sets, Accessing, Operations, Functions and Methods.

Experiment 8 Defining a function, Calling a function, Types of functions, Function Arguments- positional, keyword and default, Anonymous functions, Global and local variables, Organizing python code using functions.

Experiment 9 Recursion; Divide and conquer using recursion and iteration.

Experiment 10 Introduction to dictionaries, Accessing values in dictionaries, Working with dictionaries, Functions. Opening and closing file , Reading and writing files, File functions.

Experiment 11 Organizing python projects into modules, Importing custom modules as well as external modules, Understanding Packages, modules and external packages (e.g., numpy, pygame)

Experiment 12 Except clause, Try ? finally clause, User Defined Exceptions.

Experiment 13 Basics of AI-assisted coding using GitHub Copilot / CodiumAI - giving inputs and documentation

Experiment 14 Code comprehension - analyzing AI-generated Code

Experiment 15 Mini Project Project

Textbook(s):

1. A. B. Downey, hink Python How to Think Like a Computer Scientist, 2nd Edition, O′Reilly, 2015 ,978-1491939369

2. R.G. Dromey, How to Solve it by Computer, 1st Edition, Pearson Education India, 2008 ,978-8120303881

3. Harold Abelson , Gerald Jay Sussman with Julie Sussman, tructure and Interpretation of Computer Programs,, 2nd Edition, The MIT Press, 1996 ,978-0262510875

Reference(s):

1. Learn AI-Assisted Python Programming With GitHub Copilot and ChatGPT, ,https://www.manning.com/books/learn-ai-assisted-python-programming

2. Ron White, How Computers Work, Tenth Edition, Que Publishing, 2014 ,978-0789749840

3. NPTEL “Programming, Data Structures and Algorithms using Python”, ,https://nptel.ac.in/courses/106106145 4. GitHub Copilot in VS Code, ,,https://code.visualstudio.com/docs/editor/github-copilot

5. The modern coding, ,https://codieum.com/

6. Z. Shaw, LEARN PYTHON 3 THE HARD WAY, 1st Edition, Addison-Wesley,, 2017 ,978-0134692883.
7. Arockia Mary P, Problem Solving and Python Programming, 1st Edition, ne Books Pvt. Ltd,2021, 2021 ,978-9386761828. 8. C. Morris, ,“https://www.kaggle.com/learn/python,”
9. Programming Course Series, ,“https://docs.python.org/3/tutorial/index.html,”

Course Outcomes:

1. Apply Python language constructs to convert algorithms to code. (L3)
2. Design applications using in-built data types and packages in Python. (L5)
3. Develop applications that can deal with exceptions. (L6)
4. Implement file input and output operations using high-level programming constructs. (L3)
5. Critique code produced by AI-coding assistants. (L5)

Course Articulation Matrix:

	POs												**PSOs**		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	2		2				2	1			2	2	1
2	2	3	2		2				2	1			2	2	1
3	2	3	2		2				2	1			2	2	1
4	2	3	2		2				2	1			2	2	1
5	2	3	2		2				2	1			2	2	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2211	**FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**S**	**J**	**C**
		2	0	2	0	0	3
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:

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

MODULE 1 DC CIRCUITS **9 Hrs**

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.

MODULE 2 AC CIRCUITS **9 Hrs**

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.

MODULE 3 ELECTRICAL MACHINES **9 Hrs**

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.

MODULE 4 SEMICONDUCTOR DEVICES 9 Hrs

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.

MODULE 5 OPERATIONAL AMPLIFIERS 9 Hrs

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

List of Experiments

Experiment 1 . Verification of Kirchhoff's Laws
Experiment 2 . Verification of DC Superposition Theorem
Experiment 3 Verification of Thevenin's Theorem
Experiment 4 . Verification of Maximum power transfer Theorem
Experiment 5 . Load test on DC generator.
Experiment 6 Load test on single phase transformer.
Experiment 7 Measurement of voltage, current and power factor of single phase RL, RC series circuits.
Experiment 8 Measurement of voltage, current and power factor of single phase RLC series circuit.
Experiment 9 Measurement of power in a three phase circuit.
Experiment 10 Current Voltage Characteristics of a p-n Junction Diode/LED.
Experiment 11 Diode Rectifier Circuits.
Experiment 12 Voltage Regulation with Zener Diodes.
Experiment 13 Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
Experiment 14 Inverting and Non-inverting Amplifier Design with Op-amps.
Experiment 15 Simulation experiments using PSPICE
Experiment 16 Diode and Transistor Circuit Analysis.
Experiment 17 MOSFET Amplifier design
Experiment 18 Inverting and Noninverting Amplifier Design with Op-amps. Experiment

Textbook(s):

1. . D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering,, g, 1/e, McGraw Hill Education (India) Private Limited,, 2017
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, e, S. Chand

Publishing,,NEW DELHI, 2006 3. Adel S. Sedra and Kenneth C. Smith,, Microelectronic Circuits 6/e, Oxford University Press,, 2014

Reference(s):

1. S.K. Bhattacharya, Basic, 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:

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

2. . predict and analyse the behaviour of an electrical circuit .

3. analyse the performance quantities such as losses, efficiency and identify applications of DC machines . 4. . explain the use of transformers in transmission and distribution of electric power and other applications . 5. demonstrate the operation and applications of various electronic devices .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3											2			
2	3	3	2	2	2					1		2	3	3	
3	3	3	3	2	2					1		2	3	3	
4	3	2	3	2	2	2	3			1		2	3	3	
5	3	3	3	2	3					2	2	3	3	3	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 10-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN2261	**DATA STRUCTURES AND ALGORITHMS**	**L**	**T**	**P**	**S**	**J**	**C**
		2	0	2	0	0	3
Pre-requisite	00000000						
Co-requisite	None						
Preferable Exposure	None						

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:

- To introduce the students to ADT techniques
- To familiarize the students with linear data structures and operations on them
- To expose the concepts of stack and Queue and their applications
- To edify non-linear data structure graph and its applications
- To exemplify representation and manipulation of data using non-linear data structure trees to design algorithms for various applications

MODULE 1 INTRODUCTION AND ALGORITHM ANALYSIS 9 Hrs

Algorithm Analysis, Mathematical Background, Model, What to Analyze, Running Time Calculations, General Rules.

MODULE 2 LISTS, STACKS AND QUEUES 11 Hrs

Abstract Data Types(ADT), The List ADT: Simple Array Implementation of Lists, Linked Lists, Programming Details, Common Errors.

The Stack ADT: Stack Model, Implementation of Stacks: Linked List Implementation of Stacks, Array Implementation of Stacks ; Applications: Postfix Expressions , Infix to Postfix Conversion

The Queue ADT: Queue Model, Array Implementation of Queues, Applications of Queues.

MODULE 3 TREES 9 Hrs

Trees: Preliminaries, Implementation of Trees, Tree Traversals with an Application; Binary Trees: Implementation, Expression Trees;
The Search Tree ADT-Binary Search Trees: Make_null, Find, Find_min and find_max , Insert, Delete, Average Case Analysis (intuition)

MODULE 4 SEARCHING AND SORTING 9 Hrs

Searching: Linear Search and Binary Search.

Sorting: Preliminaries, Insertion sort:The Algorithm, Merge sort, Quick sort: Picking the Pivot, Partitioning Strategy, Small Files, Actual Quicksort Routines.

MODULE 5 GRAPHS 7 Hrs

Graph Algorithms: Definitions, Representation of Graphs, Graph Traversals

Shortest-Path Algorithms: Single Source Shortest Paths Problem, Unweighted Shortest Paths, Dijkstra's Algorithm, All-Pairs Shortest Path, Minimum Spanning Tree, Prim's Algorithm, Kruskal’s Algorithm.

List of Experiments

Experiment 1 Perform Linear Search on an array.
Experiment 2 Perform Binary Search on a list stored in an array.
Experiment 3 Develop a program to implement insertion sort technique.
Experiment 4 Develop a program to implement a quick sort technique.
Experiment 5 Develop a program to implement merge sort technique.
Experiment 6 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
Experiment 7 Create a stack and perform various operations on it.
Experiment 8 Create a queue and perform various operations on it.
Experiment 9 Construct a binary tree and perform various traversals.
Experiment 10 Implement Depth First Search, Breadth First Search traversals on a graph.
Experiment 11 Implement Dijkstra’s Shortest Path Algorithm

Textbook(s):

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C , 2nd Edition, Pearson, 2002 ,978-8131714744 2. Alfred V.Aho, John E.HopCroft Jeffrey D.Ullman, Data Structures and Algorithms, 1st Edition, Pearson, 2002 ,978-8178081021

Reference(s):

1. Seymour Lipschutz, Data Structures , 2nd Edition, McGraw Hill Education, 2014 ,978-1259029967
2. G. A. V. Pai2017, Data Structures and Algorithms: Concepts - Techniques and Applications, 1st Edition, McGraw Hill Education, 2017 ,978-0070667266
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed,, Fundamentals of Data structures in C, 1st Edition, W.H.Freeman & Co Ltd, ,978-0716782506

Course Outcomes:

1. Understand the complexity of algorithms (L2)
2. Demonstrate operations on linear data structures (L3)
3. Illustrate the mechanisms for creating, altering, and traversing various types of trees (L2)
4. Perform searching in and sorting of given data. (L3)
5. Summarize the representations, traversals, and applications of graphs.(L2)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2		2				2	2			2	2	1
2	2	2	2		2				2	2			2	2	1
3	2	2	2		2				2	2			2	2	1
4	2	2	2		2				2	2			2	2	1
5	2	2	2		2				2	2			2	2	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

MECH1011	ENGINEERING VISUALIZATION AND PRODUCT REALIZATION	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

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:

- To create awareness of engineering drawing as relevant to industry standards.
- To create awareness of engineering drawing as relevant to industry standards.
- To impart 2D sketching and 3D modeling using the relevant software.
- To teach assembly drawing and simulation of motion between mating components.
- To introduce basic 3D printing software for preparing the products for printing.

List of Experiments

Experiment 1 Manual Drawing: Introduction to Engineering graphics: Principles of Engineering Graphics and their significance, conventions in drawing lettering, BIS Conventions, Dimensioning, Sectional Views

Experiment 2 Free hand sketching, Free hand sketching of isometric & orthographic views and interpretation of drawings.

Experiment 3 Computer Aided Drafting, Introduction to CAD software: Basic draw and Modify commands in 2d

Experiment 4 Introduction to 2D and 3D modelling using CAD packages

Experiment 5 Assembly drawings, Assembly of individual 3D components, animation of motion, Introduction to parametric design

Experiment 6 Coordinating multiple moving parts under joint constraints.

Experiment 7 3D printing, Introduction to 3D printing software, slicing.

Experiment 8 Grading and rendering of simple geometries using software. Experiment

Textbook(s):

1. N D Bhatt, ‘Engineering Drawing',, 53 E, Charotar Publishers, Gujarat India, 2019
2. Lydia Sloan Cline, 'Fusion 360 for Makers, Design Your Own Digital Models for 3D Printing and CNC Fabrication –2018 ,USA, 2018

Reference(s):

1. Randy Shih, 'parametric Modeling with Autodesk Fusion 360, Spring 2021 Edition, 2021

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

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2		2					2		2	1		
2	2	2	2		2					2		2	1		
3	2	2	2		2					2		2	1		
4	2	2	2		2					2		2	1		
5	2	2	2		2					2		2	1		

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 16-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

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<table>
<tr><td rowspan="2">MECH1041</td><td rowspan="2">TECHNOLOGY EXPLORATION & PRODUCT ENGINEERING</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:

This is a fundamental engineering course that introduces the incoming students to hands-on product development experience using a combination of Mechanical Engineering and IoT concepts, programming with application of EVPR concepts and exposure to project planning.

Course Educational Objectives:

- Inculcate creativity, critical thinking and problem-solving skills with hands-on approach to all incoming freshmen.
- Emphasise product development using systems engineering approach.
- Impart multidisciplinary project-based skills with a combination of IoT, Programming,Simulation, Mechanisms and Machining.
- Involve Ideation to develop a variety of solutions to a problem statement rather than performing a standard job/experiment.
- Project planning and management to deliver the assigned project within the timeline.

List of Experiments

Experiment 1 Manufacturing economics

Experiment 2 Evaluation of manufacturing strategies

Experiment 3 OBHS (Operational Behaviour, health, safety in hazardous environment)

Experiment 4 Power tools operations and safety – Angle grinder (Cutting, Grinding and Polishing), Driller and Jigsaw

Experiment 5 Basics of Microprocessors and Microcontrollers

Experiment 6 General Introduction to Arduino, Node MCU, and Raspberry Pi.

Experiment 7 Basics of Electronics: General Introduction to the usage of Breadboard, Digital Multimeter

Experiment 8 Basics of Arduino & Node MCU coding – Libraries, board & port selection, baud rate,Basics of Troubleshooting, Cloud Interfacing etc

Experiment 9 Usage and Applications of Basic Sensors: Ultrasonic, Voltage/Current, Temp/Humidity, Gas, IR

Experiment 10 Basics of Electromagnetism – Permanent Magnet DC Motor (PMDC), Brushless DC Motor (BLDC), Stepper and Servo Motors.
Experiment 11 Basics of Drawing/Circuit Simulation - Line diagram, TinkerCAD, Multisim, PROTEUS
Experiment 12 Basics of Mechanisms - Linear motion, Cam mechanism, Belt drive, gears
Experiment 13 Demonstration of Carpentry, Tin smithy, Fitting, Welding and Injection Moulding.
Experiment 14 Problem identification and understanding the needs of the users
Experiment 15 Project management and planning. Experiment

Textbook(s):

1. Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, RMD Sundaram,Wiley India, 2019 2. Simon Monk, Programming Arduino, Mc Graw Hill Publications,, 2011

Reference(s):

1. Essaid, 507 Mechanical Movements, 2019

Course Outcomes:

1. Perform basic mechanical operations with power tools.
2. Understand and apply IoT concepts to drive mechanical components.
3. Apply multidisciplinary skills to solve practical engineering problems.
4. Conceptualize and work towards the creation of physical products.
5. Think along the lines of innovation and entrepreneurship.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	3	2	2		3	2	2	2	2	1	2
2	3	2	2	2	3	2	2		3	2	2	2	2	1	2
3	3	2	2	2	3	2	2		3	2	2	2	2	1	2
4	3	2	2	2	3	2	2		3	2	2	2	2	1	2
5	3	2	2	2	3	2	2		3	2	2	2	2	1	2

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 16-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24PROJ4777	CAPSTONE PROJECT – INTRODUCTION	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	NIL						

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 with Synthesis of the results and arrive at scientific conclusions / products / solution
5. Document the results in the form of technical report / presentation

Course Articulation Matrix:

	POs												**PSOs**		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
2	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
3	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
4	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
5	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2

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

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24IENT3777	INTERNSHIP-1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite	Completion of minimum of four semesters						
Co- requisite	NIL						
Preferable exposure	NIL						

Course Educational Objectives:

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

Contents: 1 Week

One week of work at an 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
5. formulate technical background required to participate in Internship 2.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	2	2	3	2		1	3	2	2	2	3	2	2
2	2	1	2	2	3	2		1	3	2	2	2	3	2	2
3	2	1	2	2	3	2		1	3	2	2	2	3	2	2
4	2	1	2	2	3	2		1	3	2	2	2	3	2	2
5	2	1	2	2	3	2		1	3	2	2	2	3	2	2

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

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24PROJ4888	CAPSTONE PROJECT – FINAL	L	T	P	S	J	C
		0	0	0	0	6	6
Pre-requisite	24PROJ4777						
Co- requisite	NIL						
Preferable exposure	NIL						

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 with Synthesis of the results and arrive at scientific conclusions / products / solution
5. Document the results in the form of technical report / presentation

Course Articulation Matrix:

	POs												**PSOs**		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
2	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
3	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
4	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2
5	3	2	3	3	3	2	1	1	3	2	2	2	3	2	2

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

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24IENT4888	INTERNSHIP-2	L	T	P	S	J	C
		0	0	0	0	1	3
Pre-requisite	Completion of minimum of six semesters						
Co- requisite	NIL						
Preferable exposure	NIL						

Course Educational Objectives:

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

Contents: 1 Week

Four week of work at an 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

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	2	2	3	2		1	3	2	2	2	3	2	2
2	2	1	2	2	3	2		1	3	2	2	2	3	2	2
3	2	1	2	2	3	2		1	3	2	2	2	3	2	2
4	2	1	2	2	3	2		1	3	2	2	2	3	2	2
5	2	1	2	2	3	2		1	3	2	2	2	3	2	2

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

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

HSMCH102	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

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

Course Outocmes:

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

1. explain the different human aspirations and appreciate the need for right understanding and harmony.
2. differentiate between prosperity and accumulation and elaborate different programs for ensuring health to achieve harmony within oneself
3. elaborate different aspects of human relationships and demonstrate the use of trust and respect to achieve harmony in society
4. describe the interconnectedness in nature and suggest different methods to achieve harmony with nature
5. elaborate the different dimensions of professional ethics and apply principles of ethical conduct.

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

Programme Core (PC)

24EECE1001	NETWORK THEORY AND ANALYSIS	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 aims to develop the basic concepts of network analysis, which is the pre-requisites for all the electronics engineering courses. The course deals with understanding various network reduction techniques such as source transformation, network theorems and apply these techniques to simplify different complex R-L-C networks. Design techniques of resonant circuits is imparted. Analysis and synthesis of two-port networks are dealt. Transient Response of complex electrical systems and design of stable system is also elaborated.

Course Educational Objectives:

- To impart knowledge about solving different complex circuits using various network reduction techniques such as source transformation, network theorems.
- To explain the analysis AC and DC transient response for complex R-L-C circuits.
- To familiarize AC steady state response for complex R-L-C series and parallel circuits and to analyze the circuits.
- To distinguish between series and parallel resonance and design resonant circuits.
- To acquaint the students with evaluation of two port network parameters.

MODULE 1 BASIC CONCEPTS: 9 Hrs

Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh.

MODULE 2 NETWORK THEOREMS: 9 Hrs

Superposition, Reciprocity, Millman‘s theorems, Thevenin's and Norton‘s theorems, Maximum Power transfer theorem.

MODULE 3 TRANSIENT BEHAVIOR AND INITIAL CONDITIONS ,LAPLACE TRANSFORMATION & APPLICATIONS 9 Hrs

Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations. Solution of networks, step, ramp and impulse responses, waveform Synthesis.

MODULE 4 RESONANT CIRCUITS **9 Hrs**

Series and parallel resonance, frequency- response of series and Parallel circuits, Q–Factor, Bandwidth.

MODULE 5 TWO PORT NETWORK PARAMETERS **9 Hrs**

Definition of Z, Y, h and Transmission parameters, modeling with these parameters, relationship between parameters sets

Textbook(s):

1. M.E.VanValkenburg, Network Analysis, 3/e , Pearson Education, 2019
2. Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 7/e, Tata McGraw Hill Publication, 2022 3. Sudhakar, Shyammohan S.Palli, Circuits & Networks: Analysis and Synthesis, 5/e, Tata McGraw Hill Publication, 2017

Reference(s):

1. William H Hayt, Jack E Kimmerly and Steven M.Durbin, Engineering Circuit Analysis, 9/e, Tata McGraw Hill, 2020 2. A. Chakrabarti, Circuit Theory: Analysis & Synthesis, 7/e, Dhanpat Rai & Co, 2018

Course Outcomes:

1. describe the device structure/physical operation, analyze BJT/MOSFET circuits using their large signal and small signal models .
2. distinguish between discrete component circuit design and integrated circuit design and appreciate the relative merits and demerits of BJT and MOSFET devices .
3. design current mirror circuits given the output resistance, voltage headroom and output current requirements .
4. derive the low frequency and high frequency characteristics of common source, common gate, common drain amplifiers
5. analyze and design differential amplifier circuits for gain and linearity requirements..

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2		2								3	2	
2	2	2	2		2								3	2	
3	2	2	2		2								3	2	
4	2	2	2		2								3	2	
5	2	2	2		2								3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2001	ELECTRONIC DEVICES AND CIRCUITS	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 introduces the physician construction, operation and modeling of widely used electronic devices viz pn-junction diodes, bipolar junction transistors, MOS field effect transistors and their high frequency limits.

Course Educational Objectives:

• To introduce the basic operation of semiconductors and mechanisms of current flow in open-circuit and biased pn-junctions
• To describe the physical construction, large signal and small signal modeling of diodes
• To describe the physical construction, large signal and small signal modeling of MOSFETs
• To familiarize the the physical construction, large signal and small signal modeling of Bipolar junction transistors
• To demonstrate the basic operation of electronic devices and expose the design practices of electronic circuits

MODULE 1 SEMICONDUCTORS **12 Hrs**

Intrinsic Semiconductors, Doped Semiconductors, Current Flow in Semiconductors, The pn Junction with Open-Circuit Terminals (Equilibrium), The pn Junction with Applied Voltage

MODULE 2 DIODES AND DIODE CIRCUITS **12 Hrs**

The Ideal Diode, Terminal Characteristics of Junction Diodes, Modeling the Diode Forward Characteristic, Operation in the Reverse Breakdown Region—Zener Diodes, Rectifier Circuits, Limiting and Clamping Circuits.

MODULE 3 BIPOLAR JUNCTION TRANSISTORS **12 Hrs**

Device Structure and Physical Operation, Current–Voltage Characteristics, BJT Circuits at DC Applying the BJT in Amplifier Design, Small-Signal Operation and Models, Basic BJT Amplifier Configurations. Transistor Breakdown and temperature effects

MODULE 4 MOS FIELD EFFECT TRANSISTORS **12 Hrs**

Device Structure and Physical Operation, Current—Voltage Characteristics, MOSFET Circuits at DC, Applying the MOSFET in Amplifier Design, Small-Signal Operation and Models, Basic MOSFET Amplifier Configurations, Biasing in MOS Amplifier Circuits, Discrete-Circuit MOS Amplifiers

MODULE 5 AMPLIFIER FREQUENCY RESPONSE 12 Hrs

Review of Transfer function, Frequency Response, Pole-Zero Concepts, Transfer function and AC Analysis of a First Order RC Circuit, Capacitive Effects in a PN Junction, Internal Capacitive Effects and the High-Frequency Model of the MOSFET, High-Frequency Response of the Common Source Amplifiers, High Frequency Response of Common Gate Amplifiers, High Frequency Response of Source Followers

List of Experiments

1. Experiment 1 Current Voltage Characteristics of a p-n Junction Diode/LED
2. Experiment 2 Diode Circuits for Clipping, Clamping and Rectifier Circuits
3. Experiment 3 Diode Circuits for Voltage Regulation with Zener Diodes
4. Experiment 4 Operating Region Analysis and Current Voltage Characteristics of MOSFETs
5. Experiment 5 Design, Simulation and Construction of Common Source Amplifier
6. Experiment 6 Design, Simulation and Construction of CMOS Inverter
7. Experiment 7 Current Voltage Characteristics of a Bipolar Junction Transistors
8. Experiment 8 Design, Simulation and Construction of Common Emitter Amplifier
9. Experiment 9 Transfer Function and AC Analysis of RC Circuits
10. Experiment 10 Frequency Response of Common Source Amplifiers
11. Experiment 11 Design Project - 1: Amplifier Design
12. Experiment 12 Design Project - 2: Power Supply Design
13. Experiment 13 Design Project - 3: Analog Filter Design
14. Experiment 14 Design Project - 4: Signal Source Design

Textbook(s):

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 7/e, Oxford University Press, 2017 2. Louis Frenzel, Practical Electronics for Experimenters, Tata McGraw Hill Publishers, 2017

Reference(s):

1. Behzad Razavi, Fundamentals of Microelectronics, 3/e, Wiley Student Edition, 2021

2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 11/e, Pearson Education, 2015 3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008

Course Outcomes:

1. analyze conduction properties of semiconductor materials based on doping concentrations .
2. analyze and design diode circuits for analog signal processing applications .
3. analyze and design BJT circuits based on large/signal models .
4. design MOSFET amplifier circuits for given specifications
5. derive the frequency response of amplifiers for given circuit parameters .

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2		2								3	2	
2	3	3	2		2								3	2	
3	3	3	2		2								3	2	
4	3	3	2		2								3	2	
5	3	3	2		2								3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2011	SIGNALS AND SYSTEMS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

Signals contain information about the behaviour or nature of some phenomenon and are functions of one or more independent variables. A system processes the signal for producing desired behaviour. Signal processing plays an extremely important and continually growing role in areas of science and technology such as communications, aeronautics and astronautics, acoustics, seismology, biomedical engineering and speech processing. This course introduces the basic concepts and mathematical tools required for signal processing.

Course Educational Objectives:

- To explain the mathematical representation /classification of continuous-time and discrete- time signals and systems
- To provide an understanding of characterization of linear-time invariant systems using impulse response and convolution function
- To familiarize the application of Fourier series, Fourier transform and their properties to continuous-time and discrete time signals and systems
- To impart the knowledge of Laplace and Z-transform and their properties to analyse continuous-time and discrete-time signals respectively.

MODULE 1 SIGNALS AND SYSTEMS **9 Hrs**

Signals and Systems: continuous-time and discrete-time signals, transformations of the independent variable, exponential and sinusoidal signals, the unit impulse and unit step functions, continuous-time and discrete-time systems, basic system properties

MODULE 2 LINEAR TIME INVARIANT SYSTEMS **9 Hrs**

Discrete-time LTI systems: the convolution sum, continuous time LTI systems: the convolution integral, properties of linear time-invariant systems.

MODULE 3 FOURIER ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS 9 Hrs

Fourier series representation of continuous time periodic signals, convergence and properties of continuous-time Fourier series (CTFS). Representation of Aperiodic signals, properties of the CFT, systems characterized by linear constant-coefficient differential equations.

MODULE 4 FOURIER ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS 9 Hrs

Representation of aperiodic signals: the discrete-time Fourier transform, properties of the DFT, the Fourier transform for periodic signals, systems characterized by linear constant-coefficient difference equations

MODULE 5 ANALYSIS OF CT AND DT SIGNALS USING LAPLACE/Z-TRANSFORM 9 Hrs

The Laplace Transform: the region of convergence (roc) for Laplace transforms, the inverse Laplace transform, properties of the Laplace transform. The Z-Transform: The region of convergence for the z-transform, the inverse-z transform, properties of the z-transform

Textbook(s):

1. Alan V, S. Willsky with S.Hamid Nawab, Signals and Systems, second, Pearson, 1997

Reference(s):

1. Bhagawandas P. Lathi, Linear Signals and Systems,, 2009
2. Simon Haykin,Barry Van Veen, Signals and Systems, second, 2007

Course Outcomes:

1. describe the mathematical model of continuous - time/discrete - time signals and systems and perform mathematical operations on signals
2. determine the output response of continuous time/ discrete time LTI system using convolution integral and convolution sum.
3. analyse the characteristics of linear – time invariant systems.
4. derive the frequency domain representation of signals and systems using transform techniques
5. determine the output response of LTI systems using CTFT and DTFT.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2		2								2	2	
2	2	2	2		2								2	2	
3	2	2	2		2								2	2	
4	2	2	2		2								2	2	
5	2	2	2		2								2	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 10-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2071	ANALOG CIRCUITS	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 exposes the student to the principles and design of analog building blocks including amplifiers, feedback circuits, oscillators, power amplifiers and frequency selective filters. .

Course Educational Objectives:

- To expose the student to IC design philosophy and design of integrated differential amplifier circuits
- To acquaint the students with different feedback topologies and demonstrate the design of feedback circuits.
- To expose the principles of positive feedback circuits and design methods for designing oscillator circuits for signal generation.
- To demonstrate the design of output stages with exposure to tradeoffs in linearity and efficiency considerations
- To expose the analysis and design of analog filters for signal conditioning.

MODULE 1 DIFFERENTIAL AMPLIFIERS AND CURRENT MIRROR CIRCUITS 12 Hrs

Comparison of the MOSFET and the BJT, MOS Current Sources, Current Mirrors Circuits, Current Mirrors with improved performance. Differential Amplifiers: the MOS differential pair, small-signal operation of the MOS differential pair, other non-ideal characteristics of MOS differential amplifier, the MOS differential amplifier with active load.

MODULE 2 FEEDBACK 12 Hrs

Feedback Amplifiers: The general feedback structure, properties of negative feedback, basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining loop gain

MODULE 3 OSCILLATORS 12 Hrs

Oscillators: Basic principles of sinusoidal oscillators, op amp RC oscillator circuits, LC and crystal oscillators.

MODULE 4 OUTPUT STAGES AND POWER AMPLIFIERS 12 Hrs

Output Stages and Power amplifiers: Classification of output stages, class A output stage, class B output stage, class AB output stage, power BJTs, class C output stage, MOS power transistor.

MODULE 5 ANALOG FILTER DESIGN **12 Hrs**

Filter Transmission, Types, and Specification, The Filter Transfer Function, Butterworth and Chebyshev Filters, First-Order and Second-Order Filter Functions, The Second-Order LCR Resonator. Active Filter Design

List of Experiments

1. Experiment 1 Feedback Amplifier - calculation of gain, input resistance, output resistance with and without feedback, frequency response characteristic.
2. Experiment 2 Design and Implementation of Two stage RC Coupled amplifier.
3. Experiment 3 Oscillators (Colpitts, RC phase-shift, Wein-bridge)
4. Experiment 4 Class A power amplifier.
5. Experiment 5 Class B Push - pull power amplifier.
6. Experiment 6 Tuned voltage amplifier.
7. Experiment 7 Analysis and simulation of RC differentiator/integrator
8. Experiment 8 Bistable/Monstable/Astablemultivibrators with 555 timer
9. Experiment 9 Operational Amplifier Circuits (Adders, Integrators, Differentiators, Filters).
10. Experiment 10 Op-amp based AM/FM Modulator/Demodulator Circuits.
11. Experiment 11 Data Converters
12. Experiment 12 Active Filter Design

Textbook(s):

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 7/e, Oxford University Press, 2017

Reference(s):

1. Behzad Razavi, Fundamentals of Microelectronics, 3/e, Wiley Student Edition, 2021
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 11/e, Pearson Education, 2015 3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008

Course Outcomes:

1. analyse the characteristics of different negative feedback amplifier configurations .
2. choose and design negative feedback circuits to improve the characteristics of given open loop amplifier .
3. describe the basic principle of sinusoidal oscillators and identify the usage of different oscillator circuits
4. design analog filters for the given design specification .
5. design different wave shaping circuits for signal processing applications.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3		3				2	2			3	2	1
2	3	2	3		3				2	2			3	2	1
3	3	2	3		3				2	2			3	2	1
4	3	2	3		3				2	2			3	2	1
5	3	2	3		3				2	2			3	2	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

		L	T	P	S	J	C
24EECE2111	**ELECTROMAGNETIC WAVES AND TRANSMISSION LINES**	2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This is an introductory course in engineering electromagnetics. Emphasis is placed on time-varying topics, such as transmission lines, Maxwell's equations, and plane and guided waves. The basic concepts of electromagnetic fields, including field vectors, and potentials will be covered.

Course Educational Objectives:

- Understand Maxwell's Equations and Their Significance in Static and Time-Varying Fields.
- Analyze Uniform Plane Waves in Different Media, Including Free Space, Conductors, and Dielectrics, Applying Concepts like the Poynting Theorem and Wave Polarization.
- Comprehend Wave Behavior at Boundaries, Both Normal and Oblique Incidence, and Understand Standing Wave Ratio and Effects of Dispersive Media.
- Analyze various transmission lines, including equations, parameters, input impedance, and utilize graphic methods like the Smith Chart.
- Master the Principles of Waveguides, Analyzing Waves, Differentiating TE, TM, and TEM Waves, Calculating Velocities, and Evaluating Attenuation, Including the Behavior in Rectangular Waveguides.

MODULE 1 TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS 9 Hrs

Maxwell's equations for static fields, Time-varying fields, Faraday's law of electromagnetic induction, displacement current, Maxwell's equations in point form and integral form.

MODULE 2 UNIFORM PLANE WAVE 9 Hrs

Wave equation, wave propagation in free space, wave propagation in conductor and dielectrics, Poynting theorem, skin effect, wave polarization, direction cosines.

MODULE 3 PLANE WAVES AT BOUNDARIES AND IN DISPERSIVE MEDIA 9 Hrs

Reflection of uniform plane waves by perfect conductor – normal and oblique incidence, standing wave ratio, reflection and transmission of uniform plane waves by perfect dielectric – normal and oblique incidence

MODULE 4 TRANSMISSION LINES 9 Hrs

Types of Transmission lines, Transmission line equations, Transmission line parameters, input impedance, SWR, Graphical methods-Smith Chart.

MODULE 5 WAVEGUIDES **9 Hrs**

Waves between Parallel Planes, TE waves, TM waves, Characteristics of TE and TM waves, TEM waves, velocities of Propagation, attenuation in Parallel- plane guides, wave Impedances, Rectangular waveguides.

Textbook(s):

1. William H. Hayt, Engineering Electromagnetics, 8/e, Tata McGraw Hill, 2017
2. E. C. Jordan, EM Waves and Radiating Systems,PHI, 2/e, Prentice Hall, 2015
3. Matthew N.O. Sadiku, Elements of Electromagnetics, 4/e, Oxford University Press, 2014

Reference(s):

1. David K. Cheng, Field and Wave Electromagnetics, 2/e, Pearson Education, 2014
2. J.D. Kraus, D. A. Fleish, Electromagnetics with Applications, 5/e, McGraw Hill, 2017

Course Outcomes:

1. describe and analyze electromagnetic wave propagation in free-space, conductor, and dielectric media.
2. justify the concept of electromagnetic waves in terms of transporting energy or information
3. describe the reflection of plane wave at normal and oblique incidence in free space and dispersive media .
4. Solve transmission line problems mathematically and by using a Smith chart .
5. Analyze TE, TM, and TEM waves in a waveguide.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2										2	2	
2	2	2	2										2	2	
3	2	2	2										2	2	
4	2	2	2										2	2	
5	2	2	2										2	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2291	DIGITAL LOGIC DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

Digital Logic Design is an introductory course which provides the basic concepts involved in the design and analysis of digital circuits for computing systems. A digital circuit is constructed using basic building blocks: logic gates and flip-flops. This course deals with the design of various combinational and sequential circuits used to build more complex computing systems.

Course Educational Objectives:

• To introduce number systems, conversion used for representing numbers in computational structures
• To familiarize the implementation of simple logical operations using Combinational circuits
• To acquaint the student with the design of combinational and sequential logic circuits with practical design examples • To expose different types of memories used in digital systems
• To impart the design of synchronous and asynchronous digital systems
• To demonstrate the use of standard chips and PLDs in building digital computational structures

MODULE 1 BINARY SYSTEMS AND LOGIC GATES 12 Hrs

Binary Systems: digital systems, binary numbers, number base conversions, octal and hexadecimal numbers, complements, signed binary numbers, binary codes, binary logic. Boolean Algebra and Logic Gates: basic definitions, axiomatic definition of boolean algebra, basic theorems and properties of boolean algebra, boolean functions, canonical and standard forms, digital logic gates.

MODULE 2 SIMPLIFICATION OF BOOLEAN FUNCTIONS 12 Hrs

Simplification of Boolean functions: The map method, four-variable map, five-variable map, product of sums simplification, don't-care conditions, NAND and NOR implementation, exclusive-OR function. .

MODULE 3 COMBINATIONAL LOGIC CIRCUIT DESIGN 12 Hrs

Combinational Logic: combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decoders, encoders, multiplexers. Memories: random-access memory,

memory decoding.

MODULE 4 SEQUENTIAL LOGIC CIRCUIT DESIGN 12 Hrs

Synchronous Sequential Logic: sequential circuits, latches, flip-flops, analysis of clocked sequential circuits, state reduction and assignment, design procedure. Registers and Counters: registers, shift registers, ripple counters, synchronous counters, ring counter

MODULE 5 IMPLEMENTATION OF DIGITAL LOGIC CIRCUITS 12 Hrs

Transistors as Switches, NMOS Logic Gates, CMOS Logic Gates, MOS Implementation of static latches and flipflops. Programmable Logic Devices: Programmable Logic Array, Programmable Array Logic, Complex Programmable Logic Devices, Field Programmable Gate Arrays. FPGA Design Flow

List of Experiments

1. Experiment 1 Verification of Truth Tables of Logic gates and implementation of Basic gates using Universal Gates
2. Experiment 2 Implementation of the given Boolean functions using logic gates in both SOP and POS form.
3. Experiment 3 Simplification of the given Boolean function using K-map and implement using logic gates.
4. Experiment 4 Realization and verification of Full adder and Full Subtractor using logic gates.
5. Experiment 5 Implementation of the given function using decoder and logic gates.
6. Experiment 6 Implementation of the given function using Multiplexer and logic gates.
7. Experiment 7 Verification of State Tables of SR, D, JK and T-Flip-Flops.
8. Experiment 8 Verify the operation of Shift Registers using D flip-flops.
9. Experiment 9 Design and verify the operation of 4-bit and Mod-N Ripple Counters using JK flip-flops.
10. Experiment 10 Verilog Modelling and Simulation of 1-bit full adder, 2 X 4 Decoder, Mod-13 Counter
11. Experiment 11 Study of PLA, CPLD, FPGA Datasheets and appreciating their architectural highlights
12. Experiment 12 FPGA Implementation of 1-bit full adder, 2 X 4 Decoder, 4-Bit Counter Experiment

Textbook(s):

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 5/e, Pearson Education, 2014

2. Charles Roth, Jr., Larry Kinney, Fundamentals of Logic Design, 7/e, Cengage Learning, India, 2015 3. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 7/e, Oxford University Press, 2013

Reference(s):

1. Zvi Kohavi, Switching and Finite Automata Theory, 2/e, Tata McGraw-Hill, 2008
2. John F. Wakerly, Digital Design Principles and Practices, 4/e, Pearson Education, 2008
3. Weste, Harris, CMOS VLSI Design, 4/e, Pearson Education, 2014

Course Outcomes:

1. convert any number into different base representations.
2. simplify logic expressions using Boolean laws and realize using basic and universal logic gates.
3. design combinational circuits for the given specifications.
4. design synchronous sequential circuits for the given specifications
5. differentiate asynchronous and synchronous counters and implement Multiplexers and D flip flops using CMOS technologies.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3		2								3	2	
2	3	2	3		2								3	2	
3	3	2	3		2								3	2	
4	3	2	3		2								3	2	
5	3	2	3		2								3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3001	INTRODUCTION TO VLSI DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

VLSI Design allows large number of electronic devices to be integrated in a single small chip resulting in high speed of operation and low power dissipation. This has dramatically improved the evolution of telecommunication systems and electronic appliances. This course introduces the student to the two popular VLSI design methodologies including FPGA design and full custom IC design. FPGAs are used in the design of low-volume digital integrated circuits with reconfigurability and less design time. Full custom methodology allows high-volume design of integrated circuits with low area, high speed and ultra-low-power dissipation. Further, students will be exposed to industry-standard FPGA boards and IC design tools.

Course Educational Objectives:

• To introduce the design flow of integrated circuits using hardware description languages and programmable logic devices.

• To explain the architecture and usage of different types of programmable logic devices including PLAs, PLDs, CPLDs and FPGAs

• To describe semiconductor technology evolution, the different steps of IC fabrication process and appreciate the role of mask layout in the design process.

• To provide an understanding of the constraints imposed by fabrication engineer and learn to prepare mask layouts as per design rules

• To comprehend the design of combinational and sequential circuits from MOS schematic to layout

MODULE 1 MODELING DIGITAL CIRCUITS WITH HDLS 12 Hrs

VLSI Design Methodologies: Computer Aided Design: Hardware description languages, Verilog description of combinational circuits, Verilog modules, Verilog assignments, procedural assignments, modeling flip-flops using always block, delays in Verilog, compilation, simulation, and synthesis of Verilog code, Verilog data types and operators, Counters and Registers.

MODULE 2 PROGRAMMABLE LOGIC DEVICES 12 Hrs

Programmable Logic Devices: Simple programmable logic devices (SPLDs), Complex programmable logic device (CPLD), Field programmable gate arrays (FPGAs).

MODULE 3 FULL CUSTOM IC DESIGN **12 Hrs**

IC Design Technology: Integrated Circuit (IC) era, Metal Oxide Semiconductor (MOS) and related VLSI technology, basic MOS transistors, enhancement mode transistor action, NMOS fabrication, CMOS fabrication, comparison of NMOS, CMOS, BICMOS and GaAs. Drain current vs drain-source voltage relationships, NMOS inverter, CMOS inverter.

MODULE 4 MOS CIRCUIT DESIGN PROCESS **12 Hrs**

MOS Circuit Design Process: MOS Layers, stick diagrams, design rules and layout, layout diagrams, symbolic diagrams. CMOS Circuit and Layout Design using Static Complementary CMOS Logic Style.

MODULE 5 SUBSYSTEM DESIGN AND LAYOUT **12 Hrs**

Subsystem Design and Layout: Some architectural issues, switch logic, gate (restoring) logic, examples of structured design, parity generator, multiplexers, general logic function block. Design of Latches and Flipflops using Static Complementary CMOS.

List of Experiments

1. Experiment 1 Verilog modelling, simulation and FPGA implementation of combinational logic circuits: basic gates, multiplexer, comparator, adder/subtractor.
2. Experiment 2 Verilog modelling, simulation and FPGA implementation of combinational building blocks:
3. Multipliers, decoders, address decoders, parity generator, ALU.
4. Experiment 3 Verilog modelling, simulation and FPGA implementation of sequential logic circuits: D-Latch, D-Flip flop, registers.
5. Experiment 4 Verilog modelling, simulation and FPGA implementation of sequential building blocks: Ripple counters, synchronous counters, shift registers (serial-to-parallel, parallel-to-serial)
6. Experiment 5 Verilog modelling, simulation, and FPGA implementation of finite state machines: Mealy state machine, Moore state machine,
7. Experiment 6 Digital system design examples: GCD processor example, arithmetic multiplier.
8. Experiment 7 CMOS inverter
9. Experiment 8 NAND gate
10. Experiment 9 Complex Gates
11. Experiment 10 One-bit full adder
12. Experiment 11 D-flip flop.
13. Experiment 12 6. Delay and Power Analysis of CMOS Digital Circuits

Textbook(s):

1. Charles H. Roth, Lizy Kurian John, ByeongKil Lee, Digital Systems Design using Verilog, 1/e, Cengage Learning, 2017 2. Douglas A, Pucknell, Kamran Eshraghian, Essentials of VLSI Circuits and Systems, 1/e, Prentice Hall, 2012 3. Weste, Harris, CMOS VLSI Design, 4/e, Pearson Education, 2015

Reference(s):

1. Kang, Leblibici, CMOS Digital Integrated Circuits, 4/e, 2018
2. Jan M. Rabaey, Digital Integrated Circuits, 2/e, 2016
3. Jackson, Hodges, Analysis and Design of Digital Integrated Circuits, 3/e, 2010

Course Outcomes:

1. Model combinational/sequential logic circuits and their testbenches at different levels of abstraction in Verilog . 2. Describe and compare the architectures of different programmable logic devices .
3. Explain the evolution of IC technology and its fabrication process .
4. Derive the stick diagram and mask layout for a given MOS circuit .
5. Build combination and sequential building blocks at the subsystem level using different MOS circuit styles .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3		3								3	2	
2	2	2	3		3								3	2	
3	2	2	3		3								3	2	
4	2	2	3		3								3	2	
5	2	2	3		3								3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3011	ANTENNA ANALYSIS AND DESIGN	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course familiarizes all modes of communications are tending towards wireless. Any wireless device is to be equipped with antenna, which converts the energy suitably for radiation into free space or vice versa. Concepts of radiation and various types of antennas based on various classifications are introduced in this course. Synthesis of antennas, that is, building an antenna array for generating a desired radiation pattern is also presented.

Course Educational Objectives:

- To introduce the basic characteristics and fundamental parameters of antennas.
- To familiarize the concepts of wire antennas
- To acquaint the student with knowledge of antenna array analysis.
- To impart knowledge about types of antenna arrays and their synthesis
- To introduce antennas for mobile communications

MODULE 1 ANTENNA CHARACTERISTICS **9 Hrs**

Introduction, types of antennas, radiation mechanism, review of fundamental parameters – radiation pattern, power density, intensity, directivity, gain, beam width, band width, efficiency, polarization, antenna radiation efficiency, antenna equivalent area, maximum directivity and maximum effective area, Friis transmission equation

MODULE 2 WIRE ANTENNAS **9 Hrs**

Infinitesimal dipole, small dipole antenna, half wavelength dipole, region separation, ground effects

MODULE 3 ANTENNA ARRAY ANALYSIS **9 Hrs**

Introduction, Two-element array, N-element Linear Array: Uniform Amplitude and Spacing,
N-element Linear Array: Directivity, N-element Linear Array: Uniform Spacing, Nonuniform Amplitude, Superdirectivity

MODULE 4 ANTENNA ARRAY SYNTHESIS **9 Hrs**

Introduction, Continuous Sources, Schelkunoff Polynomial Method and Fourier transform Method

MODULE 5 ANTENNAS FOR MOBILE APPLICATIONS **9 Hrs**

Antennas for Mobile Communication: Introduction to Microstrip antenna, rectangular patch, quality factor, bandwidth, and efficiency, input impedance, Smart antenna systems.

List of Experiments

1. Experiment 1 Simulate and visualize the radiation pattern of different antenna types using HFSS.
2. Experiment 2 Use MATLAB Antenna Toolbox to plot 2D and 3D radiation patterns for various antennas.
3. Experiment 3 Calculate and compare the directivity and gain of antennas using HFSS simulations. Experiment 4 Implement algorithms in MATLAB to calculate directivity and gain from simulated radiation patterns.
4. Experiment 5 Simulate antenna structures with varying dimensions and materials in HFSS to analyze Bandwidth.
5. Experiment 6 Use MATLAB to analyze S-parameter data and determine the bandwidth of antennas. Experiment 7 Design impedance matching networks using HFSS to improve antenna performance. Experiment 8 Use MATLAB Antenna Toolbox to optimize matching networks for maximum power transfer.
6. Experiment 9 Simulate antenna arrays with different configurations and element spacings in HFSS. Experiment 10 Use MATLAB to analyze the array factor and beamforming characteristics of antenna arrays.
7. Experiment 11 Simulate adaptive beamforming algorithms for smart antenna systems in HFSS. Experiment 12 Implement beamforming algorithms in MATLAB and evaluate their performance in different scenarios.
8. Experiment 13 Design microstrip antennas with specific resonant frequencies and radiation patterns using HFSS.
9. Experiment 14 Use MATLAB to optimize the dimensions of microstrip antennas for desired performance metrics.
10. Experiment 15 Simulate and optimize rectangular patch antennas for bandwidth and efficiency in HFSS.
11. Experiment 16 Implement MATLAB scripts to automate the design process and analyze antenna
12. Performance.
13. Experiment 17 Use HFSS to synthesize antenna arrays with desired radiation patterns and sidelobe levels.
14. Experiment 18 Implement synthesis algorithms in MATLAB and compare synthesized arrays with simulated results.

15. Experiment 19 Extract antenna parameters such as radiation efficiency, input impedance, and equivalent area from HFSS simulations.
16. Experiment 20Use MATLAB to process simulation data and calculate antenna parameters for different operating conditions.Experiment

Textbook(s):

1. Contantine A. Balanis, Antenna Analysis and Design, 3/e, Wiley Publications, 2009
2. Girish Kumar, K. P. Ray, Broadband Microstrip Antennas, Artech House, 2002

Reference(s):

1. John D Kraus , . Antennas , 2/e, TATA Mc Graw Hill ,

Course Outcomes:

1. Explain the radiation mechanism of an antenna and its fundamental parameters and observe practically the radiation pattern of antennae.
2. Distinguish the wired antennas based on their field components.
3. Explain how to improve the strength and directivity of antenna using antenna arrays .
4. Design of antenna using different pattern synthesis methods .
5. Identify the requirement of microstrip and smart antenna in mobile applications and the design of microstrip antenna using simulation software .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2										3	3	
2	2	2	2										3	3	
3	2	2	2										3	3	
4	2	2	2										3	3	
5	2	2	2										3	3	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3021	ANALOG AND DIGITAL COMMUNICATIONS	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 familiarizes the student with different types of signal transmission techniques and explores the basic principles in the analysis and design of analog and digital communication systems, including design objectives, constraints and trade-offs.

Course Educational Objectives:

- To introduce the need for modulation and Amplitude Modulation
- To explain different angle modulation techniques and characteristics of super heterodyne receiver
- To familiarize analog to digital conversion techniques
- To impart knowledge on the baseband transmission and various digital modulation schemes
- To provide an understanding on BER performance of various digital modulation schemes

MODULE 1 AMPLITUDE MODULATION SYSTEMS **12 Hrs**

Introduction, Need for modulation, Generation and detection of AM, Power relations, Spectral Characteristics, generation and detection of DSBSC, SSB, VSB, Frequency division multiplexing.

MODULE 2 ANGLE MODULATION SYSTEMS **12 Hrs**

Properties of angle modulation, representation of FM and PM signals, NBFM, WBFM, transmission bandwidth of FM systems, generation of FM, detection of FM using PLL, receiver characteristics, super heterodyne receivers.

MODULE 3 ANALOG TO DIGITAL CONVERSION **12 Hrs**

Sampling process, pulse modulation schemes-pulse amplitude, pulse width, pulse position modulation. pulse code modulation (PCM), differential pulse code modulation, delta modulation, time division multiplexing.

MODULE 4 BASEBAND/ BANDPASS TRANSMISSION OF DIGITAL DATA **12 Hrs**

Intersymbol interference, nyquist criterion, digital band pass modulation schemes-amplitude shift keying, phase shift keying, frequency shift keying, QPSK, M-ary digital modulation schemes.

MODULE 5 NOISE IN DIGITAL COMMUNICATIONS **12 Hrs**

BER, detection of a single pulse in noise, optimum detection of BPAM, BPSK, BFSK, comparison of BER performance of various digital modulation schemes

List of Experiments

1. Experiment 1 Spectral Analysis of Signals and Frequency Shifting Property
2. Experiment 2 Amplitude Modulation and Demodulation
3. Experiment 3 Frequency Modulation and Demodulation
4. Experiment 4 Sampling and Aliasing
5. Experiment 5 Transmit filtering and Matched Filter Design for Bandlimited Channels
6. Experiment6 Digital PAM transmission and Reception
7. Experiment 7 Carrier Modulation with Digital Signals (ASK, PSK, FSK)
8. Experiment 8 Setting up the SDR and transmitting and receiving baseband samples
9. Experiment 9 Amplitude Modulation
10. Experiment 10 Frequency Modulation
11. Experiment 11 Frequency offset estimation
12. Experiment 12 Symbol modulation and TX filtering
13. Experiment 13 Building a simple channel sounder
14. Experiment 14 Gain control and building a simple AGC
15. Experiment 15 Timing estimation and frame synchronization

Textbook(s):

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications, 2/e, Wiley Student Edition, 2015
2. Proakis, Salehi, Fundamentals of Communication Systems, 1/e, Pearson Education, 2014

Reference(s):

1. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2011
2. John G. Proakis, MasoudSalehi, Digital Communications, 5/e, McGraw Hill Publications, 2010
3. Simon Haykin, Communication Systems, 5/e, Wiley publications, 2010
4. Barry Lee , Digital Communication, 3/e, Springer Publications, 2004

Course Outcomes:

1. Determine the bandwidth requirement for transmission of signals using analog modulation techniques.
2. Determine the bandwidth requirement for transmission of signals using analog modulation techniques.

3. Classify different transmission techniques for digital transmission of analog signals.
4. Classify different transmission techniques for analog transmission of digital signals.
5. Estimate the performance of digital communication systems in presence of noise.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2		2				2	2			3	3	2
2	3	2	2		2				2	2			3	3	2
3	3	2	2		2				2	2			3	3	2
4	3	2	2		2				2	2			3	3	2
5	3	2	2		2				2	2			3	3	2

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3031	**DATA COMMUNICATIONS & NETWORKING**	**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 is designed to impart a basic understanding of the working of data communication networks, with the Internet as the case in point. Starting with the OSI reference model with which the user understand directly the role of each layer to transmit data, it covers the important principles and protocols in the application, transport, network, data link and physical layers.

Course Educational Objectives:

• To introduce the basics of computer network technology, typical network scenarios, layering models and service descriptions
• To demonstrate the data link layer aspects and physical layer technologies enabling the internet.
• To acquaint the unicast and multicast routing aspects of network layer
• To acquaint the principles and design issues of transport layer services and the protocols supporting the services for different network applications
• To familiarize the principles and usage of networking applications including web, HTTP, DNS

MODULE 1 OVERVIEW OF DATA COMMUNICATION AND NETWORKING 9 Hrs

Analog and digital signal, Data communications, Networks, Circuit switching, Packet switching , The Internet, Protocols and standards, Layered tasks, OSI model, TCP/IP protocol Architecture.

MODULE 2 PHYSICAL LAYER 9 Hrs

Guided media, Unguided media, baseband and passband transmission of signals(briefly), Telephone modems, FDM, WDM, TDM, Telephone networks, DSL technology, Cable modem, Bluetooth, SONET, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Connecting devices, Backbone network, Virtual LAN

MODULE 3 DATA LINK LAYER 9 Hrs

Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Random access, Controlled access, Channelization

MODULE 4 NETWORK AND TRANSPORT LAYER **9 Hrs**

Network Layer: Internetworks, Addressing, Routing, ARP, IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols.

Transport layer: Process to process delivery, User datagram protocol (UDP), Transmission control protocol (TCP)

MODULE 5 APPLICATION LAYER **9 Hrs**

DNS (ARP and RARP), Mail protocol (SMTP, POP, IMAP), DHCP, Web services (WWW, HTTP, HTTPS, FTP), telnet, DHCP, Client server and P2P application, Relation between Application layer and Transport

Other technologies overview: PSTN, ISDN and its type, Frame relay, DSL and ADSL, VoIP, Bluetooth, Wi-Fi, Overview of GSM, Wi-Max, 3G and 4G(LTE), Near field Communication(NFC).

Textbook(s):

1. Ferouzan, Behrouz A., Data Communications and Networking, 5/e, TATA McGraw Hill , 2017
2. Stallings William, Data and Computer Communication, 10/e, Pearson Education , 2017

Reference(s):

1. Black, Ulylers D, Data Communication and Distributed Networks, 3/e, PHI, 1999
2. Tanenbaum, Andrew S., Computer Networks, 6/e, PHI, 2022

Course Outcomes:

1. Distinguish Analog and digital signal in communication, and explain basics of networks and, role of each layer of OSI model and TCP/IP model.
2. Explain transmission media and network devices, multiplexing, data networks.
3. Apply channel allocation, framing, error and flow control techniques.
4. Describe about addressing, subnetting & Routing Mechanism in network layer, and process to process communication in transport layer with TCP and UDP protocols.
5. Explain the different protocols HTTP, SNMP, SMTP, FTP used at application layer

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3							1			3	2	
2	2	2	3							1			3	2	
3	2	2	3							1			3	2	
4	2	2	3							1			3	2	
5	2	2	3							1			3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3041	CONTROL SYSTEMS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

Control systems plays a crucial role in almost all real-life applications including electrical, mechanical and aerospace systems. There wide applications for defence and civilan purposes are important for safe critical systems. In this course, students will be explored the basics of linear systems and simple control systems design and analysis in time and frequency domains.

Course Educational Objectives:

- To expose various concepts of systems modelling and representation using block diagrams and signal flow graphs.
- To analyse the systems in time domain
- To demonstrate stability of the system
- To impart knowledge on stability of the system in frequency domain
- To design the control systems for various systems

MODULE 1 INTRODUCTION 9 Hrs

Block diagram reduction and signal flow graphs (Mason's gain formula). Introduction to transfer function and state space equations – modelling of simple electrical and mechanical systems, conversion of transfer function to state space models and vice-versa.

MODULE 2 TIME DOMAIN SPECIFICATIONS 9 Hrs

Standard test signals. Time domain specifications for first and second order systems and steady state errors. Step response of second order systems and their analysis (one electrical and one aerospace system).

MODULE 3 STABILITY - 1 9 Hrs

Routh-Hurwitz stability criteria, rules to draw root locus and manual sketch of root locus for simple systems.

MODULE 4 STABILITY – 2 9 Hrs

Frequency domain specifications. Rules for construction for Bode plots and polar plots; simple manual plots of Bode and polar plots. Introduction to Nyquist stability theory.

MODULE 5 CONTROL SYSTEMS DESIGN **9 Hrs**

Lag-lead compensator, PID controller, Controllability and observability, pole placement controller, and Luenberger observer design for second and third order system (manual).

Textbook(s):

1. Nise, N.S, Control systems engineering, John Wiley & Sons, 2020
2. Ogata, K, Modern control engineering, 5/e, Pearson, 2010

Reference(s):

1. Dorf, R. C., and Bishop R. H, Modern control systems, 13/e, Pearson, 2017

Course Outcomes:

1. Apply the concepts of block diagram reduction to find transfer functions and state space models .
2. Analyze the step response of closed loop systems
3. Analyze the stability of linear systems .
4. Analyze the linear systems from frequency domain perspective .
5. Design the control systems for typical systems .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	1							2	2	2
2	2	2	2	2	2	1							2	2	2
3	2	2	2	2	2	1							2	2	2
4	2	2	2	2	2	1							2	2	2
5	2	2	2	2	2	1							2	2	2

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3051	COMPUTER ORGANIZATION AND DESIGN	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

The purpose of learning this course is to acquire knowledge about processor, memory, input / output devices interconnected by bus. It encompasses the definition of the machine's instruction set architecture. The course emphasizes instruction set design, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O sub systems

Course Educational Objectives:

- To understand the Register transfer language and Arithmetic, Logical, Shift micro operations
- To interpret the computer registers and instruction cycle
- To classify different addressing modes and data manipulation algorithms
- To identify various peripheral devices and interrupts
- To illustrate memory hierarchy and different types of memories

MODULE 1 INSTRUCTION SET ARCHITECTURE 9 Hrs

Memory locations and addresses, memory operations, instructions and instruction sequencing, addressing modes, assembly language, stacks, subroutines, additional instructions, dealing with 32-bit immediate values, CISC instruction sets, RISC and CISC styles, example programs, encoding of machine instructions.

MODULE 2 BASIC INPUT/OUTPUT 9 Hrs

Accessing I/O Devices, interrupts. Software: The assembly process, loading and executing object programs, linker, libraries, compiler, debugger, high level language for I/O tasks, interaction between assembly and c language, the operating system.

MODULE 3 BASIC PROCESSING UNIT 9 Hrs

Some fundamental concepts, instruction execution, hardware components, instruction fetch and execution steps, control signals, hardwired control, CISC-style processors. Pipelining: Basic concept—the ideal case, pipeline organization, pipelining issues, data dependencies, memory delays, branch delays, resource limitations, performance evaluation

MODULE 4 INPUT/OUTPUT ORGANIZATION 9 Hrs

Bus structure, bus operation, arbitration, interface circuits, interconnection standards. The Memory System: Basic concepts, semiconductor ram memories, read-only memories, direct memory access, memory hierarchy, cache memories, performance considerations, virtual memory, memory management requirements, secondary storage.

MODULE 5 ARITHMETIC & PARALLEL PROCESSING AND PERFORMANCE 9 Hrs

Addition and subtraction of signed numbers, design of fast adders, multiplication of unsigned numbers, multiplication of signed numbers, fast multiplication, integer division, floating-point numbers and operations. Hardware multithreading, vector (SIMD) processing, shared-memory multiprocessors, cache coherence, message-passing multicomputer.

Textbook(s):

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky & Naraig Manjikian, Computer Organization and Embedded Systems, 6/e, McGraw Hill Publications, 2010

Reference(s):

1. Patterson, Hennessy, Computer Organization and Design, 4/e, 2011
2. Kai Hwang and A. Briggs, Computer Architecture and Parallel Processing, 2012
3. DezsoSima, Terence Fountain, Peter Kacsuk, Advanced Computer Architecture, 2011

Course Outcomes:

1. Describe the Register transfer language and Arithmetic, Logical, Shift micro operations
2. Differentiate various the computer registers and explain the steps of instruction cycle
3. Classify different addressing modes and data manipulation algorithms
4. Appraise various peripheral devices and interrupts
5. Interpret memory hierarchy and different types of memories

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	2		2								2	2	2
2	2	1	2		2								2	2	2
3	2	1	2		2								2	2	2
4	2	1	2		2								2	2	2
5	2	1	2		2								2	2	2

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3061	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

Electronic gadgets became part and parcel of a common man these days. Microcontroller is an essential heart of any electronic gadget. It is the device which is responsible for the operation the gadget whatever may be the application of use. Microprocessor is that component which drives the microcontroller. Essential features of the microprocessor as well as the microcontroller are introduced in this course. Interfacing this controller with many a number of peripherals is also treated elaborately

Course Educational Objectives:

- To familiarize the concepts and architecture of 16 bit microprocessor 8086.
- To explain assembly language programming of 8086 microprocessor.
- To demonstrate the architecture, instruction set and programming of 8051 microcontroller.
- To impart the knowledge of C programming to interface various peripherals like data converters, timers, serial port etc.
- To demonstrate microcontroller based embedded system.

MODULE 1 8086 MICROPROCESSOR 12 Hrs

Introduction to 8086 – architecture – pin description – External memory interfacing – bus cycle –some important companion chips - Maximum mode bus cycle-memory interfacing - Minimum mode System configuration- Maximum mode system configuration – Interrupts processing

MODULE 2 8086 INSTRUCTION SET AND ADDRESSING MODE 12 Hrs

Addressing modes – Instruction set and assembler directives – Assembly language programming using MASM – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros– Byte and String Manipulation.

MODULE 3 I/O INTERFACING 12 Hrs

I/O interfacing – Parallel communication interface – Keyboard /display controller - Timer -D/A and A/D Interface -Serial communication interface —Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

MODULE 4 MICROCONTROLLER 12 Hrs

Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.

MODULE 5 INTERFACING MICROCONTROLLER AND INTRODUCTION TO ARM 12 Hrs

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, Architecture Revisions, Arm Processor Families

List of Experiments

1. Experiment 1 Arithmetic operations on 8 bit and 16 bit operands.
2. Experiment 2 Transfer block of data from one memory location to another memory location.
3. Experiment 3 Programs using monitor routines.
4. Experiment 4 Compute maximum, minimum and sorting (ascending and descending).
5. Experiment 5 Generate Fibonacci series, average of N numbers and factorial of N.
6. Experiment 6 Arithmetic operations on 8051.
7. Experiment 7 Transfer given string serially with suitable baud rate.
8. Experiment 8 Generation of waveforms using timers of 8051.
9. Experiment 9 Interface DAC with 8051 to generate waveforms.
10. Experiment 10 Interface ADC with 8051 to read analog data and display read data.
11. Experiment 11 Demonstration of ARM Development System and Tools
12. Experiment 12 Basic Experiments involving memory and I/O interfacing Experiment

Textbook(s):

1. AK Ray, KM Bhurchandi, Advanced Microprocessors and Peripherals, 3/e, Tata McGraw Hill Publications, 2017 2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2/e, Pearson, 2007

3. Ramesh S. Gaonkar , Microprocessor Architecture, Programming, and Applications with the 8085, 6/e, Penram International Publishing, 2013

4. Andrew Sloss, Dominic Symes, and Chris Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Morgan Kaufmann, 2004

Reference(s):

Course Outcomes:

1. Understand the architecture, pin configuration, and memory interfacing of the 8086 microprocessor
2. Analyze 8086 instruction set, addressing modes, and develop assembly language programs using MASM.
3. Interface various I/O devices such as keyboard, display controllers, ADC, DAC, timers, and interrupt controllers with 8086.
4. Understand the architecture, instruction set, and programming of the 8051 microcontroller. .
5.Perform interfacing and programming of peripherals with 8051 and understand ARM processor fundamentals.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3		3								3	2	
2	2	2	3		3								3	2	
3	2	2	3		3								3	2	
4	2	2	3		3								3	2	
5	2	2	3		3								3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3071	DIGITAL SIGNAL PROCESSING	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

Unprecedented developments in the interpersonal communications and on demand entertainment is enabled with the Digital Signal Processing (DSP) engineering. DSP is the heart of digital revolution that brought music players, mobile phones, etc. into every walk of common man life. It unified the electronics, communications, and computer science. All electronic systems today use powerful DSP concepts as their foundations. A thorough understanding of digital signal processing fundamentals and techniques is imparted in this course.

Course Educational Objectives:

- To introduce the frequency analysis of discrete time LTI systems
- To identify different hardware structures for IIR systems
- To explain the numerical computation of DFT / FFT along with their properties and applications
- To expose the design of IIR filters
- To expose the design of FIR filters

MODULE 1 DISCRETE TIME SYSTEMS 12 Hrs

Transform Analysis of Discrete Time LTI Systems: Frequency response of LTI systems. System Functions for Systems Characterized by Linear Constant Coefficient Difference Equations: Stability, causality, impulse response for rational system functions. Structures for IIR Discrete Time Systems: Direct, parallel and cascade form.

MODULE 2 DISCRETE AND FAST FOURIER TRANSFORM 12 Hrs

The Discrete Fourier Transform (DFT): Representation of periodic sequences. The discrete Fourier series, Fourier representation of finite duration sequences, the discrete Fourier Transform (DFT), computation of DFT, properties of the DFT, circular convolution and linear convolution using DFT, overlap-add method, overlap-save method. Fast Fourier Transform (FFT): Radix-2 decimation-in-time and decimation-in-frequency FFT algorithms, inverse FFT.

MODULE 3 DESIGN OF IIR FILTERS 12 Hrs

Design of IIR Filters: Design of analog prototypes from digital filter specifications using Butterworth and Chebyshev approximations, design of IIR filters from analog filters, Butterworth filters and Chebyshev filters design using impulse invariance, bilinear transformation

MODULE 4 DESIGN OF FIR FILTERS **12 Hrs**

Design of FIR Filters: Linear discrete time systems with generalized linear phase, design of linear phase FIR filters using window functions (rectangular, Hamming, Hanning, Blackman and Kaiser) frequency sampling technique.

MODULE 5 PROCESSOR FUNDAMENTALS **12 Hrs**

Features of DSP processors - DSP processor packaging(Embodiments)- Fixed point Vs floating point DSP processor data paths - Fixed point Vs floating point DSP processor data paths – pipelining - TMS320 family of DSPs (architecture of C5x)- Memory architecture of a DSP processor (Von Neumann - Harvard) - Addressing modes.

List of Experiments

Topic

Experiment 1Generation of discrete time signals in time domain.
Experiment 2 Implementation of discrete time systems in time domain.
Experiment 3 Frequency analysis of discrete time signals using DTFT.
Experiment 4 Frequency analysis of discrete time systems using DTFT
Experiment 5 Discrete Fourier transform (DFT) and properties
Experiment 6 FIR filter design.
Experiment 7 IIR filter design.
Experiment 8 Study of TMS320C6478 DSK and code composer studio.
Experiment 9 Sinusoidal waveform generation.
Experiment 10 FIR filter implementation on LCDK Kit.
Experiment 11 IIR filter implementation on LCDK Kit.
Experiment 12 Mini project on DSP (Example: DTMF generation and detection using correlation processing/FFT).Experiment

Textbook(s):

1. A.V. Oppenheim, R. W. Schafer, Digital Signal Processing , Prentice Hall of India, 2004

Reference(s):

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007
2. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011 3. Ifeachor E.C, Jervis B.W, Digital Signal Processing – A Practical Approach, 2/e, Pearson Education, 2002

Course Outcomes:

1. Analyze discrete-time systems using transform techniques (Z-transform, Fourier Transform) and study their stability & causality.
2. Implement Discrete and Fast Fourier Transforms for signal analysis and processing.
3. Design Infinite Impulse Response (IIR) filters using Butterworth and Chebyshev approximations.
4. Design Finite Impulse Response (FIR) filters using windowing and frequency sampling techniques.
5. Understand the architecture of DSP processors and analyze their data paths, memory architectures,

and addressing modes.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	2	3								3	3	1
2	3	2	3	2	3								3	3	1
3	3	2	3	2	3								3	3	1
4	3	2	3	2	3								3	3	1
5	3	2	3	2	3								3	3	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

Programme Elective (PE)

Programme Elective (PE)

Track: Aerospace & Defence

24AERO2091	AEROSPACE AND DEFENCE ELECTRONICS BASICS	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 covers fundamental concepts in electronic systems relevant to the aerospace and defense industries. Topics include avionics, radar systems, communication systems, and electronic warfare. Students will gain insights into the design, integration, and maintenance of electronic components in aircraft and defense systems. The course emphasizes the unique challenges and requirements of electronics in these high-stakes environments. Practical applications, case studies, and emerging technologies in aerospace and defense electronics are explored to provide a comprehensive understanding of the subject.

Course Educational Objectives:

- To grasp the fundamental principles of electronics as they apply to aerospace and defence contexts, comprehending their significance in aviation and national security.
- To analyze and assess electronic systems used in aerospace and defence applications, understanding their functionalities and performance requirements.
- To apply theoretical knowledge to practical scenarios, designing and optimizing electronic circuits and systems for specific aerospace and defence purposes.
- To understand the working principles of aerospace and defence instruments.
- To evaluate various electrical loads' effects in aircrafts.

MODULE 1 INTRODUCTION TO AEROSPACE AND DEFENCE ELECTRONICS 9 Hrs

Importance of Electronics in Aerospace and Defence, Overview of Electronic Systems in Aviation and Defence, Evolution of airplanes, classification of aircraft, and space vehicles, Functions of major components of an airplane, Role of Electronics in National Security

MODULE 2 SYSTEMS ENGINEERING AND REQUIREMENTS **9 Hrs**

Methods used to determine system requirements from mission needs, Operational requirements, Military Equipment standards (e.g., JSS Penta 5 standard), Introduction to combat systems

MODULE 3 ELECTRONIC SIMULATION AND MODELING **9 Hrs**

Digital simulation models in defence for determining engineering and performance trade-offs, Decision theory, hypothesis testing, and probabilities of false alarm and detection

MODULE 4 ELECTRONIC INSTRUMENTS **9 Hrs**

Tachometers, temperature gauges, pressure gauges - operation and principles, Flight instruments: gyroscope, accelerometers, Airspeed indicators: TAS and EAS; Machmeters, altimeters.

MODULE 5 ELECTRICAL SYSTEMS **9 Hrs**

Electrical loads in aircraft and power generation and control of AC and DC, Bus bars, power distribution of different voltages AC & DC, Over/under load protection devices, speed, and frequency protection devices.

Textbook(s):

1. Ian Moir and Allan Seabridge, Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley, 2018,9781860582899

Reference(s):

1. R.P.G. Collinson, Introduction to Avionics Systems, Springer, 2014
2. Stephen Corda, Introduction to Aerospace Engineering with a Flight Test Perspective, Wiley & Sons, 2017 ,9781118953365
3. Filippo Neri, Introduction to Defense Electronics, Artech, 2018 ,9781580531795
4. U.S. Department of Transportation Federal Aviation Administration, Aviation Maintenance Technician Handbook - Airframe, 2023
5. U.S. Department of Transportation Federal Aviation Administration , Aviation Maintenance Technician Handbook - General, 2023
6. Leading Edge, Combat Systems Engineering & Integration Navsea Warfare Centers , 2013

Course Outcomes:

1. Gain foundational knowledge of electronics principles as applied to aerospace and defence.
2. Analyze and assess electronic systems in aerospace and defence contexts.
3. Apply theoretical knowledge to design electronic circuits for specific aerospace and

defence applications.

4. Understand the operational principles of aerospace and defence instruments.
5. Understand power generation and distribution of electrical systems in air crafts.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24AERO3221	AVIONICS SYSTEMS AND TECHNOLOGIES	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 introduces the students to a comprehensive understanding of avionics systems and technologies, equipping them with the knowledge and skills necessary to excel in the field of aviation electronics. Through theoretical learning and practical applications, students will be prepared to contribute to the design, maintenance, and integration of avionic systems, ensuring the safety and efficiency of modern aircraft.

Course Educational Objectives:

- Understand the principles of avionics systems, including navigation, communication, and surveillance technologies.
- Explore the integration of avionics components and their role in enhancing aircraft safety and performance.
- Gain knowledge of avionic sensors, communication protocols, and data processing algorithms.
- Analyze avionics system architectures and their application in modern aircraft platforms.
- Develop skills in troubleshooting, maintenance, and the implementation of emerging avionics technologies.

MODULE 1 FOUNDATIONS OF AVIONICS SYSTEMS 9 Hrs

Importance and Scope of Avionics in Aviation, Components and Functions of Avionics Systems, Regulations and Standards in Avionics, Communication Systems: Voice, Data, Satellite Communication, Navigation Systems: GPS, Inertial Navigation, VOR, DME, Ground-Based and Satellite-Based Surveillance Systems

MODULE 2 FLIGHT CONTROL AND DISPLAY SYSTEMS 9 Hrs

Flight Control Systems, Fly-by-Wire Technology, Control Laws and Modes, Redundancy for Flight

Safety, Human-Machine Interface and Cockpit Displays, Human-Centered Design Principles, Cockpit Displays and Information Presentation, Avionics Software Development and Verification

MODULE 3 AVIONICS INTEGRATION AND MAINTENANCE 9 Hrs

Avionics System Integration, Avionics Architecture and Components, Data Bus Systems (e.g., ARINC 429, MIL-STD-1553), Sensors and Sensor Integration, Maintenance and Health Monitoring, Maintenance Procedures and Best Practices, Health Monitoring and Fault Detection

MODULE 4 EMERGING TECHNOLOGIES IN AVIONICS 9 Hrs

Next-Generation Avionics, Electric Aircraft and Urban Air Mobility, Synthetic Vision Systems AI, Machine Learning, and Big Data in Avionics

MODULE 5 MODEL-BASED ENGINEERING 9 Hrs

Model-Based Engineering for Avionics, Introduction to Model-Based Engineering, Simulation Tools (Simulink and MATLAB), Control Strategies and Simulation for Avionics

Textbook(s):

1. Vladimir Ivanovich Baburov, Shatrakov Y.G., Boris Victorovich Ponomarenko, Igor Victorovich Avtin, Principles of Integrated Airborne Avionics, Springer, 2021 ,978911608964

Reference(s):

1. Guoqing Wang and Wenhao Zhao, The Principles of Integrated Technology in Avionics Systems, Kendall Hunt Publishing, 2020 ,9780128166512
2. Ian Moir, Allan Seabridge, Military Avionics Systems, Willey, 2019 ,9781119601005, 1119601002

Course Outcomes:

1. Gain a comprehensive understanding of avionic systems, components, and their integration into aircraft, fostering a solid foundation in aviation technology. (L2)
2. Analyze advanced communication protocols and navigation technologies to design and troubleshoot systems crucial for safe and efficient flight operations (L5)
3. Derive on the intricacies of fly-by-wire and autopilot systems, emphasizing control algorithms and sensor integration, enhancing skills for developing and maintaining reliable flight control mechanisms (L3).
4. Understand the insights into radar systems and various sensors employed in avionics, allowing students to analyze, select, and optimize sensor configurations essential for situational awareness and safety in different flight conditions (L4).
5. Understand the latest advancements in avionics, including unmanned aerial systems (UAS), artificial

intelligence applications, and cybersecurity considerations, preparing students to adapt to the evolving landscape of aviation technology(L4)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4001	SATELLITE COMMUNICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

The satellites are an essential part of telecommunication systems worldwide, which carry large number of data, telephone traffic in addition to television signals. This course deals with the satellite inventions, frequency allocation to different regions worldwide, and gives information about satellite orbits, satellite launching methods, design of satellite and satellite subsystems, satellite link over the earth, satellite application in communication, internet and remote sensing.

Course Educational Objectives:

- To introduce invention of satellite and developments in worldwide.
- To explain the basics of orbital mechanics, the types of satellite orbits, the location of ground stations, and the look angles from ground stations to the satellite
- To provide knowledge of various modulation and multiplexing techniques in satellite communication.
- To familiarize the link budget for satellite performance.
- To examine concepts of propagation losses in satellite networking for voice and internet communication, data networks, and scientific data.

MODULE 1 INTRODUCTION TO SATELLITE COMMUNICATIONS 9 Hrs

Importance and applications of satellite communication, Overview of satellite communication system components, Historical development and evolution of satellite technologies, Ethical considerations in satellite communication, Satellite Frequency bands, Applications

MODULE 2 SATELLITE ORBITS AND SUBSYSTEMS 9 Hrs

Geostationary and non-geostationary orbits, Kepler's laws of Planetary motion, Orbital Period and Velocity, Effects of Orbital inclination, Look angles, Orbital perturbations, Subsystems: Altitude and orbit control system, TT&C Sub-System, Altitude control Sub-System, Power Systems, Communication Subsystems, Satellite antenna Equipment.

MODULE 3 PROPAGATION EFFECTS 9 Hrs

Atmospheric Absorption, Cloud Attenuation, Ionospheric Scintillation, Low angle fading, Rain Induced attenuation, rain induced cross polarization interference.

MODULE 4 MODULATION SCHEMES AND MULTIPLE ACCESS TECHNIQUES IN SATELLITE COMMUNICATION **9 Hrs**

Multi-Level Gaussian Frequency Shift Keying (MGFSK), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Demand Assignment Multiple Access (DAMA), Wavelet Packet Modulation (WPM,) Spread Spectrum Concepts.

MODULE 5 LINK DESIGN **9 Hrs**

Satellite link design, earth station design, link budget components: transmission power, gains, losses, noise, Link margin analysis and fade margin, satellite applications in remote sensing.

Textbook(s):

1. Dennis Roddy , Satellite Communications, McGraw Hill Education , 2017 ,978-0070077850
2. Timothy Pratt, Charles Bostian, and Jeremy Allnutt, Satellite Communications, 2nd , Wiley , 2006 ,978-8126508334

Reference(s):

1. Anil K. Maini, Varsha Agrawal , Satellite Communications, Wiley, 2019 ,978-8126520732
2. ,https://tbc-python.fossee.in/book-details/191/

Course Outcomes:

1. Understand the basic information about satellite communications systems.
2. Identify the frequency allocations to satellite services orbital mechanism substations.
3. Analyse the propagation effect due to atmospheric conditions.
4. Understand the communication methodologies in satellite communication.
5. Design link design with respect to satellite and earth stations.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3081	RADAR SYSTEMS AND SIGNAL PROCESSING	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 introduces how a radar functions, especially to modern systems' digital signal processing. The most important processes for the radar's performance will be covered, including propagation and reflection of electromagnetic radiation, the radar equation, waveforms, Doppler processing, detection theory and tracking. Through exercises using modern numerical tools you will gain practical experience with numerical methods for digital signal processing and calculation of radar performance.

Course Educational Objectives:

- Develop a comprehensive understanding of radar systems, enabling proficiency in detection, noise jamming scenarios, and bistatic radar analysis.
- Demonstrate Master advanced signal processing techniques.
- Acquire expertise in radar waveform design.
- Explore advanced radar techniques, encompassing SAR data characteristics.
- Develop a strong foundation in DSP architectures and programming.

MODULE 1 RADAR FUNDAMENTALS 9 Hrs

Radar Block Diagram, Radar Equation, Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar.

MODULE 2 ADVANCED RADAR SIGNAL PROCESSING 9 Hrs

Moving Target Indication (MTI) techniques, Pulse-Doppler radar principles, Introduction to Multiple-Input, Multiple-Output (MIMO) radar, Cognitive radar and adaptive beamforming, Impulse Response, Frequency Response Characteristic, and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver, Efficiency of Non-Matched Filters.

MODULE 3 RADAR WAVEFORM DESIGN 9 Hrs

Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties, Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Waveform Design Requirements, Optimum Waveforms for Detection in Clutter.

MODULE 4 ADVANCED RADAR TECHNIQUES 9 Hrs

Strip map SAR Data Characteristics, Strip map SAR Image Formation Algorithms, Spotlight SAR Data Characteristics, the Polar Format Image Formation, Algorithm for Spotlight SAR, Spatial Filtering, Space-Time Signal Environment, Modelling and, Processing, Dimension STAP, Advanced STAP Algorithms.

MODULE 5 DSP ARCHITECTURES AND PROGRAMMING 9 Hrs

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Memory space of TMS320C54XX Processors.

Textbook(s):

1. Merrill Skolnik , Introduction to Radar Systems, 3rd Edition, McGraw Hill Education, 2017
2. Mark A. Richards , Fundamentals of Radar Signal Processing, McGraw Hill Education, 2005

Reference(s):

1. Mark A. Richards, James A. Scheer and William A. Holm, Principles of Modern Radar: Basic principles, SciTech Publishing Inc, 2010

Course Outcomes:

1. Know how a radar is built and understand the principles of behavior.
2. Understand how radar signals propagate through a medium, and the mechanisms for signal reflection from the target and unwanted reflections.
3. Understand the basic principles of signal processing done in a radar.
4. Be able to assess what type of radar is suitable for which task (choice of waveforms, frequency bands).
5. Be able to understand the DSP processors and different addressing modes and memory maps.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN2301	FUNDAMENTALS OF CYBER SECURITY	L	T	P	S	J	C
		2	0	2	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, cyberstalking, key loggers, crimes. The knowledge gained in this course can be applied to identify, classify, and estimate the criminal plans of the attackers, and predict the web threats and security implications.

Course Educational Objectives:

• Learn the foundations of cyber security and the threat landscape.

• To equip students with the technical knowledge and skills needed to protect and defend against cyber threats. • To expose students to social and ethical contexts of cyber security.

• To expose students to responsible use of online social media networks

MODULE 1 INTRODUCTION TO CYBER SECURITY AND THREATS IN THE CYBERSPACE 8 Hrs

Cybersecurity Definition, Key Terms, Security Threats, Vulnerability Assessments, Roles in Security, Critical Thinking in Cybersecurity. Network Security Model, Security services, Security Mechanisms, Threat Examples, Malware and Ransomware, Threat Protection, Internet Security Threats, Security Threat, Cyber Kill Chain, ISO 2700x.

MODULE 2 KEY SECURITY CONCEPTS AND SECURING PARAMETERS 10 Hrs

CIA Triad, Non-Repudiation -Access Management, Incident Response, Identifying and Assessing Risk and Controlling Risk, Perimeter Security in the Real World, Hiding the Private Network, Understanding Private Networks, Protecting the Perimeter, Understanding the Perimeter, Proxy Servers, Demilitarized Zones, Honeypots, Extranets

MODULE 3 SECURITY PROTOCOLS-I **9 Hrs**

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, Information Technology Infrastructure Library (ITIL) and AAA.

MODULE 4 SECURITY PROTOCOLS-II **10 Hrs**

Access Control Methods, Access Control - Physical and Logical, Open Web Application Security Project (OWASP). Firewalls – Application Gateway, XML Gateway, Stateless and Stateful, Antivirus/Antimalware, Firewalls-Packet Filtering, Protecting Remote Connections, Intrusion Detection and Prevention Systems-Security tools.

MODULE 5 CYBER FORENSICS **8 Hrs**

Network forensics, Digital Evidence and Computer Crime, History and Terminology of Computer Crime Investigation, The Investigative Process, Investigative Reconstruction, Digital Evidence in the Courtroom, Unmanned Aerial Vehicle Forensics basics.

List of Experiments

Experiment 1 Introduction: Design an IP Address Scheme, Implementing VLANs and Trunk, Configuring Servers
Experiment 2 Secure Switch Physical Ports
Experiment 3 Initial and Security Settings for Network Devices
Experiment 4 Secure Remote Access
Experiment 5 Creating cyber world
Experiment 6 Communicating in a cyber world
Experiment 7 WEP/WPA2 PSK/WPA2 Radius
Experiment 8 Configuring VPN transport and tunnel mode
Experiment 9 Router and switch redundancy and resilience
Experiment 10 Server firewalls and routers ACLs Experiment

Textbook(s):

1. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Cyber Security Essentials, 1st Edition, ybex Wiley Publisher, , 2018 ,ISBN: 978-1119362395
2. Nina Godbole and SuNone Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st Edition, Wiley India Publisher, , 2011 ,ISBN: 978-8126521791

Reference(s):

1. William Stallings, Cryptography and Network Security – Principles and Practice,, 7th Edition, Pearson Education Publisher, , 2017 , ISBN: 978-9332585225 ,
2. Michael Whitman, Herbert Mattord , Principles of Information Security: A Dimensional Approach, 6th Edition, Course Technology Inc Publisher, , 2018 ,ISBN: 978-1337102063

Course Outcomes:

1. Understand various Cyber security key terms and Internet security threats (L2)
2. Knowledge about security perimeter construction (L1)
3. Outline the network access and cloud security (L1)
4. Examine about access control methods and firewall implementations (L3)
5. Apply knowledge about forensics in cyber crimes (L3)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3091	ELECTROMAGNETIC COMPATIBILITY	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 provides the introduction and theoretical background of electromagnetic interference and electromagnetic compatibility and review of electromagnetic fundamentals layout and control of interfaces Grounding or earthing, Electromagnetic Shielding Shielded cables Filters and Surge protectors. The course further provides how electromagnetic interference plays a critical role in the aerospace and defence sectors.

Course Educational Objectives:

- Gain insight into EMC principles including coupling mechanisms like capacitive and inductive coupling.
- Explore nonideal behavior of components and its impact on EMC, considering factors like variability.
- Learn about measuring and mitigating conducted emissions, and strategies for reducing susceptibility.
- Understand principles of electromagnetic shielding and lightning protection, and methods for implementation.
- Familiarize with EMC requirements, standards, and testing, including studies on intentional electromagnetic interference and error-free performance evaluation.

MODULE 1 EMC BASICS & COUPLING 9 Hrs

The importance of EMC, Introduction to EMC - Sources, units, Electromagnetic principles, High-frequency behaviour of components, Crosstalk or near-field coupling - Capacitive coupling, inductive coupling, common-impedance coupling, Crosstalk or near-field coupling - Crosstalk combinations, Crosstalk or near-field coupling, Electromagnetic coupling in the far-fields.

MODULE 2 NONIDEAL BEHAVIOR OF COMPONENTS 9 Hrs

Wires, Printed Circuit Board (PCB) Lands, Effect of Component Leads, Resistors, Capacitors, Inductors Ferromagnetic Materials--Saturation and Frequency Response, Common-Mode Chokes, Electromechanical Devices, Digital Circuit Devices, Effect of Component Variability, Mechanical Switches.

MODULE 3 EMISSIONS AND SUSCEPTIBILITY 9 Hrs

Measurement of Conducted Emissions, Power Supply Filters, Power Supplies, Power Supply and Filter Placement, Conducted Susceptibility, Simple Emission Models for Wires and PCB Lands, Simple Susceptibility Models for Wires and PCB Lands.

MODULE 4 SHIELDING AND LIGHTNING PROTECTION 9 Hrs

Earthing, Electromagnetic Shielding, Shielded cables, Filters and Surge protectors.

Lightning Protection: Introduction, Lightning protection - Currents, charges and fields, Buildings, Lightning Protection - Towers, Lightning safety, Protection from high-intensity solar and other cosmic radiation.

MODULE 5 EMC ANALYSIS 9 Hrs

EMC Requirements & Standard, Testing and Difficulties, Intentional Electromagnetic Interference-1, EMI-EMC studies of the error-free performance of such complex systems.

Textbook(s):

1. Christos Christopoulos, Principles andechniques of Electromagnetic Compatibility (Electronic Engineering Systems Book 6), Second edition, CRC Press, 2007
2. Clayton R. Paul, Introduction to Electromagnetic Compatibility, Second edition, Wiley , 2010

Reference(s):

1. H Ott, Electromagnetic Compatibility Engineering, Second edition, 2009

Course Outcomes:

1. Identify and analyze sources of electromagnetic disturbances
2. Show theoretically how electromagnetic noise couples to an electrical system
3. Understand the conducted and radiated emissions and susceptibility
4. Understand shielding mechanisms and electromagnetic coupling
5. Able to understand the EMC standards of aerospace and defence.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3101	DIGITAL IMAGE PROCESSING	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 introduces the fundamental concepts and general principles of processing of images which are digital in nature. It covers the key stages of digital image processing techniques. This course finds a wide range of real time applications like automatic number plate detection, visual effects, 3D modelling, radar imaging, remote sensing imaging, biometric recognition, and other applications.

Course Educational Objectives:

- Understand image acquisition, sampling, quantization, and pixel relationships.
- Learn histogram equalization and specification for contrast enhancement.
- Understand various transforms (2-D DFT, Walsh, Hadamard, DCT, Haar) and their applications.
- Apply spatial and frequency domain methods for image enhancement.
- Explore image compression basics, segmentation methods, and restoration techniques.

MODULE 1 FUNDAMENTALS OF IMAGE PROCESSING **9 Hrs**

Image acquisition, image sampling and quantization, relationships between pixels. Histogram processing: Histogram equalization. Histogram specification

MODULE 2 IMAGE TRANSFORMS **9 Hrs**

2-D DFT, properties, Walsh transform, Hadamard transform, discrete cosine transform, Haar transform, comparison of different transforms.

MODULE 3 IMAGE ENHANCEMENT **9 Hrs**

(by spatial domain methods) point processing, image smoothing and sharpening filters in spatial domain. Image Enhancement: (by frequency domain methods) Image smoothing and image sharpening filters in frequency domain, Homomorphic filter, comparison of filters in frequency domain and spatial domain.

MODULE 4 IMAGE COMPRESSION FUNDAMENTALS **9 Hrs**

Types of redundancy, Image compression model: lossy and lossless, Variable length coding, LZW coding, basics of image compression standards: JPEG, JPEG 2000.

MODULE 5 IMAGE SEGMENTATION **9 Hrs**

Thresholding, Region based segmentation, Edge linking. Image Restoration: Estimation of degradation function, Restoration filters: Inverse filter, Wiener filter, Constraint least square filtering.

Textbook(s):

1. R.C. Gonzalez, R.E. Woods, Digital Image processing, 3rd Edition, Pearson Education, 2009

Reference(s):

1. Anil K. Jain, Fundamentals of Digital Image processing, 1989
2. Rafael C. Gonzalez, Richard E. Woods, Steven L, Digital Image Processing using MATLAB, 2004
3. William K. Pratt, Digital Image Processing, 2004
4. S. Jayaraman, S. Esakkirajan, T.Veerakumar, Digital Image Processing, 2011

Course Outcomes:

1. Understand basics of digital image processing.
2. Explain different algorithms for image enhancement, compression, segmentation and restoration.
3. Apply various transforms on digital images.
4. Apply image enhancement and compression methods to tackle any industry-oriented problem domain with image processing techniques.
5. Use segmentation and restoration techniques on various digital image processing problem domains

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE3111	COMMAND, CONTROL AND COMMUNICATION SYSTEMS	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 in-depth exploration of command, control, and communication (C3) systems, and focuses on their theoretical foundations, technologies, and practical applications. Students will gain knowledge on designing, implementing, and managing effective C3 systems, data acquisition in various domains, hydraulic and pneumatic systems, environmental control Systems.

Course Educational Objectives:

- Understand the fundamental concepts, terminologies, and principles related to command, control, and communication systems.
- Evaluate various communication technologies and their applications in C3 systems.
- Apply information fusion techniques to enhance situational awareness and decision-making.
- Analyse the role of environmental control systems.
- Understand the principles of hydraulic and pneumatics systems

MODULE 1 INTRODUCTION TO COMMAND, CONTROL, AND COMMUNICATION SYSTEMS 9 Hrs

Definitions and significance of C3 systems, Historical evolution and applications in different sectors, Hierarchical and decentralized command structures, Decision-making processes and models, Information flow and feedback mechanisms

MODULE 2 COMMUNICATION TECHNOLOGIES 9 Hrs

Wired and wireless communication fundamentals, Data transmission methods and protocols, Network topologies and architectures

MODULE 3 SENSOR SYSTEMS AND DATA ACQUISITION 9 Hrs

Sensor types and functionalities, Sensor fusion for improved accuracy, Data collection, preprocessing, and storage, Techniques for fusing data from multiple sources, Enhancing situational awareness in dynamic environments.

MODULE 4 ENVIRONMENTAL CONTROL SYSTEMS **9 Hrs**

Need for a controlled environment in aircraft, Refrigeration systems - vapour cycle systems, boost-strap air cycle system, Humidity control, aircraft anti-icing and de-icing systems, air distribution systems, Cabin pressurization, g-tolerance, rain dispersal, anti-misting and demisting.

MODULE 5 HYDRAULIC & PNEUMATIC SYSTEMS **9 Hrs**

Hydraulic circuit design, hydraulic actuation, hydraulic fluid, hydraulic pumps, Types of hydraulic systems, landing gear systems - retraction, steering, braking and anti-skid. Basic working principle of pneumatic systems, pneumatic power system components, Use of pneumatic power in aircraft, sources of pneumatic power.

Textbook(s):

1. Ian Moir and Allan Seabridge, Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration,, 3rd Edition, John Wiley & Sons , 2008
2. Guy H Walker, Neville A. , Stanton and Daniel P. Jenkins, Command and Control: The Sociotechnical Perspective, 1st Edition , CRC Press, 2017

Reference(s):

1. E. H. J. Pallett Pearson Education, Aircraft Instruments and Integrated Systems, 1st Edition, 1992
2. David S. Alberts and Richard E. Hayes, Network Centric Warfare: Developing and Leveraging Information Superiority", 2nd Edition , 2000
3. Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, 1993
4. NASA System Engineering Handbook , 2007

Course Outcomes:

1. Understand the fundamental concepts, terminologies, and principles of command, control, and communication systems.
2. Analyze the various data preprocessing and aquation techniques.
3. Evaluate various communication technologies and their applications in C3 systems.
4. Understand the importance of environmental control systems.
5. Evaluate the role of Hydraulic and pneumatic Systems in the aerospace and defense sector.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE3121	JAMMING AND ECM/ECCM TECHNOLOGIES	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 provides the introduction and theoretical background of electromagnetic interference and electromagnetic compatibility and review of electromagnetic fundamentals layout and control of interfaces grounding or earthing, Electromagnetic Shielding Shielded cables Filters and Surge protectors. The course further provides how electromagnetic interference plays a critical role in aerospace and defense sectors.

Course Educational Objectives:

- Gain insight into Electronic Attack (EA) principles and various Jamming types.
- Understand On-Board ECM Systems, including Escort Jamming and Self-Protection Jamming methods.
- Explore Off-Board ECM Systems such as Infrared Countermeasures (IRCM) and Communications Countermeasures (COM-ECM).
- Study the implementation of Airborne Tactical Jamming System and Shipboard Self-Defense System.
- Learn about Infrared Counter-Countermeasures (IRCCM) and Communications Counter Countermeasures (CCM), including protection against solar and cosmic radiation.

MODULE 1 ELECTRONIC ATTACKS & JAMMING 9 Hrs

Principals of Electronic Attack (EA), Jammer architecture, Jamming-to-Signal Ratio, Jamming Types Burn-Through, Cover Jamming, Range Deceptive Jamming, Inverse Gain Jamming, Repeater Jamming Equations, Noise Jamming vs. Deception.

MODULE 2 ON-BOARD JAMMING TECHNIQUES 9Hrs

Repeater vs. Transponder. Escort Jamming, Self-Protection Jamming, ECM techniques, On-Board ECM Systems.

MODULE 3 OFF-BOARD JAMMING TECHNIQUES 9 Hrs

Off-Board ECM Systems, Infrared Countermeasures (IRCM), Communications Countermeasures (COM-ECM), Electro-Optic Counter Measure (EOCM) Systems.

MODULE 4 ECM/ECCM TECHNIQUES 9 Hrs

Airborne Tactical Jamming System, Shipboard Self-Defense System, EA/Susceptibility against Weapon Systems, Search Radar Counter-Countermeasures

MODULE 5 IRCCM, COMMUNICATIONS-CCM TECHNIQUES 9 Hrs

Infrared Counter-Countermeasures, Communications Counter Countermeasures. Protection from high-intensity solar and other cosmic radiation.

Textbook(s):

1. Adrian Graham, Communications, Radar and Electronic Warfare, first edition, Wiley , 2010
2. Bahman Zohuri, Radar Energy Warfare and the Challenges of Stealth Technology, first edition, springer, 2020
3. S.A. Vakin, L.N. Shustov, R.H. Dunwell, Fundamentals of Electronic Warfare (Radar Library, first edition, Artech House Publishers , 2001

Reference(s):

1. Naval Air Warfare Center Weapons Division, Electronic Warfare & Radar Systems Engineering Handboo, forth edition, 2011

Course Outcomes:

1. Understand the concept of electronic attacks and jamming.
2. Design of on-board jamming techniques.
3. Design of Off board jamming Techniques
4. Understand the concept of ECM, ECCM
5. Understand the concept of IR CCM, Communications CCM

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE2301	EMBEDDED SYSTEMS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

An embedded system is a multidisciplinary course that requires a knowledge of both hardware and software. The applications of embedded systems are enormous, a few applications are line-following robots, GPS systems, cameras, etc. The objective of this course is to provide knowledge of hardware and software used in embedded systems. The course provides insights of interfacing techniques and the importance of real-time operating system including arm processors and programming

Course Educational Objectives:

- To understand purpose of Embedded systems and its building blocks.
- To familiarize advanced 32-bit ARM architecture.
- Understand the ASM programming.
- Understand various peripheral interfacing techniques.
- Understand various RTOS in Embedded System.

MODULE 1 INTRODUCTION TO EMBEDDED SYSTEMS 9 Hrs

Classification of embedded systems based on generation and complexity. Major application of embedded systems. Purpose of embedded systems, Characteristics of embedded systems,

Elements of embedded systems, Watchdog timer.

MODULE 2 ARM ARCHITECTURE 9 Hrs

Compare CISC Vs RISC architectures, Compare Von Neumann and Harvard Architecture, ARM design philosophy, The General-Purpose Registers in the ARM Section.

MODULE 3 ARM OPERATING MODES AND INSTRUCTION SET 9 Hrs

ARM Register set, ARM operating modes, ARM CPSR (Current Program Status Register), the ARM Memory Map, LPC2148 processor architecture, Arithmetic and Logic Instructions and Programs, Rotate and Barrel Shifter, Shift and Rotate Instructions in ARM, Branch Call and Looping in ARM, Calling Subroutine with BL, Simple ALP programs on Arithmetic & logical operations.

MODULE 4 ARM ASSEMBLY LANGUAGE PROGRAMMING &ARM PERIPHERALS 9 Hrs

C statements in ARM Assembly Language Programming, Smallest, largest, Ascending, descending and even or odd number programs, Timer programming, UART programming, LED, LCD interfacing with ARM processor, Interfacing of LM35 temperature sensor.

MODULE 5 RTOS BASED EMBEDDED SYSTEM DESIGN 9 Hrs

Operating system basics, types of operating systems, tasks, process, and threads, Multiprocessing, and multitasking, task scheduling: non-pre-emptive and pre-emptive scheduling, Task Synchronization Techniques LED blinking with free RTOs with Arduino.

List of Experiments

1. Write an ALP to sum of N numbers.
2. Write an ALP to find the number of 0's and 1's in a 32 bit data.
3. Write an ALP to arrange ascending and descending order from given string.
4. Write an embedded C program for Data transfer and data reversal in memory locations.
5. Write an embedded C program for generate prime numbers from 1 to 100.
6. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
7. Interface a DAC and generate Triangular and Square waveforms.
8. Interface and Control a DC Motor.
9. Interface a 4×4 keyboard and display the key code on an LCD. Experiment
10. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between

Textbook(s):

1. Rajkamal, Embedded system-Architecture, Programming, Design, 3rd edition, Tata McGraw Hill, 2017
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi and Janice Mazidi, ARM Assembly Language Programming & Architecture, 2nd edition, MicroDigital Ed., 2016

Reference(s):

1. Trevor Martin, Insider's Guide To Philips Arm7 Based Microcontroller, 1st edition, 2005
2. Shibu K.V, Introduction to Embedded Systems,, 2009

Course Outcomes:

1. Understand the importance of embedded systems.
2. Familiarize with advanced 32-bit ARM architecture.
3. Evaluate programs using ARM.
4. Perform interfacing of peripherals to ARM processor.
5. Understanding the task scheduling.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

24EECE4011	UNMANNED AERIAL VEHICLES	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course provides an in-depth introduction to the technology behind Unmanned Aerial Vehicles. Students will gain a solid foundation in the principles, components, and systems that make up UAVs.

Course Educational Objectives:

- Explain the fundamental principles of Unmanned Aerial Vehicles.
- Describe the basic aerodynamic concepts.
- Illustrate the concepts of stability and flight control.
- Identify and discuss different types of propulsion and Payloads.
- To get introduced to Mission Planning, MPCS architecture and interfaces.

MODULE 1 INTRODUCTION AVIATION HISTORY AND OVERVIEW OF UAV SYSTEMS 9 Hrs

Introduction Aviation History and Overview of UAV systems, Classes and Missions of UAVs, Definitions and Terminology, UAV fundamentals, Communication Methodology & Protocols, Examples of UAV systems-very small, small, Medium and Large UAV

MODULE 2 BASIC AERODYNAMICS 9 Hrs

Basic Aerodynamics equations, Aircraft polar, the real wing and Airplane, Induced drag, the boundary layer, Flapping wings, Total Air-Vehicle Drag. Performance: Overview, climbing flight, Range and Endurance – for propeller-driven aircraft, range- a jet-driven aircraft, Guiding Flight.

MODULE 3 STABILITY AND CONTROL 9 Hrs

Overview, Stability, longitudinal, lateral, dynamic stability, Aerodynamics control, pitch control, lateral control, Autopilots: sensor, controller, actuator, airframe control, inner and outer loops, Flight-Control Classification, Overall Modes of Operation, Sensors Supporting the Autopilot.

MODULE 4 PROPULSION: 9 Hrs

Overview, Thrust Generation, Powered Lift, Sources of Power, The Two-Cycle Engine, The Rotary Engine, Electric Motors, and Sources of Electrical Power. Construction technique and materials, Skin or Reinforcing Materials, Resin Materials, Core Materials.

MODULE 5 MISSION PLANNING AND CONTROL 9 Hrs

Overview, MPCS Architecture, Local Area Networks, Elements of a LAN, Levels of Communication, Bridges and Gateways, Physical Configuration, Planning and Navigation, MPCS Interfaces, Air Vehicle and Payload Control: Overview, Modes of Control.

List of Experiments

1. Making of symmetric airfoil Experimen
2. Making of Cambered airfoil
3. Modelling skeleton structure of wing
4. Skin moulding of aircraft wing
5. Making of winglet
6. Sheet forming of empennage
7. Design, fabrication and flying of engine powered RC plane
8. Design, fabrication and flying of battery powered RC model airplanes.
9. Design, fabrication and flying of quadcopters.
10. Design, fabrication and flying of gliders.
11. Design, fabrication and flying of solar powered RC planes.
12. Design, fabrication and flying of a blended wing body.
13. Design, fabrication and flying of parachutes.

Textbook(s):

1. Paul Gerin Fahlstrom and Thomas James Gleason , Introduction to UAV Systems, 4th Edition , Wiley,, 2012

2. Landen Rosen, Unmanned Aerial Vehicle, Alpha Editions , 2015

Reference(s):

1. P K Garg1st Edition , Introduction To Unmanned Aerial Vehicles, 2020

Course Outcomes:

1. Understand the basic concepts of UAV systems.
2. Explain the basic of aerodynamics and performance.
3. Apply the knowledge of stability and control required for UAVs.
4. Select the propulsion system and materials for structures.
5. Demonstrate the practical skills gained in Mission Planning, MPCS architecture and interfaces

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE3131	ELECTRONIC PACKAGING AND TESTING	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 in depth analysis of device failure rate time and temperate, electrical and mechanical failure analysis. Further students can able model the faults in the combination and sequential circuits, perform the fault analysis and test pattern generation using ATPG algorithms, can able to build the testable circuit with test vectors.

Course Educational Objectives:

- Explore the importance of packaging in electronics, including design parameters.
- Study fault models like logic faults and learn detection methods.
- Acquire skills in various tests including short circuit, analog, and digital tests.
- Understand challenges in signal and power distribution, electromagnetic interference, and thermal considerations.
- Study advanced fault diagnosis methods such as delay fault diagnosis and path-sensitive techniques.

MODULE 1 PACKAGING 9 Hrs

Need of Packaging, Electronics Packaging Requirements, Packaging Design Parameters. Selection of Packaging Materials and packaging Types, Electrical Issues of Systems Packaging.

MODULE 2 PACKAGING ISSUES 9 Hrs

Signal and Power Distribution, Electromagnetic Interference, Clock Distribution, Noise Sources, Digital and RF Issues, Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals, Thermal Design considerations in systems packaging

MODULE 3 FAULT MODELING 9 Hrs

Logic Fault model – Fault detection & Redundancy, Fault Equivalence and Fault Location Fault dominance– Single Stuck at Fault Model – Multiple Stuck at Fault Models, Bridging Fault Model, LFSR.

MODULE 4 FAULT DIAGNOSIS **9 Hrs**

BIST, Random logic BIST, memory BIST, delay fault, path sensitive technique. Memory Test: Memory density and defect trends, faults, memory test levels, march test notation, fault modeling, memory testing Digital DFT and Scan Design: Ad-Hoc DFT methods, scan design.

MODULE 5 BOARD TESTING **9Hrs**

Unpowered short circuit tests, Unpowered analog tests, Powered in-circuit digital, analog and mixed signal tests, Optical and X-ray inspection procedures.

Textbook(s):

1. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw Hill, 2001
2. Michael L. Bushnell and Vishwani D. Agarwal, Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits, springer, 2006

Reference(s):

1. NirajJha, Sandeep Gupta, NirajJha, Sandeep Gupta, 2010
2. Dimitris Gizopouilos, Advances in Electronic Testing, 2006
3. Renesas Electronics , Semiconductor Reliability Handbook, 2017

Course Outcomes:

1. Give a comprehensive introduction to the various packaging types used along with the associated thermal, speed, signal and integrity power issues
2. Enable design of packages which can withstand higher temperature, vibrations and shock
3. Learn about faulty diagnosis and fault tolerance
4. Able to perform different testing methods
5. Analyze the concepts of Testing and testing methods

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

Programme Elective (PE)

Track # : Telecommunications

24EECE4021	SOFTWARE DEFINED RADIO AND NETWORKS	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 offers an in-depth exploration of Software Defined Radio (SDR) technology and the basics of software-defined networks, covering SDR systems' principles, implementation, and applications. Students will delve into various aspects of SDR, including signal processing, hardware platforms, RF front end design, and practical implementation. The course aims to equip students with the knowledge and skills to design, develop, and analyze SDR systems for various communication and radio frequency (RF) applications.

Course Educational Objectives:

1. Understand the fundamentals of Software Defined Radio (SDR) technology and SDR architectures. •
2. To familiarize SDR platforms and tools.
3. Explain RF receiver and transmitter considerations in SDR.
4. To familiarize the student with the components in and working of SDNs.
5. Design and implement practical SDR applications.

MODULE 1 INTRODUCTION TO SDR AND SDR ARCHITECTURES 9 Hrs

What Is a SDR?, Requirements for SDR and its business models, architectures of SDR, specifications, Signal Processing Devices, Signal Processing Architectures: GPP-Based SDR, FPGA-Based SDR, Architecture for FPGA-Based SDR, Hybrid and Multi-FPGA Architectures.

MODULE 2 SDR PLATFORMS & DEVELOPMENT TOOLS 9 Hrs

GNURadio, Open-Source SCA Implementation: Embedded, Front End for Software Radio, System Simulation, Firmware Development, Software Development.

MODULE 3 FLEXIBLE RF RECEIVER AND TRANSMITTERS ARCHITECTURE 9 Hrs

Receiver Architecture Options: Single-Carrier and Multi-Carrier Receiver Designs, Zero IF Receiver Architectures, Implementation of a Digital Receiver: Frequency Conversion Using Under sampling, Achieving Processing Gain Using Oversampling, Noise Figure, PA Requirements for Base Stations and by Handsets, Linear Upconversion Architectures: Analogue Quadrature Upconversion, Quadrature Upconversion with Interpolation, Interpolated Bandpass Upconversion.

MODULE 4 INTRODUCING SDN AND WORKING OF SDNS 9 Hrs

Historical Background, The Modern Data Center, Traditional Switch Architecture, Why SDN: Evolution of Switches and Control Planes, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs, How SDN Works: Characteristics of SDNs, SDN Operation,

MODULE 5 PRACTICAL SDR APPLICATIONS USING MATLAB 9 Hrs

Waveform Generation Using MATLAB and SDR, Spectral Analysis, Airplane Tracking Using ADSB Signals, FM Receiver, FM Transmitter, Transmitting and Receiving Images.

Textbook(s):

Software Defined Radio - Architectures, Systems & Functions,by M Dillinger and published by John Wiley & Sons Inc; 1st edition

Reference(s):

Software Defined Radio: Theory and Practice by John M.Reyland from Artech house

Course Outcomes:

1.Identify the operations of SDR architectures.
2.Analyze and SDR platforms and tools.
3.Describe various SDR RF transmitters and receivers.
4.Identify the functions of various components and the working of SDN .
5.Implement SDR Applications

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 10-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4001	SATELLITE COMMUNICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

The satellites are an essential part of telecommunication systems worldwide, which carry large number of data, telephone traffic in addition to television signals. This course deals with the satellite inventions, frequency allocation to different regions worldwide, and gives information about satellite orbits, satellite launching methods, design of satellite and satellite subsystems, satellite link over the earth, satellite application in communication, internet and remote sensing.

Course Educational Objectives:

- To introduce invention of satellite and developments in worldwide.
- To explain the basics of orbital mechanics, the types of satellite orbits, the location of ground stations, and the look angles from ground stations to the satellite
- To provide knowledge of various modulation and multiplexing techniques in satellite communication.
- To familiarize the link budget for satellite performance.
- To examine concepts of propagation losses in satellite networking for voice and internet communication, data networks, and scientific data.

MODULE 1 INTRODUCTION TO SATELLITE COMMUNICATIONS 9 Hrs

Importance and applications of satellite communication, Overview of satellite communication system components, Historical development and evolution of satellite technologies, Ethical considerations in satellite communication, Satellite Frequency bands, Applications

MODULE 2 SATELLITE ORBITS AND SUBSYSTEMS 9 Hrs

Geostationary and non-geostationary orbits, Kepler's laws of Planetary motion, Orbital Period and Velocity, Effects of Orbital inclination, Look angles, Orbital perturbations, Subsystems: Altitude and orbit control system, TT&C Sub-System, Altitude control Sub-System, Power Systems, Communication Subsystems, Satellite antenna Equipment.

MODULE 3 PROPAGATION EFFECTS 9 Hrs

Atmospheric Absorption, Cloud Attenuation, Ionospheric Scintillation, Low angle fading, Rain Induced attenuation, rain induced cross polarization interference.

MODULE 4 MODULATION SCHEMES AND MULTIPLE ACCESS TECHNIQUES IN SATELLITE COMMUNICATION 9 Hrs

Multi-Level Gaussian Frequency Shift Keying (MGFSK), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Demand Assignment Multiple Access (DAMA), Wavelet Packet Modulation (WPM,) Spread Spectrum Concepts.

MODULE 5 LINK DESIGN 9 Hrs

Satellite link design, earth station design, link budget components: transmission power, gains, losses, noise, Link margin analysis and fade margin, satellite applications in remote sensing.

Textbook(s):

1. Dennis Roddy , Satellite Communications, McGraw Hill Education , 2017 ,978-0070077850
2. Timothy Pratt, Charles Bostian, and Jeremy Allnutt, Satellite Communications, 2nd , Wiley , 2006 ,978-8126508334

Reference(s):

1. Anil K. Maini, Varsha Agrawal , Satellite Communications, Wiley, 2019 ,978-8126520732
2. ,https://tbc-python.fossee.in/book-details/191/

Course Outcomes:

1. Understand the basic information about satellite communications systems.
2. Identify the frequency allocations to satellite services orbital mechanism substations.
3. Analyse the propagation effect due to atmospheric conditions.
4. Understand the communication methodologies in satellite communication.
5. Design link design with respect to satellite and earth stations.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4031	OPTICAL COMMUNICATIONS AND NETWORKS	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 in-depth exploration of optical communication systems and networks, covering the principles, technologies, and challenges associated with transmitting and processing information using light. Students will delve into various aspects of optical communication, including optical fiber transmission, modulation techniques, multiplexing, network architectures, and emerging trends. The course aims to equip students with a comprehensive understanding of optical communication and its applications in modern telecommunications networks.

Course Educational Objectives:

1. Understand the fundamentals of optical communication systems.
2. Describe optical fiber transmission principles and characteristics.
3. Analyze modulation techniques and multiplexing in optical systems.
4. Explain network architectures and protocols in optical networks.
5. Identify challenges and emerging trends in optical communication.

MODULE 1 INTRODUCTION TO OPTICAL COMMUNICATION 9 Hrs

Importance and applications of optical communication, Overview of optical communication system components, Historical development and evolution of optical communication technologies, Ethical considerations in optical communication.

MODULE 2 OPTICAL FIBER TRANSMISSION 9 Hrs

Basics of optical fiber propagation, Optical fiber modes and dispersion, Optical sources and detectors, Hands-on involving optical fiber simulations.

MODULE 3 MODULATION TECHNIQUES IN OPTICAL COMMUNICATION 9 Hrs

Analog and digital modulation principles, Intensity Modulation (IM) and Direct Detection (DD), Phase Modulation (PM) and Coherent Detection (CD), Hands-on involving modulation simulations.

MODULE 4 MULTIPLEXING AND DEMULTIPLEXING **9 Hrs**

Wavelength Division Multiplexing (WDM), Dense WDM (DWDM) and Coarse WDM (CWDM), Time Division Multiplexing (TDM) and Space Division Multiplexing (SDM), Hands-on involving multiplexing simulations.

MODULE 5 OPTICAL NETWORK ARCHITECTURES **9 Hrs**

Optical network topologies: ring, star, mesh, Optical transport network (OTN) architecture, Optical layer protocols and signaling, Hands-on involving optical network simulations.

Textbook(s):

1.John Senior, Optical Fiber Communications: Principles and Practice,

2.Gerd Keiser, Optical Fiber Communications,

Reference(s):

1. Rajiv Ramaswami, Kumar N. Sivarajan, and Galen H. Sasaki, . Optical Networks: A Practical Perspective, 2. 2. Online resources and articles discussing recent trends in optical communication,

Course Outcomes:

1. List the advantages of optical fiber channels over other wired and wireless channels
2. Describe the ray transmission and other physical effects involved in optical fiber transmission
3. Describe Different modulation techniques.
4. Describe different multiplexing and demultiplexing techniques.
5. Describe optical network topologies.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3141	PRINCIPLES OF RADAR SYSTEMS	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 exploration of Radar systems and the techniques used in Radar applications. Students will learn about the principles of radar operation, system components, waveform design, target detection, and tracking. The course covers advanced techniques like pulse compression and modern Radars. By the end of the course, students will have an understanding of basic and modern radar systems and their applications in various domains.

Course Educational Objectives:

- To introduce the students to Understand the principles of radar systems and their components.
- To equip the students with the knowledge and skills to describe radar waveforms, antenna systems, and target characteristics.
- To enable the students to Analyze tracking algorithms in Radar
- To enhance the students critical thinking and problem-solving skills in the concepts of Pulse radar and MTI.
- To develop the students understanding of Pulse compression techniques and expose the students to the modern trends and developments in radar systems.

MODULE 1 INTRODUCTION TO RADAR SYSTEMS 9 Hrs

Radar block diagram, frequencies, applications, Radar equation, Minimum detectable signal, Probability of false alarm and threshold detection, Radar cross-section and system losses, and Hands-on Practice Radar range equation

MODULE 2 CW AND FMCW RADAR 9 Hrs

Doppler Effect, CW Radar, applications, FM-CW radar, altimeter, Multiple Frequency Radar Radar Clutter, Hands-on practice demonstrating the shift in frequency due to motion, and Hands- on practice analyse the range and doppler shift of targets.

MODULE 3 PULSE DOPPLER AND MTI RADAR 9 Hrs

Pulse Doppler Radar, Moving Target Indicator, Delay Line Canceller, Range-gated Doppler Filters, Non-coherent MTI, and Hands-on practice to implement delay lines and canceller filters.

MODULE 4 TRACKING RADAR 9 Hrs

Sequential lobing, Conical scanning, Mono pulse radar, Phase comparison mono pulse, Tracking in range, Comparison of trackers, Hands-on practice for estimating target angles.

MODULE 5 PULSE COMPRESSION AND CODING TECHNIQUES 9 Hrs

Pulse Compression: Matched Filters, Range Resolution, Pulse compression waveforms, Linear Frequency Modulated waveforms, Phase-coded waveforms, and Hands-on practice radar pulses with different pulse widths. Introduction to Modern Radars: Synthetic Aperture Radar, Meteorological Radar, Ground Penetrating Radar, Slope Stability Radar.

Textbook(s):

1. Merrill Skolnik., Introduction to Radar Systems,
2. Mark.A. Richards. , Principles of Modern Radar,
3. Hugh Griffiths and Christopher Baker. , Introduction to Radar Systems,
4. Merrill Skolnik., Radar Handbook,

Reference(s):

1. Michael Kolawole. , Radar Systems, Peak Detection and Tracking ,
2. David K. Barton. , Modern Radar System Analysis Software and User's Manual ,
3. John C. Toomay. , Radar Principles for the Non-Specialist ,
4. Charles E. Cook. , Radar Signals: An Introduction to Theory and Application

Course Outcomes:

1. By the end of this course, students will be able to remember the basic concepts and terms of radar systems, such as radar block diagram, frequencies, applications, radar equation, radar cross-section
2. By the end of this course, students will be able to understand the principles and operations of different types of radar systems, such as CW and FMCW radar, pulse Doppler and MTI radar, tracking radar,
3. By the end of this course, students will be able to apply the knowledge of radar systems to solve problems related to radar range, detection, clutter, resolution, etc.
4. By the end of this course, students will be able to analyze the performance and limitations of various radar systems and compare their advantages and disadvantages.
5. By the end of this course, students will be able to create their own radar waveforms using different compression and coding techniques.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3151	INFORMATION THEORY AND CODING	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 offers a comprehensive study of information theory and coding techniques. Students will delve into the fundamental principles that underlie efficient communication and data compression. The course covers topics such as entropy, mutual information, error correction codes with some applications, and data compression methods. Students will gain a deep understanding of how information can be efficiently transmitted and stored, making them well-equipped to design and analyze communication systems with optimal coding strategies.

Course Educational Objectives:

- Understand the key concepts of information theory and coding.
- Calculate entropy and mutual information to analyze communication systems.
- Explain error correction codes and their applications.
- Design and analyze data compression techniques.
- Identify challenges and applications of information theory and coding.

MODULE 1 INTRODUCTION TO INFORMATION THEORY AND SOURCE CODING 9 Hrs

Basics of communication systems and information theory. Entropy and its properties. Conditional entropy and mutual information. Ethical considerations in data compression and communication. Shannon's source coding theorem. Huffman coding and arithmetic coding. Transform coding: Discrete Cosine Transform (DCT). Hands-on involving data compression simulations.

MODULE 2 CHANNEL CAPACITY AND CHANNEL CODING THEOREMS 9 Hrs

Channel capacity and capacity achieving codes. Shannon's noisy channel coding theorem. Error detection and correction codes. Hands-on involving channel capacity calculations.

MODULE 3 LINEAR BLOCK CODES 9 Hrs

Basics of linear block codes, Cyclic codes, Hamming codes, LDPC codes, Hands-on involving linear block code simulations

MODULE 4 CONVOLUTIONAL CODES AND TURBO CODES 9 Hrs

Convolutional coding and Viterbi decoding, Turbo codes and iterative decoding, Performance comparison of error control codes, Hands-on involving convolutional code simulations.

MODULE 5 APPLICATIONS OF BLOCK CODES AND CONVOLUTIONAL CODES 9 Hrs

Applications of block codes in magnetic tapes and disks, Applications of convolutional codes in burst error correction in ARQ systems. Course project: Coding scheme design and performance analysis

Textbook(s):

1.Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, 2nd edition, 2012
2. Shu Lin and Daniel J. Costello, Error Control Coding: Fundamentals and Applications, 2nd edition, 2005

Reference(s):

1. Todd K. Moon, Error Correction Coding, 2nd Edition, Wiley-Inter science, 2021
2. Cary W. Huffman, Vera Pless , Fundamentals of Error-Correcting Codes, 1st Edition, Cambridge University Press,, 2003
3. Online resources and articles discussing recent trends in information theory and coding.,
4. Yuan Zing, Practical Guide to Error Control Coding with MATLAB,, , ArtecBook Publishers,, 2010
5. Sam Shanmugam, Digital and Analog Communication Systems , John Wiley and Sons, 2008

Course Outcomes:

1. Design lossless source codes for discrete memory less source to improve the efficiency of information transmission
2. Evaluate the information capacity of discrete memory less channels and determine possible code rates achievable on such channels
3. Apply linear block codes for error correction and error detection
4. Apply convolutional codes and turbo codes for error correction and error detection
5. Understand the real time applications of linear block codes and convolutional codes

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3161	FUNDAMENTALS OF WIRELESS COMMUNICATIONS	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 the fundamentals of wireless communication systems. Students will explore the principles, evaluation of wireless communication technologies, wireless channel modeling and basics of 3G/ 4G wireless communication technologies such as Code Division for Multiple Access (CDMA), Orthogonal Frequency Division Multiplexing (OFDM), and Principle of Multiple Input Multiple Output (MIMO). The course aims to equip students with a strong foundation in wireless and also present an elaborate introduction to the principles and performance of these fundamentals 3G/4G wireless technologies. These concepts are helpful for further study or improving research skills in the field of wireless communications.

Course Educational Objectives:

- To understand the fundamental principles of wireless communication and BER performance of wireless systems
- To describe the wireless channel modelling and Doppler impact on wireless channel.
- To analyze the path loss models and link budget.
- To explain the importance of diversity techniques and principles of MIMO wireless communication
- To analyze the importance of CDMA and BER performance of OFDM used in 4G systems.

MODULE 1 PRINCIPLES OF WIRELESS COMMUNICATIONS 9 Hrs

Introduction to 3G/4G Wireless Communications, the Wireless Communication Environment, Modelling of Wireless Systems, Rayleigh Fading Wireless Channel, BER Performance of Wireless Systems.

MODULE 2 THE WIRELESS CHANNEL **9 Hrs**

Basics of Wireless Channel Modelling: Max Delay Spread, RMS Delay Spread, Delay Spread, Coherence Bandwidth and Inter Symbol Interference, Doppler Fading in Wireless Systems. Doppler impact on Wireless Channel.

MODULE 3 WIRELESS SYSTEM PLANNING **9 Hrs**

Free Space Propagation Model, Ground Reflection Model, Practical Link Budget Design using Pathloss Models: Log distance Pathloss Model, Lognormal Shadowing, Outdoor Propagation models: Okumura Models, Hata Model.

MODULE 4 DIVERSITY AND PRINCIPLES OF MIMO WIRELESS COMMUNICATION **9 Hrs**

Principle of Diversity, Diversity Techniques, BER of Multiple Antenna Wireless Systems, Multiple Input Multiple Output (MIMO) Systems, MIMO Receivers: Zero -Forcing (ZF) receiver, MMSE Receiver.

MODULE 5 :PRINCIPLES OF CDMA/OFDM WIRELESS COMMUNICATION **9 Hrs**

Introduction to Code Division Multiple Access (CDMA), Basic CDMA Mechanism, Properties of PN Sequences, Advantages of CDMA Systems, Introduction to Orthogonal Frequency Division Multiplexing (OFDM), Schematic Representation of OFDM Transmitter and Receiver, Cyclic Prefix in OFDM Systems, BER Performance of OFDM Systems

Textbook(s):

1. Aditya Jagannatham, “Principles of Modern Wireless Communications System – Theory and Practice”, Print Edition, McGraw Hill India, 2015
2. Theodore S. Rappaport,, "Wireless Communications: Principles and Practice", 2, Pearson India Education Services Pvt. Ltd,, 2020

Reference(s):

1. David Tse, Pramod Viswanath,, "Fundamentals of Wireless Communication”, , 2005
2. Andrea Goldsmith, "Wireless Communications”, 2005
3. Gottapu Sasibhushna Rao, Mobile Cellular Communication, first, 2012

Course Outcomes:

1. understand the basic principles of wireless communication system .
2. analyze the wireless channel modelling and its parameters .
3. evaluate the wireless system planning and pathloss models .
4. explain the importance of diversity and MIMO systems .
5. describe the significance of CDMA and OFDM systems and evaluate the BER of OFDM system (L5)

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3171	MOBILE COMMUNICATION SYSTEM WITH OPTIMIZATION	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 integrates the study of mobile communication systems with applied optimization techniques. Students will gain a comprehensive understanding of mobile communication principles and explore how optimization methods are employed to enhance the performance and efficiency of wireless networks.

Course Objectives:

1. To understand the fundamentals of mobile communication systems, including their evolution, architecture, and key components.
2. To analyze the design principles of cellular networks, focusing on frequency reuse, capacity planning, and handoff mechanisms.
3. To explore various wireless communication technologies and protocols, including 2G, 3G, 4G, and emerging 5G networks.
4. To apply optimization techniques for improving network performance, resource allocation, energy efficiency, and quality of service (QoS).

   To evaluate future trends in mobile communication, including the impact of 6G, IoT, AI, and advanced security challenges.

MODULE 1 Introduction to Mobile Communication Systems 9 Hrs

Evolution of Mobile Communication (1G to 5G). Fundamentals of Mobile Communication. Mobile Network Architecture. Key Components: Base Stations, Mobile Devices, Switches. Wireless Propagation and Channel Models

MODULE 2 Cellular System Design and Frequency Reuse 9 Hrs

Basic Concepts of Cellular Systems. Frequency Reuse and Co-Channel Interference Cell Planning and Handoff Mechanisms. Capacity and Coverage Optimization.Mobile IP and Roaming

MODULE 3 Wireless Communication Technologies and Protocols **9 Hrs**

2G (GSM, CDMA), 3G (UMTS, HSPA), 4G (LTE) Technologies. Introduction to 5G and Beyond MAC, RRC, and PHY Layer Protocols. Multiple Access Techniques (FDMA, TDMA, CDMA, OFDMA). Resource Allocation and Scheduling

MODULE 4 Optimization Techniques in Mobile Communication **9 Hrs**

Introduction to Optimization in Wireless Networks. Resource Allocation and Load Balancing. Energy Efficiency Optimization. Traffic Management and QoS Optimization. Machine Learning in Mobile Network Optimization

MODULE 5 :Advanced Topics and Future Trends in Mobile Communication **9 Hrs**

5G Network Architecture and Use Cases. Edge Computing and Network Slicing. IoT and M2M Communication. Challenges in Mobile Network Security. Future Trends: 6G, AI Integration, Quantum Communication

Textbook(s):

1.G. S. Raju, *Mobile Communication Systems*, 2nd Edition, McGraw-Hill Education, 2012.
2.Singh, S., *Wireless Communication and Networking*, 2nd Edition, Elsevier, 2017.

Reference(s):

1.John G. Proakis and Masoud Salehi, *Digital Communications*, 5th Edition, McGraw-Hill, 2007.
2.Harri Holma and Antti Toskala, *LTE for UMTS: Evolution to LTE-Advanced*, 2nd Edition, Wiley, 2012.

Course Outcomes:

1. Explain the evolution, architecture, and fundamental principles of mobile communication systems.
2. Analyze and design cellular systems, focusing on frequency reuse, capacity, and handoff strategies..
3. Compare different wireless communication technologies and their protocols for efficient network performance.
4. Apply optimization techniques to improve resource allocation, energy efficiency, and quality of service in mobile networks.
5. Evaluate advanced mobile communication technologies and predict future trends based on current innovations.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2021	APPLIED LINEAR ALGEBRA WITH MACHINE LEARNING, WIRELESS COMMUNICATION AND DATA ANALYTICS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course integrates concepts from linear algebra into practical applications in machine learning, wireless communication, and data analytics. Students will gain hands-on experience in solving real-world problems using linear algebra techniques.

Course Educational Objectives:

- To apply linear algebra concepts to solve problems in machine learning, wireless communication, and data analytics.
- To Implement data preprocessing, feature engineering, and dimensionality reduction techniques using matrices
- To Develop a deep understanding of matrix factorization, optimization, and regularization in machine learning.
- To Explore applications of linear algebra in wireless communication systems.
- To Gain proficiency in solving practical problems related to data analytics using linear algebra.

MODULE 1 INTRODUCTION TO LINEAR ALGEBRA 9 Hrs

Linear Algebra: Review of Vector and Matrix operations, Linear Independence, span and basis, Matrix factorizations: LU, QR and Singular Value Decomposition

MODULE 2 LINEAR ALGEBRA IN MACHINE LEARNING 9 Hrs

Linear Regression: Least squares method, Regularization techniques (L1 and L2 regularization), Principal Component Analysis (PCA) for dimensionality reduction, Eigen values and Eigen vectors in machine learning

MODULE 3 LINEAR ALGEBRA IN WIRELESS COMMUNICATION 9 Hrs

Introduction to wireless communication systems, MIMO systems and channel matrices, precoding and beamforming using linear algebra, channel estimation and equalization.

MODULE 4 LINEAR ALGEBRA IN DATA ANALYTICS **9 Hrs**

Data Representations: Matrices and data frames, Matrix operations for data preprocessing, matrix factorization for collaborative filtering and recommendation systems, singular value decomposition for data compression and denoising

MODULE 5 LINEAR ALGEBRA IN NEURAL NETWORKS **9 Hrs**

Introduction to Neural networks and deep learning, backpropagation algorithm with matrix calculus, weight initialization and optimization techniques, Convolutional neural networks, and matrix convolutions.

List of Experiments

Experiment 1 Introduction to MATLAB functions for vector and matrix operations.
Experiment 2 Solving systems of linear equations using MATLAB.
Experiment 3 Eigenvalues and eigenvectors computations in MATLAB.
Experiment 4 MIMO System Simulation in MATLAB
Experiment 5 Beamforming Simulation in MATLAB.
Experiment 6 Data Preprocessing in MATLAB
Experiment 7 Singular Value Decomposition (SVD) in MATLAB
Experiment 8 Introduction to Neural Networks using MATLAB.
Experiment 9 Case study on machine learning project
Experiment 10 Case study on wireless communication project Experiment

Textbook(s):

1. Lay, David C., Steven R. Lay, and Judi J. McDonald, Linear Algebra and its applications, 5/e, Pearson, 2016
2. Strang, Gilbert, Introduction to linear algebra, Wellesley-Cambridge Press, 2022
3. Meyer, Carl D., and Ian Stewart, Matrix analysis and applied linear algebra, Society for Industrial and Applied Mathematics, 2023
4. Bishop, Christopher M., and Nasser M. Nasrabadi, Pattern recognition and machine learning, 4/e, springer,New York, 2006
5. Müller, Andreas C., and Sarah Guido, Introduction to machine learning with Python: a guide for data scientists, O'Reilly Media, Inc, 2016
6. Theodore, S. Rappaport, Wireless communications: principles and practice, 2002
7. Biglieri, E., Calderbank, R., Constantinides, A., Goldsmith, A., Paulraj, A., & Poor, H. V, MIMO wireless communications, Cambridge university press., 2007
8. Du, K. L., & Swamy, M. N, Wireless communication systems: from RF subsystems to 4G

enabling technologies, Cambridge University Press, 2010

9. Tse, David, and Pramod Viswanath, Fundamentals of wireless communication, Cambridge university press, 2005 10. Malvar, H, Wireless Communications over MIMO Channels, 2006

Reference(s):

Course Outcomes:

1. Demonstrate a solid understanding of fundamental linear algebra concepts, including vectors, matrices, matrix operations, linear independence, span, and basis.
2. Apply linear algebra techniques to solve real-world problems in the fields of machine learning, wireless communication, and data analytics.
3. Comprehend and apply matrix factorization methods such as Singular Value Decomposition (SVD) and Principal Component Analysis (PCA) for dimensionality reduction and feature engineering.
4. Gain insights into wireless communication systems, MIMO technology, channel matrices, precoding, and beamforming, with an ability to explain their applications.
5. Apply linear algebra concepts to machine learning tasks such as linear regression, matrix factorization for recommendation systems, and matrix convolutions in Convolutional Neural Networks (CNNs).

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:
BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4041	**LTE AND ADVANCED LTE TECHNOLOGIES FOR MOBILE COMMUNICATIONS**	**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 Long-Term Evolution (LTE) and advanced LTE technologies used in modern mobile communication systems. Students will explore the fundamentals of LTE, including architecture, air interface, protocols, and deployment considerations. Additionally, advanced LTE topics such as carrier aggregation, MIMO, HetNets, and LTE-Advanced Pro will be covered. The course aims to equip students with a deep understanding of LTE technologies and their role in shaping the future of mobile communication.

Course Educational Objectives:

- Understand the principles and architecture of LTE networks.
- Describe the LTE air interface and its protocols.
- Analyze advanced LTE technologies like carrier aggregation and MIMO.
- Explain the concept of LTE-Advanced Pro and its features.
- Identify challenges and emerging trends in LTE and mobile communication.

MODULE 1 INTRODUCTION TO LTE AND AIR INTERFACE AND PROTOCOLS 9 Hrs

Evolution of mobile communication from 2G to LTE,LTE's role in 4G and beyond, LTE architecture and network elements , Ethical considerations in mobile communication LTE physical layer: OFDM and SC-FDMA,MAC, RLC, and PDCP protocols RRC and NAS protocol layers.

MODULE 2 LTE DEPLOYMENT AND PLANNING 9 Hrs

LTE network planning and optimization, Frequency bands and spectrum allocation , LTE coverage and capacity planning Hands-on involving LTE coverage simulations.

MODULE 3 LTE TECHNOLOGIES 9 Hrs

Carrier aggregation: benefits and challenges. Multiple Input Multiple Output (MIMO) techniques. Beamforming and spatial multiplexing. Hands-on involving carrier aggregation

MODULE 4 ADVANCED LTE TECHNOLOGIES **9 Hrs**

HetNets: Heterogeneous networks and small cells.LTE-Advanced Pro features: License Assisted Access (LAA), IoT support. Enhanced Coordinated MultiPoint (eCMP),Hands-on involving HetNet simulations.

MODULE 5 EMERGING TRENDS AND FUTURE OF MOBILE COMMUNICATION **9 Hrs**

5G and beyond: the role of LTE in 5G networks.Network Function Virtualization (NFV) and Software-Defined Networking (SDN) in LTE.Trends in mobile communication: Massive MIMO, millimeter-wave,3GPP standards

Textbook(s):

1.Erik Dahlman, Stefan Parkvall, and Johan Skold, 4G LTE/LTE-Advanced for Mobile Broadband,

2.Martin Sauter, From GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband,

3.Frank E. Kaput, Introduction to 4G Mobile Communications,

Reference(s):

1.Erik Dahlman, Stefan Parkvall, and Johan Skold, 5G NR: The Next Generation Wireless Access Technology,

2.Mischa Dohler and Patrick Marsch, 5G Mobile and Wireless Communications Technology,

3.Online resources and articles discussing recent trends in 5G and LTE technologies and applications,

Course Outcomes:

1.Identify the functional Evolution of mobile communication to LTE.

2.Analyze and understand LTE architecture and network elements.

3.Distinguish various architectures in advanced LTE standards.

4.Understand usage of advanced SDN,MIMO techniques.

5.Describe and compare the advanced standards for3GPP & 5G

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4051	5G TECHNOLOGIES AND ITS APPLICATIONS	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 overview of 5G technologies and their diverse applications across various industries. Students will explore the fundamental principles of 5G networks, including architecture, key technologies, and deployment considerations. Additionally, the course will cover the wide range of applications that leverage 5G capabilities, such as IoT, smart cities, healthcare, and more. The course aims to equip students with the knowledge to understand, design, and apply 5G technologies in real-world scenarios.

Course Educational Objectives:

- Understand the foundational principles of 5G networks and technologies.
- Describe the architecture and key components of 5G networks.
- Analyze the technical advancements and challenges of 5G.
- Identify various applications of 5G technologies in different industries.
- Design and propose 5G-based solutions for specific use cases.

MODULE 1 INTRODUCTION TO 5G RADIO ACCESS TECHNOLOGIES 9 Hrs

Importance and evolution of mobile communication: from 2G to 5G,Key features and goals of 5G networks, Overview of 5G network architecture and components, Ethical considerations in 5G technology deployment, Massive MIMO and beamforming in 5G. Millimeter-wave (mmWave) technology, Full-duplex and small cell networks, Hands-on involving mmWave simulations.

MODULE 2 5G CORE NETWORK AND VIRTUALIZATION 9 Hrs

Architecture and components of the 5G core network, Network Function Virtualization (NFV) and Software-Defined Networking (SDN) in 5G, Network slicing and service-based architecture. Hands-on involving network slicing simulation.

MODULE 3 ADVANCED 5G TECHNOLOGIES **9 Hrs**

Carrier aggregation and dual connectivity, Ultra-Reliable Low-Latency Communication (URLLC).Vehicle-to-Everything (V2X) communication, Hands-on involving advanced 5G simulations.

MODULE 4 5G APPLICATIONS IN DIFFERENT INDUSTRIES **9 Hrs**

IoT and Industrial IoT (IIoT) applications with 5G, 5G-enabled smart cities and urban infrastructure, Telemedicine and healthcare applications, Hands-on involving IoT and smart city simulations.

MODULE 5 EMERGING TRENDS AND FUTURE OF 5G **9 Hrs**

5G evolution: Beyond 5G and the role of 6G, Security and privacy challenges in 5G networks, Proposal of a 5G-based solution for a specific application.

Textbook(s):

1. Theodore S. Rappaport, Wireless Communications Principles and Practice, second edition, 2002 2. 2. Stephen Boyd and Lieven Vandenberghe, Convex Optimization,

Reference(s):

1. Erik Dahlman, Stefan Parkvall, and Johan Skold, . "5G NR: The Next Generation Wireless Technology",
2. Mischa Dohler and Patrick Marsch, "5G Mobile and Wireless Communications Technology",
3. Online resources and articles discussing recent trends in 5G technologies and applications.,

Course Outcomes:

1. Understand the fundamentals of 5G technology, including its architecture, key components, and the differences between 5G and previous generations of wireless networks.
2. Analyze the spectrum allocation and frequency bands used in 5G networks and explain the advantages of millimeterwave and 6GHz frequencies.
3. Analyze the spectrum allocation and frequency bands used in 5G neworks and explain the advantages of millimeter wave and 6GHz frequencies.
4. Evaluate the impact of 5G on data rates, latency and network capacity.
5. Explore the various use cases and applications of 5G technology across industries such as healthcare, autonomous vehicles, smart cities and Internet of Things(IoT).

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

Programme Elective (PE)

Track # : Sensors and IoT

24EECE2031	INTRODUCTION TO IOT AND ITS APPLICATIONS	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 the Internet of Things (IoT) and its wide ranging applications. Students will learn about the fundamental concepts, technologies, and challenges of IoT, and how it is transforming various industries. The course covers both theoretical understanding and practical aspects, enabling students to grasp the potential of IoT and its impact on our connected world.

Course Educational Objectives:

- Introduce the fundamental concepts of IoT.
- To Understand the various IoT Protocols.
- To learn how to use cloud services for IoT applications.
- Introduce the application areas of IoT technologies by conducting industrial case studies.
- To learn the security principles and methodologies for the Internet of Things.

MODULE 1 INTRODUCTION TO IOT & SENSOR INTERFACING 9 Hrs

Introduction and Characteristics of IoT, IoT Enablers and Connectivity layers, Overview of IoT architectures and components. Characteristics of the sensor, Classification of sensors, Types of Actuators.

MODULE 2 IOT COMMUNICATION PROTOCOLS AND NETWORKING 9 Hrs

Data Communication protocols for IoT, IoT-specific protocols: MQTT, CoAP, AMQP, HTTP. Network topologies and scalability in IoT.

MODULE 3 IOT PLATFORMS AND CLOUD SERVICES 9 Hrs

Cloud computing and its role in IoT, IoT platforms: AWS IoT, Azure IoT, Google Cloud IoT, IBM

Watson IoT: Data storage, processing, and analytics in the cloud, Remote device monitoring and management.

MODULE 4 IOT APPLICATIONS IN VARIOUS DOMAINS 9 Hrs

Smart cities and urban infrastructure, Industrial IoT (IIoT) and Industry 4.0, Healthcare and wearable devices, Agriculture, and environmental monitoring.

MODULE 5 SECURITY, PRIVACY, AND FUTURE TRENDS 9 Hrs

Security challenges in IoT devices and networks, Authentication and encryption in IoT, Privacy concerns and data protection, Emerging trends and the future of IoT.

Textbook(s):

1. y Sudip Misra, Anandarup Mukherjee and Arijit Roy, “Introduction to IoT”, first Edition, Cambridge University Press, 2022 ,1108959741
2. Olivier Hersent, David Boswarthick, The Internet of Things – Key applications and Protocols, Omar Elloumi and Wiley, 2012
3. Arvind Ravulavaru, “Enterprise Internet of Things” Handbook Build end-to-end IoT solutions using popular IoT platforms, Packt Publishing,UK, 2018 ,9781788838399
4. Reza Vahidnia and F. John Dian, “Cellular Internet of Things for Practitioners’, British Columbia Institute of Technology Vancouver,Canada,

Reference(s):

1. Ovidiu Vermesan, Peter Friess, Internet of Things Converging Technologies for Smart Environments, and Integrated Eco Systems, River Publishers Series in Communication,USA, 2013
2. Internet of Things, White Papers,Spain, ,http://www.libelium.com/resources/case-studies
3. Erik Brynjolfsson and Andrew McAfee, "The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies" ,

Course Outcomes:

1. Understand the principles and components of the Internet of Things.
2. Describe the technologies and communication protocols used in IoT.
3. Analyze the cloud services and industries influenced by IoT.
4. Design and implement simple IoT solutions.
5. Recognize the security and privacy challenges in IoT applications.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2041	IOT SENSORS AND ACTUATORS	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 delves into the world of IoT sensors and actuators, exploring the technologies, principles, and applications of these essential components in the Internet of Things ecosystem. Students will learn about various sensor types, their characteristics, and how they interact with the digital world. Additionally, the course covers the role of actuators in enabling remote control and automation in IoT applications. Through theoretical understanding, hands-on labs, and projects, students will develop skills to work with IoT sensors and actuators effectively.

Course Educational Objectives:

- To Understand the role and importance of sensors and actuators in IoT.
- To Describe the characteristics and types of IoT sensors.
- To Explain the principles of IoT actuators and their applications
- To Design and interface sensors with IoT platforms.
- To Develop control systems using actuators in IoT applications.

MODULE 1 CLASSIFICATION AND PERFORMANCE CHARACTERISTICS OF SENSOR AND ACTUATORS 9 Hrs

Introduction: Classification of Sensors and Actuators - General Requirements for Interfacing - Units and Measures - Transfer function - Impudence and matching - Range. Span, Resolution. Accuracy. Errors. Repeatability. Sensitivity and analysis - Hysteresis. Nonlinearity and saturation - Frequency response, response time and bandwidth -Calibration - Excitation - Dead band - Reliability.

MODULE 2 TEMPERATURE SENSORS AND THERMAL ACTUATORS 9 Hrs

Thermosensitive sensors: Thermistors, Resistance temperature, and silicon resistive sensors – Thermoelectric sensors – Other Temperature sensors: Optical and Acoustical -Thermomechanical

Sensors and Actuators – Case study: Breath analyser using temperature

MODULE 3 OPTICAL SENSORS AND ACTUATORS **9 Hrs**

Principles of Optics: Optical units – Quantum effects – Quantum-based Optical sensors Photoelectric sensors – Charge coupled device (CCD) based – Thermal-based Optical sensors – Active infrared (AFIR) sensors – Optical Actuators – Case study: Liquid Level Indicator using Optical Sensors

MODULE 4 ELECTRIC AND MAGNETIC SENSORS AND ACTUATORS **9 Hrs**

Principles of Electric and Magnetic fields: Basic units – The Electric field: Capacitive Sensors& Actuators – Magnetic sensors and actuators – Magnetoresistance – Magneto strictive Sensors and Actuators – Magnetometers – Magnetic actuators: Voice Coil Actuators, Motors as Actuators & Magnetic Solenoid Actuators and Magnetic Valves – Case Study: Speed sensing and odometer in a car using smart sensors

MODULE 5 MECHANICAL SENSORS AND ACTUATORS **9 Hrs**

Definitions and units – Force Sensors: Strain Gauges, Semiconductor Strain Gauges & Tactile Sensors – Accelerometers: Capacitive Accelerometers, Strain Gauge, Accelerometers & Magnetic Accelerometers – Pressure Sensors: Mechanical, Piezoresistive, Capacitive & Magnetic – Velocity sensing – Inertial sensors and actuators: Mechanical or Rotor & Optical Gyroscopes – Case study: Tire-pressure monitoring system using smart sensors

Textbook(s):

1. Nathan Ida, Sensors, Actuators and their Interfaces , 2nd Edition, United Kingdom., 2020
2. 2. Patranabis D, Sensors and Actuators, Prentice Hall of India (Pvt) Ltd,

Reference(s):

1. 1. Jacob Fraden, “Handbook of Modern Sensors Physics, Designs, and Applications, 5nd Edition, Springer, Switzerland., 2. 2. Subhas Chandra Mukhopadhyay, Krishanthi P.Jayasundera, Akshya K. Swain., Sensors for Everyday Life Environmental and Food Engineering, Volume 23, Springer, Switzerland., 2017

Course Outcomes:

1. Describe the static characteristics of sensors and its classification .
2. Illustrate temperature sensors and actuators working principles
3. Demonstrate optical sensors and actuators working principles .

4. Use of Electric and Magnetic Sensors and Actuators .
5. Explain Mechanical Sensors and Actuators .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3181	IOT ARCHITECTURE AND PROTOCOLS	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 explores the architecture and communication protocols that form the foundation of the Internet of Things (IoT). Students will gain an in-depth understanding of how IoT systems are structured, including device-to-cloud communication, data processing, and security considerations. The course covers various communication protocols used in IoT, enabling students to design and implement efficient and secure IoT solutions. Through theoretical concepts, practical exercises, and projects, students will be equipped to design and develop IoT systems.

Course Educational Objectives:

- Understand the architecture and components of IoT systems.
- Describe the communication protocols used in IoT.
- Design and implement IoT applications using appropriate protocols.
- Analyze the challenges and considerations in IoT data processing.
- Recognize security and privacy aspects of IoT architecture.

MODULE 1 IOT NETWORK ARCHITECTURE AND DESIGN 9 Hrs

IoT Network Architecture and Design: Drivers behind new network architectures, Comparing IoT architectures- The oneM2M IoT Standardized Architecture, The IoT World Forum Standardized Architecture. A simplified IoT architecture.

MODULE 2 SMART OBJECTS AND CONNECTING SMART OBJECTS 9 Hrs

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 802.11ah - Topology. LORAWAN - Topology.

MODULE 3 IOT COMMUNICATION ARCHITECTURES AND PROTOCOLS 9 Hrs

Control Units – Communication modules – Bluetooth – Zigbee – WiFi – GPS - IoT Protocols (IPv6, 6LoWPAN, CoAP,MQTT,AMQP,BLE, Z-wave),

MODULE 4 APPLICATION PROTOCOLS FOR IOT 9 Hrs

IoT Application Transport Methods: Generic Web-based protocols. IoT Application Layer Protocols, CoAP, MQTT.

MODULE 5 DATA AND ANALYTICS FOR IOT 9 Hrs

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. Edge streaming analytics: Comparing Big Data and Edge Analytics, Edge Analytics Core Functions, Distributed Analytics Systems

Textbook(s):

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals, Cisco Press, 2017
2. SimoneCirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, Internet of Things,
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things, 1st Edition, Academic Press, 2014
4. Peter Waher, Learning Internet of Things, PACKT publishing,
5. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014

Reference(s):

1. Misra, S., Mukherjee, & Roy, Introduction to IoT, Cambridge: Cambridge University Press, 2021
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals, Cisco Press, 2017
3. Hersent, Olivier, David Boswarthick, and Omar Elloumi, The internet of things, . John Wiley & Sons, 2011

Course Outcomes:

1. Distinguish between different IoT network architectures.Understand the concept of Cloud IoT Architecture.
2. Choose the appropriate access technology for a given IoT application.
3. Analyze the difference between protocol design at the network, transport and application layers for IoT and that for the Internet.
4. Explain the working of popular IoT protocols at the network and application layers.
5. Employ IoT data analytics techniques.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3261	INTRODUCTION TO AUTOSAR	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 equips students with a deep understanding of AUTOSAR, covering architecture, components, methodologies, and practical implementation through hands-on activities. Students will gain insights into the challenges and benefits of adopting AUTOSAR, preparing them for real-world applications in automotive software development.

Course Educational Objectives:

- Understand the significance of AUTOSAR in automotive software development.
- Describe the architecture and components of AUTOSAR.
- Explain the benefits and challenges of using AUTOSAR.
- Apply AUTOSAR methodologies in automotive software design.
- Analyze real-world applications and case studies of AUTOSAR implementation.

MODULE 1 INTRODUCTION TO AUTOSAR 9 Hrs

Importance of AUTOSAR in automotive software development, Overview of AUTOSAR architecture and goals, Ethical considerations in adopting AUTOSAR.

MODULE 2 AUTOSAR ARCHITECTURE AND COMPONENTS 9 Hrs

Basic software architecture - RTE, BSW, and Application Layer, Communication stacks - CAN, LIN, Ethernet, etc. Sensor and actuator abstraction, Hands-on involving basic AUTOSAR components.

MODULE 3 AUTOSAR METHODOLOGY AND WORKFLOWS 9 Hrs

AUTOSAR methodology and development workflow, Configuration and integration of software components, Application software design and mapping, Hands-on involving software component configuration.

MODULE 4 AUTOSAR COMMUNICATION AND DIAGNOSTIC SERVICES 9 Hrs

AUTOSAR communication mechanisms, Diagnostic communication and error handling, Implementation of diagnostic services, Hands-on involving communication, and diagnostic services.

MODULE 5 CHALLENGES, FUTURE TRENDS, AND REAL-WORLD APPLICATIONS 9 Hrs

Challenges in migrating to AUTOSAR, Benefits of AUTOSAR for software development, Future trends in AUTOSAR development, Case studies of AUTOSAR implementation in industry.

Textbook(s):

1. Happel, A., Hoff, C., & Roser, S, AUTOSAR Compendium - Part 1: Application & RTE, Springer., 2014
2. Happel, A., Hoff, C., & Roser, S, AUTOSAR Compendium - Part 2: Basic Software & Communication., Springer., 2015

Reference(s):

1. Scheid, O., & Bauer, G, AUTOSAR: Automotive Software Architecture - An Introduction, Springer, 2012
2. Heinrich, G., Happel, A., & Roser, S, AUTOSAR Explored: Practical Experience with the Automotive Software Architecture, Springer., 2017

Course Outcomes:

1. articulate the significance of AUTOSAR in automotive software development.
2. engage in hands-on activities involving basic AUTOSAR components.
3. able to design and map application software within the AUTOSAR framework.
4. develop hands-onskills in implementing diagnostic services and working with communication mechanisms in the context of AUTOSAR.
5. analyze real-world case studies of AUTOSAR implementation in industry, drawing insights into practical applications and success stories.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN3271	CLOUD COMPUTING FOR IOT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	Internet of Things / Fundamentals of Computer Networks						

Course Description:

This course delves into the world of IoT sensors and actuators, exploring the technologies, principles, and applications of these essential components in the Internet of Things ecosystem. Students will learn about various sensor types, their characteristics, and how they interact with the digital world. Additionally, the course covers the role of actuators in enabling remote control and automation in IoT applications. Through theoretical understanding, hands-on labs, and projects, students will develop skills to work with IoT sensors and actuators effectively.

Course Educational Objectives:

- To understand cloud computing in IoT applications.
- Learn cloud deployment models and services
- Using cloud platforms to understand data storage, processing, and analysis.
- Design IoT architectures using cloud services.
- Integrating IoT with cloud computing.

MODULE 1 INTRODUCTION TO CLOUD COMPUTING FOR IOT **9 Hrs**

Importance of cloud computing in IoT applications. Overview of cloud computing models: IaaS, PaaS, SaaS. Ethical considerations in IoT data storage and processing. Impact of cloud computing on industries.

MODULE 2 CLOUD DEPLOYMENT MODELS AND ARCHITECTURES **9 Hrs**

Public, private, hybrid, and multi-cloud deployment. Scalability and elasticity in cloud architectures. Cloud-native design principles for IoT applications. Hands-on involving cloud deployment models.

MODULE 3 CLOUD SERVICES FOR IOT DATA MANAGEMENT 9 Hrs

Cloud storage solutions: object storage, databases. Real-time data processing using serverless computing. Big data analytics and cloud-based data warehouses. Hands-on involving cloud data storage and processing.

MODULE 4 IOT DATA INTEGRATION AND APIS 9 Hrs

Data integration challenges in IoT ecosystems. API design and management for IoT data sharing. RESTful APIs and MQTT for IoT communication. Hands-on involving API design and integration.

MODULE 5 SCURITY & PRIVACY IN CLOUD-BASED IOT, CASE STUDIES & FUTURE TRENDS 9Hrs

Cloud security considerations: data encryption, access control. Identity and access management (IAM) for IoT devices. Privacy-preserving techniques in cloud-based IoT. Hands-on involving cloud security practices.

Textbook(s):

1. Rajkumar Buyya, Mastering Cloud Computing: Foundations and Applications Programming, Illustrated, Morgan Kaufmann Publishers In, 2013
2. Saurabh Mishra, Cloud Computing for Internet of Things: A Survey,
3. Online resources and articles discussing recent trends in cloud computing for IoT.,

Reference(s):

1. Raj Kamal, INTERNET OF THINGS:Architecture and Design Principles, 2nd Edition, McGraw Hill Education,India, 2017 2. Rajkumar Buyya,Amir Vahid Dastjerdi, Internet of Things, 1st edition, 2016

Course Outcomes:

1. Understand the role of cloud computing in supporting IoT applications. (L2)
2. Describe different cloud deployment models and services. (L2)
3. Implement data storage, processing, and analysis using cloud platforms. (L3)
4. Design scalable and resilient IoT architectures using cloud services. (L6)
5. Recognize challenges and considerations in integrating IoT with cloud computing (L4)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE2051	EMBEDDED SYSTEMS FOR IOT	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 delves into the world of embedded systems and their role in the Internet of Things (IoT) ecosystem. Students will learn about the design, programming, and integration of embedded systems for IoT applications. The course covers hardware platforms, real-time operating systems, sensor interfacing, and communication protocols used in IoT devices. Through theoretical concepts, hands-on labs, and projects, students will gain the skills to develop and deploy embedded systems for IoT applications.

Course Educational Objectives:

- Learn embedded systems in IoT applications.
- Recognize the architecture and components of embedded systems.
- Learn sensor interfacing and data acquisition in embedded systems
- Learn programming embedded systems using real-time operating systems.
- Learn to Design and build an IoT application using embedded systems.

MODULE 1 INTRODUCTION TO EMBEDDED SYSTEMS FOR IOT 6 Hrs

Importance of embedded systems in IoT applications. Overview of embedded system architecture. Ethical considerations in designing embedded IoT devices. Impact of embedded systems on industries.

MODULE 2 MICROCONTROLLERS AND MICROPROCESSORS 6 Hrs

Introduction to microcontrollers and microprocessors. Selection criteria for embedded system hardware. Memory organization and input/output interfacing. Hands-on involving microcontroller programming.

MODULE 3 REAL-TIME OPERATING SYSTEMS FOR EMBEDDED SYSTEMS 6 Hrs

Introduction to real-time operating systems (RTOS). Characteristics and requirements of RTOS. Task scheduling and management in RTOS. Hands-on involving RTOS programming.

MODULE 4 SENSOR INTERFACING, DATA ACQUISITION & COMMUNICATION PROTOCOLS FOR IOT 6Hrs

Types of sensors used in IoT applications. Analog-to-digital conversion (ADC) techniques. Interfacing sensors with microcontrollers. Hands-on involving sensor interfacing. Overview of communication protocols: UART, SPI, I2C. Wireless communication protocols: Zigbee, BLE. Data transmission and reliability in embedded systems. Hands-on involving communication protocol implementation.

MODULE 5 IOT APPLICATION DEVELOPMENT WITH EMBEDDED SYSTEMS 6 Hrs

Designing IoT applications using embedded systems. Data processing and analytics on embedded platforms. Case studies of real-world embedded IoT applications. Final project showcasing an embedded IoT application.

Textbook(s):

1. Muhammad Ali Mazidi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C" , 2. Jean J. Labrosse., "MicroC/OS-II: The Real-Time Kernel",
3. Online resources and articles discussing recent trends in embedded systems for IoT.,

Reference(s):

1. Raj Kamal , Embedded Systems-Architecture,Programming and Design, Hill Education(India) Private Limited, 2017 2. James K, Embedded Systems, Student Edition, Wiley India Pvt. Ltd, 2009

Course Outcomes:

1. Understand the role of embedded systems in IoT applications.
2. Describe the architecture and components of embedded systems.
3. Implement sensor interfacing and data acquisition in embedded systems.
4. Develop and program embedded systems using real-time operating systems.
5. Design and build an IoT application using embedded systems.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4061	WIRELESS SENSOR NETWORKS	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 in-depth understanding of wireless sensor networks (WSNs), their design, operation, and applications. Students will learn about the fundamental principles of WSNs, communication protocols, energy management, and the challenges associated with these networks. Through theoretical lectures, hands-on labs, and projects, students will gain the skills to design and analyse wireless sensor networks for various real-world scenarios.

Course Educational Objectives:

- To Understand the fundamental principles and components of wireless sensor networks.
- To Describe different communication protocols used in wireless sensor networks.
- To Analyse the energy consumption and management challenges in WSNs.
- To Design and simulate wireless sensor networks for specific applications.
- To Recognize the security and privacy considerations in wireless sensor networks.

MODULE 1 INTRODUCTION OF WIRELESS SENSOR NETWORK
9 Hrs

Introduction of wireless sensor network, Network design objective, Technological background, Network architecture Classification of WSN. Protocol stack of WSN, Medium access control at data link layer, Network layer, Transport layer, WSN design challenges. Types of WSN, Applications of WSN.

MODULE 2 PHYSICAL LAYER AND MAC PROTOCOLS
9 Hrs

Physical Layer Technologies, Overview of RF Wireless Communication, Channel Coding, Modulation, Wireless Channel Effects, PHY Layer Standards. Fundamentals of (wireless) MAC protocols, Contention-based, Reservation-based and Hybrid MAC protocols overview, CSMA Mechanism, Contention-Based Medium Access, S-MAC, Hidden and exposed node problems

MODULE 3 ROUTING AND TRANSPORT PROTOCOLS **9 Hrs**

Challenges for Routing, classification of routing protocol, The SPIN protocol, Network deployment topologies, Protocol Classification in Transport Layer, Introduction to the time synchronization problem, Data aggregation.

MODULE 4 ENERGY MANAGEMENT IN WSNS AND LOCALIZATION **9 Hrs**

Power-efficient communication strategies, Sleep/wake scheduling, Challenges in Localization, Ranging Techniques, Range-Based Localization, Range-Free Localization

MODULE 5 SECURITY IN WSN **9 Hrs**

Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and ZigBee Security

Textbook(s):

1. S Nilanjan DeyAmira S. Ashour Simon James Fong , ecurity and Privacy Issues in IoT Devices and Sensor Networks, Academic Press, 2021
2. Ian F. Akyildizand Mehmet Can Vuran, “Wireless Sensor Networks”, Wiley Publishing, 2010
3. Ankur Dumka, Sandip K. Chaurasiya, Arindam Biswas, and Hardwari Lal Mandoria , A Complete Guide to Wireless Sensor Networks From Inception to Current Tre, CRC Press, USA., 2019
4. Waltenegus Dargie and Christian Poellabauer, “Fundamentals of Wireless Sensor Networks- Theory and Practice” , Wiley Publishing, 2010
5. Bhaskar Krishnamacharya, “Networking Wireless Sensors” , Cambridge University Press, 2005 6. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, Wiley Publishing, 2010

Reference(s):

1. Siva Yellampalli, Wireless Sensor Networks Design, Deployment and Appplications, IntechOpen, 2021 2. Daniel Minoli Kazem Sohraby, Taieb Znati, Wireless Sensor Networks, Wiley India Pvt. Limited, 2004 3. Mohammad S. Obaidat, Sudip Misra, “Principles of Wireless Sensor Networks”, Cambridge University Press, 2014

Course Outcomes:

1. Identify the components in WSN, layers and its challenges .
2. Describe the modulation techniques used at physical layer and protocols used at mac layer .
3. Outline the various protocols used in routing and transportation in WSN .
4. Apply the localization techniques used in WSN .
5. Demonstrate security aspects in WSN.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3191	IOT DEVICE DESIGN AND DEVELOPMENT	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 students with the knowledge and skills to design and develop Internet of Things (IoT) devices from concept to implementation. Students will learn the entire product development lifecycle, including hardware design, firmware development, sensor integration, and connectivity. The course covers hands-on design challenges and encourages innovation in creating functional and efficient IoT devices. Through theoretical knowledge, practical exercises, and group projects, students will gain the expertise to bring IoT device ideas to reality.

Course Educational Objectives:

- Understand the IoT device design and development lifecycle.
- Describe the components and architecture of IoT devices.
- Integrate sensors, actuators, and connectivity in IoT devices.
- Develop firmware and software for IoT devices
- Design and prototype functional IoT devices for specific applications.

MODULE 1 INTRODUCTION TO IOT DEVICE DESIGN AND DEVELOPMENT 9 Hrs

Importance of IoT device development, Overview of the product development lifecycle, Ethical considerations in IoT device design, Impact of IoT devices on industries

MODULE 2 IOT HARDWARE COMPONENTS AND SELECTION 9 Hrs

Selection criteria for IoT hardware components, Microcontrollers, sensors, actuators, and communication modules, Power management and energy efficiency, Hands-on involving hardware component selection.

MODULE 3 SENSOR INTEGRATION AND DATA ACQUISITION 9 Hrs

Types of sensors used in IoT applications, Sensor characteristics and data acquisition techniques, Analog and digital sensor interfacing, Hands-on involving sensor integration.

MODULE 4 CONNECTIVITY AND COMMUNICATION PROTOCOLS 9 Hrs

Communication modules: Wi-Fi, Bluetooth, Zigbee, Data transmission and messaging protocols, MQTT, CoAP, HTTP for IoT communication, Hands-on involving communication protocol implementation. Digital Twins in IoT : Introduction to Digital Twins, Core Components of Digital Twins, Implementation and Deployment, Hands-on Digital Twin Use Cases and Applications

MODULE 5 IOT DEVICE PROTOTYPING AND PROJECT SHOWCASE 9 Hrs

Designing and prototyping functional IoT devices, Testing, debugging, and iteration, Group projects showcasing functional IoT devices. Future trends in IoT device design and development.

Textbook(s):

1. Charulatha Kalluri and Vasudeva Varma, Internet of Things,
2. Kim Fowler, Beginning Sensor Networks with Arduino and Raspberry Pi,
3. 3. Online resources and articles discussing recent trends in IoT device design and development.,

Reference(s):

1. Adrian McEwen (Author), Hakim Cassimally., Designing the Internet of Things Paperback , 2013 2. O'Reilly Media, Designing for the Internet of Things, 2015

Course Outcomes:

1. Describe Understand the IoT device design and development lifecycle .
2. the components and architecture of IoT devices .
3. Integrate sensors, actuators, and connectivity in IoT devices .
4. Develop firmware and software for IoT devices.
5. Design and prototype functional IoT devices for specific applications .

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3201	INDUSTRIAL IOT AND AUTOMATION	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 explores the intersection of the Internet of Things (IoT) and industrial automation, focusing on the integration of smart technologies to enhance efficiency and productivity in industrial processes. Students will learn how IoT devices, sensors, and data analytics are used to monitor and control industrial systems. The course covers automation concepts, communication protocols, and real-world applications in manufacturing, logistics, and more. Through theoretical concepts, hands-on labs, and case studies, students will develop the skills to implement IoT solutions in industrial environments.

Course Educational Objectives:

- Introduce the fundamental concepts of IIoT.
- Discover key IIoT concepts including communication protocols, data storage and security.
- To understand an Industrial Automation method.
- To provide students with a good depth of knowledge of Designing Industrial IoT Systems for various applications.

MODULE 1 INTRODUCTION & ARCHITECTURE 9 Hrs

What is IIoT and connected world?, Difference between IoT and IIoT, Importance of IoT in industrial processes, Overview of industrial automation concepts, Architecture of IIoT, Challenges of IIOT.

MODULE 2 COMMUNICATION BUS PROTOCOLS 9 Hrs

Overview, Protocol structure, Function codes, Modbus plus protocol: Data Highway, Profibus PA/DP/FMS: Protocol stack, System operation. CAN BUS: Concepts of bus access and arbitration, CAN Protocol: Errors, Properties, detection, processing, Introduction to CAN 2.0B.

MODULE 3 DATA ANALYTICS AND DECISION-MAKING IN INDUSTRIAL IOT 9 Hrs

Data collection and preprocessing in industrial contexts, Real-time data analytics and visualization., Predictive maintenance and anomaly detection.

MODULE 4 CONTROL SYSTEMS AND AUTOMATION ALGORITHMS 9 Hrs

Introduction to control systems and automation, PID control and feedback loops, Model-based control and optimization.

MODULE 5 CASE STUDIES AND FUTURE TRENDS 9 Hrs

IIoT applications in the Energy sector, Health Care, Manufacturing and Logistics, Future trends in industrial IoT and automation.

Textbooks:

1. Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. – *Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications* (IEEE Communications Surveys & Tutorials, 2015).

2. Rajkumar Buyya & Amir Vahid Dastjerdi – *Internet of Things: Principles and Paradigms* (Morgan Kaufmann, 2016).

Reference Books:

1. Bert van Loon – *Industrial IoT: Realizing the Potential of Connected Enterprises* (Artech House, 2018).

2. Olivier Hersent, David Boswarthick, & Omar Elloumi – *The Internet of Things: Key Applications and Protocols* (Wiley, 2012).

Course Outcomes:

1. Understand the role of IoT in industrial automation.
2. Describe the components and architecture of industrial IoT systems.
3. Integrate sensors, actuators, and controllers for industrial automation
4. Develop data analytics and control algorithms for industrial processes.
5. Implement IoT solutions for real-world industrial applications.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-04-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE3211	IOT FOR TRANSPORTATION	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 focuses on the applications of Internet of Things (IoT) in the transportation sector, ranging from smart vehicles to intelligent transportation systems. Students will learn how IoT technologies enhance efficiency, safety, and sustainability in transportation. The course covers vehicle-to-vehicle communication, traffic management, real-time monitoring, and data analytics. Through theoretical knowledge, case studies, and practical projects, students will gain insights into designing IoT solutions for the transportation industry.

Course Educational Objectives:

- Understand the role of IoT in transforming transportation systems
- Describe the components and architecture of IoT-enabled transportation solutions.
- Implement vehicle-to-vehicle and vehicle-to-infrastructure communication.
- Develop data analytics and decision-making systems for transportation.
- Design and propose innovative IoT solutions for transportation challenges.

MODULE 1 INTRODUCTION TO IOT FOR TRANSPORTATION 9 Hrs

Importance of IoT in transportation systems, Overview of intelligent transportation systems, Ethical considerations in IoT-enabled transportation, Impact of IoT on transportation sectors.

MODULE 2 IOT IN SMART VEHICLES 9 Hrs

Integration of IoT in vehicles: connected cars, Vehicle-to-vehicle and vehicle-to-infrastructure communication, Real-time monitoring and predictive maintenance, Hands-on labs involving vehicle IoT systems.

MODULE 3 TRAFFIC MANAGEMENT AND CONTROL **9 Hrs**

IoT-based traffic monitoring and congestion management, Adaptive traffic signals and smart intersections, Data-driven optimization of traffic flow, Hands-on labs involving traffic management simulations.

MODULE 4 REAL-TIME TRACKING AND NAVIGATION **9 Hrs**

GPS and sensor-based vehicle tracking, Real-time navigation and route optimization, Fleet management and logistics optimization, Hands-on labs involving real-time tracking systems.
Data Analytics in Transportation: Data collection and preprocessing for transportation analytics. Real-time data analysis for traffic patterns and behaviour, Predictive analytics for transportation planning. Hands-on labs involving transportation data analysis.

MODULE 5 CASE STUDIES AND FUTURE TRENDS **9 Hrs**

Case studies of IoT in transportation solutions, Applications in public transportation, autonomous vehicles, etc. Future trends in IoT-enabled transportation. Final project showcasing an innovative transportation IoT solution.

Textbook(s):

1. Umit S. Bititci, et al, The Internet of Things in Logistics and Supply Chain Management: A Review, 2. Hongyu Wu and Zongjian He, Big Data Analytics for Intelligent Transportation: A Survey,
3. 3. Selected research papers and articles from relevant conferences and journals.,

Reference(s):

1. Carmen Balan , Internet of Things in Transportation: Game Changer in the Supply Chains , The Bucharest University of Economic Studies,
2. Naveenkumar Marati (Editor) Akash Kumar Bhoi (Editor) Victor Hugo C. de Albuquerque (Editor) Akhtar Kalam (Editor), AI Enabled IoT for Electrification and Connected Transportation ,

Course Outcomes:

1. Understand the role of IoT in transforming transportation systems.
2. Describe the components and architecture of IoT-enabled transportation solutions.
3. Implement vehicle-to-vehicle and vehicle-to-infrastructure communication.
4. Develop data analytics and decision-making systems for transportation.
5. Design and propose innovative IoT solutions for transportation challenges.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

Programme Elective (PE)

Track # : AI and ML Applications

24CSEN2311	MACHINE LEARNING TECHNIQUES	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course provides an introduction to the field of machine learning. Machine Learning is a flourishing subject which creates models that can automatically learn from data and detect patterns from data. Machine learning applications are diverse, ranging from self-driven cars to disaster management systems. With the easy availability of data from different devices and measurements, machine learning techniques become imperative in analyzing trends hidden in the data. This course focuses on the major tasks of machine learning, viz., supervised and unsupervised learning approaches that can robustly address non-linear, noisy, and high-dimensional data..

Course Educational Objectives:

- Understand the basic concepts of machine learning
- Impart the various approaches to supervised learning.
- Demonstrate unsupervised learning approaches.
- Familiarize with dimensionality reduction techniques
- Demonstrate ML approach with real-time data

MODULE 1 INTRODUCTION TO ML **9 Hrs**

Basics of ML: Definition and key concepts, Historical overview of machine learning. Types of Machine Learning Systems: Supervised, unsupervised, reinforcement learning, Semi-supervised and self-supervised learning. Machine Learning Challenges: Overfitting, underfitting, bias, variance, Evaluation metrics, and model performance.

MODULE 2 GUIDELINES FOR ML EXPERIMENTS **9 Hrs**

Experimental design in machine learning, Hyperparameter tuning, and model selection. Working with Real Data: Data acquisition and preprocessing, Dealing with missing data and outliers. Data Preparation, Training, and Fine-Tuning the Model: Data splitting for training and testing, Hyperparameter tuning techniques.

MODULE 3 DIMENSIONALITY REDUCTION TECHNIQUES **9 Hrs**

Curse of Dimensionality: Understanding challenges in high-dimensional data. Feature Selection and Extraction: Techniques for selecting relevant features and dimensionality reduction through feature extraction. Linear Discriminant Analysis: Dimensionality reduction for classification, Application in pattern recognition. Principal Component Analysis (PCA): Basics of PCA, data compression, and visualization applications.

MODULE 4 SUPERVISED LEARNING **9 Hrs**

Supervised Learning- Introduction to Classifier: Binary and multiclass classification, Evaluation metrics for classification. Multi-label Classification, Multi-output Classification: Handling multiple labels and outputs, Applications in real-world scenarios. Tree-Based Classifiers: Decision trees and ensemble methods, Random Forests, and Gradient Boosting. Neural Network-Based Classifiers: Basics of neural networks for classification, Deep learning architectures for classification.

MODULE 5 UNSUPERVISED LEARNING **9 Hrs**

Unsupervised Learning- Clustering: K-Means: Grouping data into clusters, Applications in segmentation, Using Clustering for Image Segmentation: Image segmentation techniques, Unsupervised learning in computer vision. DBSCAN, Other Clustering Algorithms: Density-based clustering, Alternative clustering methods.

List of Experiments

1. Experiment 1 Implement a simple classification task using a well-known dataset (e.g., Iris dataset).
2. Experiment 2 Preprocess a real-world dataset with missing values and outliers.
3. Experiment 3 Use PCA for dimensionality reduction on a high-dimensional dataset and compare
4. Experiment 4 Implement supervised learning using a labeled dataset and unsupervised learning using an unlabeled dataset.
5. Experiment 5 Create a synthetic dataset that exhibits overfitting or underfitting
6. Experiment 6 Design an experiment to evaluate the impact of different hyperparameter values on model Performance
7. Experiment 7 Split a dataset into training and testing sets, and fine-tune a model using
8. Experiment 8Implement a decision tree classifier and evaluate its performance on a binary classification Task
9. Experiment 9 Apply K-Means clustering to a dataset and visualize the resulting clusters

Textbook(s):

1. Ethem ALPAYDIN, Introduction to Machine Learning, PHI Learning Pvt. Ltd., 2015 ,978-8120350786 2. Oliver Theobald , Machine Learning For Absolute Beginners: A Plain English Introduction , 3rd Edition, Kindle Edition, 2018 ,978-9332901384

Reference(s):

1. Geron, Aurélien, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow,
2. Andrew Ng., "Machine Learning Yearning",

3. Provost, Foster, and Tom Fawcett., "Data Science for Business",
4. Stefan Jansen, "Hands-On Machine Learning for Algorithmic Trading" ,
5. Chandola, Varun, "Anomaly Detection Principles and Algorithms" ,
6. Zheng, Alice, "Feature Engineering for Machine Learning",
7. Duda, Richard O., Peter E. Hart, and David G. Stork, "Pattern Classification" ,
8. Seni, Giovanni, and John Elder, "Ensemble Methods in Machine Learning" ,

Course Outcomes:

1. Understand the concepts and theory of Machine Learning (L2)
2. Compare performance using different techniques of Machine Learning. (L4)
3. Apply dimensionality reduction techniques for cleaning data. (L3)
4. Apply supervised learning concepts on real-time problems (L3)
5. Apply unsupervised learning concepts on real-time problems (L3)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2						2			3	2	
2	2	2	2	2	2					2			3	2	1
3	2	2	2	2	2					2			3	2	1
4	2	2	2	2	2					2			3	2	1
5	2	2	2	2	2					2			3	2	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN2321	FUNDAMENTALS OF NEURAL NETWORKS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course provides a comprehensive exploration of artificial neural networks (ANNs), a fundamental component of machine learning and deep learning. Students will gain an in-depth understanding of the architecture, training algorithms, and applications of ANNs. The course covers both theory and hands-on implementation, allowing students to build and train ANNs for various tasks. By the end of the course, students will be equipped to design and apply ANNs to real-world problems.

Course Educational Objectives:

- To introduce the fundamentals of artificial neural networks.
- To teach the different training techniques for neural networks
- To familiarize the student with the architecture and components of feedforward and recurrent networks.
- To explore the applications of neural networks.
- To teach the basics of generative models.

MODULE 1 INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 9 Hrs

Importance and applications of artificial neural networks. Overview of neural network architectures and terminology. Neuron model and activation functions. Single-layer perceptron and its limitations. Feedforward neural networks and multi-layer perceptrons.

MODULE 2 TRAINING NEURAL NETWORKS 9 Hrs

Backpropagation algorithm and chain rule. Gradient descent optimization and learning rate tuning. Regularization techniques: dropout, L2 regularization.

MODULE 3 DEEP LEARNING ARCHITECTURES 9 Hrs

Introduction to Deep learning architectures: Neural Networks (CNNs) for image analysis, Recurrent Neural Networks (RNNs) for sequential data, Long Short-Term Memory (LSTM) networks, Hands-on exercises involving CNNs and RNNs.

MODULE 4 APPLICATIONS OF NEURAL NETWORKS **9 Hrs**

Natural Language Processing (NLP) with ANNs, Image classification and object detection, Speech recognition using ANNs.

MODULE 5 ADVANCED TOPICS AND FUTURE TRENDS **9 Hrs**

Generative models: Autoencoders and Generative Adversarial Networks (GANs).

List of Experiments

1. Experiment 1 Building a Single-Layer Perceptron
2. Experiment 2 Implementing Backpropagation Algorithm
3. Experiment 3 Tuning Learning Rates for Convergence
4. Experiment 4 Applying Dropout Regularization
5. Experiment 5 Implementing L2 Regularization
6. Experiment 6 Building a Feedforward Neural Network

Textbook(s):

1. Charu C. Aggarwal, Neural Networks and Deep Learning, 1st Edition, Springer International Publishing AG part of Springer Nature, 2018 ,978-3319944623
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016 ,978-0262035613

Reference(s):

1. Christopher M. Bishop, Pattern Recognition and Machine Learning,
2. Satish Kumar, Neural Networks A Classroom Approach, 2nd Edition, McGraw Hill Education,India, 3. Michael A. Nielsen, Neural Networks and Deep Learning: A Textbook,

Course Outcomes:

1. explain the fundamentals of artificial neural networks (L2).
2. implement backpropagation and gradient descent for training ANNs (L3).
3. explain different deep learning architecture (L2).
4. illustrate different applications of ANNs (L2).
5. develop and evaluate ANNs for various tasks and applications (L6).

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2					2			3	2	
2	2	2	2	2	2					2			3	2	1
3	2	2	2	2	2					2			3	2	
4	2	2	2	2	2					2			3	2	
5	2	2	2	2	2					2			3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN2331	FUNDAMENTALS OF DEEP LEARNING	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course offers an in-depth exploration of deep learning, a subfield of machine learning focused on neural networks with multiple layers. Students will delve into the architecture, training algorithms, and applications of deep neural networks. The course covers both foundational concepts and advanced topics in deep learning, enabling students to build and apply deep learning models to various real-world tasks.

Course Educational Objectives:

- To introduce the principles and significance of deep learning.
- To familiarize the student with the architecture and components of deep neural networks.
- To teach the applications of recurrent neural networks
- To edify autoencoders and deep generative models
- To create awareness of different applications of deep learning.

MODULE 1 INTRODUCTION TO DEEP LEARNING **9 Hrs**

Importance and applications of deep learning, Overview of deep neural network architectures, Building blocks of deep neural networks, Activation functions: sigmoid, ReLU, etc. Weight initialization and regularization techniques.

MODULE 2 CONVOLUTION NETWORKS **9 Hrs**

Architectures, Convolution operations, Pooling layer, Variants of the basic Convolution Function, Efficient Convolution algorithms.

MODULE 3 RECURRENT NEURAL NETWORKS (RNNS) AND SEQUENCES **9 Hrs**

Understanding sequential data and RNNs, Long Short-Term Memory (LSTM) networks, Applications of RNNs.

MODULE 4 AUTO ENCODERS **9 Hrs**

Auto encoders: Under complete auto encoders, regularized encoders, stochastic encoders and decoders.

MODULE 5 APPLICATIONS OF DEEP LEARNING **9 Hrs**

Large scale Deep learning, Computer vision, speech recognition, NLP, and other applications. Introduction to Generative Adversarial Networks (GANs) and their applications

List of Experiments

1. Experiment 1 Building and Training a Feedforward Neural Network Implement a basic feedforward neural 1 network for a classification task using either MATLAB or Python with a deep learning library like TensorFlow or PyTorch.
2. Experiment 2 Convolutional Neural Network (CNN) for Image Classification Create and train a CNN for 2
3. image classification using a popular dataset (e.g., CIFAR-10 or MNIST) with appropriate data augmentation techniques.
4. Experiment 3.Recurrent Neural Network (RNN) for Sequence Prediction Implement an RNN for sequence prediction using LSTM cells. Train the model on a relevant dataset.
5. Experiment 4Autoencoder for Image Compression Build and train an autoencoder to compress and
6. reconstruct images. Evaluate the quality of reconstruction and the compression ratio.
7. Experiment 5Generative Adversarial Network (GAN) for Image Generation Develop a GAN to generate realistic images. Train the generator and discriminator on a dataset such as CelebA or MNIST.
8. Experiment 6Text Classification with Word Embeddings Perform text classification using word embeddings and an RNN. Use a dataset with labeled text documents.
9. Experiment 7LSTM for Time Series Prediction Apply LSTM networks for time series prediction, such as predicting stock prices or temperature trends, using historical data.
10. Experiment 8 Speech Recognition using Convolutional Neural Networks Develop a speech recognition system using a CNN. Train the model on a dataset of spoken words or phrases.Experiment

Textbook(s):

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016 ,978-0262035613 2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015

Reference(s):

1. Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Deep Learning, 1st Edition, Pearson, 2. Sandro Skansi, Introduction to Deep Learning, Springer,

Course Outcomes:

1. Understand the basic principles of deep learning (L2)

2. Explain the architecture and components of deep neural networks (L2).
3. Illustrate Recurrent Neural Networks (RNNs) and Sequences (L2)
4. Explain different autoencoders and deep generative models (L2)
5. Develop and evaluate deep learning models for various applications (L6)

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	2		1					1			1		1
2	2	1	2		1					1			2		1
3	2	1	3		1					1			2		1
4	2	1	3		1					1			2	1	2
5	2	1	2		1					1			2	2	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24CSEN3281	FUNDAMENTALS OF NATURAL LANGUAGE PROCESSING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	Python programming /R Programming						

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 the design of intelligent agents. Natural language processing is the subfield 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 provide an understanding of the architecture and design of Natural language processing
- To introduce various tagging techniques
- To teach adoption of concepts of context free grammars for NLP
- To provide knowledge on semantic properties of embeddings
- To pave a way to create the applications such as sentiment analysis

MODULE 1 INTRODUCTION 10 Hrs

Introduction, Regular Expressions, Text Normalization, Edit Distance, Regular Expressions, Words, Corpora, Simple Unix Tools for Word Tokenization, Word Tokenization, Word Normalization, Lemmatization and Stemming, Sentence Segmentation, Minimum Edit Distance, Summary.

MODULE 2 N-GRAM LANGUAGE MODELS 9 Hrs

N-Grams, Evaluating Language Models: Training and Test Sets, Perplexity, Sampling sentences from a language model, Generalization and Zeros, Smoothing.

MODULE 3 NAIVE BAYES, TEXT CLASSIFICATION AND SENTIMENT 9 Hrs

Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked example, Optimizing for Sentiment Analysis, Naive Bayes for other text classification tasks, Naive Bayes as a Language Model, Evaluation:

Precision, Recall,F-measure, Test sets and Cross-validation

MODULE 4 VECTOR SEMANTICS **9 Hrs**

Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models,

MODULE 5 EMBEDDINGS **8 Hrs**

Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Mode, Large Language Models - brief overview

Textbook(s):

1. Daniel Jurafsky, James H Martin, Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition , 3rd Edition, Prentice Hall, 2000 ,9780131227989, 013122798X
2. C. Manning, H. Schutze , Foundations of Statistical Natural Language Processing, MIT Press, 1999 ,9780262303798, 0262303795
3. Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019 ,9780262042840, 0262042843

Reference(s):

1. Jalaj Thanaki, Python Natural Language Processing: Explore NLP with machine Learning and deep learning Techniques, 2017 ,9781787285521, 1787285529
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
9. ,SWAYAM: Natural language Processing, https://onlinecourses.nptel.ac.in/noc19_cs56/preview

Course Outcomes:

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. Apply lexical and vector semantics to design word embeddings.
5. Distinguish between lexical and vector semantics to design word embeddings.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2								3	2	
2	2	2	2	2	2								3	2	
3	2	2	2	2	2								3	2	
4	2	2	2	2	2								3	2	
5	2	2	2	2	2								3	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 03-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4071	MACHINE LEARNING FOR AUDIO, IMAGE AND VIDEO ANALYSIS	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 in-depth exploration of machine learning techniques applied to the analysis of audio, images, and video data. Students will delve into the fundamentals of audio acquisition, representation, and storage, image and video acquisition, speech and handwriting recognition, automatic face recognition, and video segmentation. Through lectures, hands-on exercises, and real-world applications, students will gain the skills and knowledge necessary to apply machine learning for the analysis of audio, images, and videos.

Course Educational Objectives:

- To understand the principles of acoustics, production, and perception and learn about audio acquisition, encoding, storage formats, and time-domain audio analysis.
- To gain knowledge of human eye physiology and image acquisition devices and learn about colour representation, image formats, video principles, and the MPEG standard for video compression.
- To explore the fundamentals of speech and handwriting recognition, including Hidden Markov Models (HMM) training and performance assessment.
- To learn about face detection, localization, lighting normalization, feature extraction, classification, and performance assessment.
- To explore applications of video segmentation and keyframe extraction.

MODULE 1 AUDIO ACQUISITION, REPRESENTATION AND STORAGE 8 Hrs

Acoustics, Speech Production and Perception, Audio Acquisition, Audio Encoding and Storage Formats, Time-Domain Audio Analysis.

MODULE 2 IMAGE AND VIDEO ACQUISITION, REPRESENTATION AND STORAGE 9 Hrs

Human Eye Physiology, Image Acquisition Devices, Colour Representation, Image Formats, Video Principles, MPEG Standard.

MODULE 3 SPEECH AND HANDWRITING RECOGNITION 10 Hrs

Structure of a recognition system, low-level processing aspects of handwritten and spoken data, HMM training, recognition process and performance measures, state-of-the-art recognition systems.

MODULE 4 AUTOMATIC FACE RECOGNITION **9 Hrs**

Face Recognition General Approach, Face Detection and Localization, Lighting Normalization, Feature Extraction, Classification, Performance Assessment, Experiments

MODULE 5 VIDEO SEGMENTATION AND KEYFRAME EXTRACTION **9 Hrs**

Applications of Video Segmentation, Shot Boundary Detection, Shot Boundary Detection with Torchvision, Keyframe Extraction, Keyframe Extraction with Torchvision and Torch

Textbook(s):

1. Francesco Camastra and Alessandro Vinciarelli, Machine Learning for Audio, Image and Video Analysis: Theory and Applications, 1, Springer London,London, 2008
2. A.V. Oppenheim and R.W. Schafer, Discrete-Time Signal Processing, Prentice- Hall, 1989
3. T. Painter and A. Spanias, Perceptual coding of digital audio, IEEE, 2000

Reference(s):

1. T. Acharaya and A. K. Ray, Image Processing: Principles and Applications, John Wiley and Sons, Hoboken, New Jersey., 2005 ,13 978-0-471-71998-4
2. D. Le Gall, MPEG: a video compression standard for multimedia applications, ACM, 1991

Course Outcomes:

1. Illustrate the principle of audio acquisition, representation, and storage .
2. Illustrate the principle of image and video acquisition, representation, and storage .
3. Analyse the performance of speech and handwriting recognition .
4. Explain the different steps involved in the face recognition system .
5. Explain the application of video segmentation and keyframe extraction .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2										2	2	
2	2	2	2										2	2	
3	2	2	2	1									2	2	1
4	2	2	2										2	2	
5	2	2	2										2	2	

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4081	MACHINE LEARNING FOR ANTENNA ARRAY APPLICATIONS	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 exploration of machine learning techniques and their applications in the field of antenna array systems. Students will delve into various aspects of machine learning, including linear support vector machines, deep learning, direction of arrival estimation, beamforming, and the integration of machine learning with reconfigurable antennas and cognitive radio. Through lectures, hands-on exercises, and real-world examples, students will develop the skills and knowledge necessary to apply machine learning to antenna array applications.

Course Educational Objectives:

• To gain a solid understanding of the foundational concepts of machine learning, including linear support vector machines, linear Gaussian processes, and kernels for signal and array processing.
• To explore the fundamental principles of deep learning, including neural network structures and their applications in antenna array systems.
• To gain the ability to implement neural networks for DOA estimation.
• To learn how to implement advanced beamforming methods, such as Support Vector Machine Beamforming, Beamforming with Kernels, and Radial Basis Function Neural Network (RBF NN) Beamforming.
• To explore the integration of machine learning algorithms with antenna array.

MODULE 1 INTRODUCTION TO SUPPORT VECTOR MACHINE 8 Hrs

Review of Linear Support Vector Machines, Linear Gaussian Processes, Kernels for Signal and Array Processing

MODULE 2 INTRODUCTION TO DEEP LEARNING 8 Hrs

Fundamental Concepts of Deep Learning, Deep Learning Structures

MODULE 3 DETECTION OF ARRIVAL ESTIMATION 9 Hrs

Direction of Arrival Estimation: Fundamentals of DOA Estimation, Conventional DOA Estimation, Statistical Learning Methods, Neural Networks for Direction of Arrival

MODULE 4 BEAMFORMING IN ANTENNA 10 Hrs

Beamforming: Fundamentals of Beamforming, Conventional Beamforming, Support Vector Machine Beamformer, Beamforming with Kernels, RBF NN Beamformer

MODULE 5 COGNITIVE RADIO NETWORK 10 Hrs

Reconfigurable Antennas and Cognitive Radio: Introduction, Basic Cognitive Radio Architecture, Reconfiguration Mechanisms in Reconfigurable Antennas, Examples, Machine Learning Implementation on Hardware.

Textbook(s):

1. Manel Martínez-Ramón, Arjun Gupta, José Luis Rojo-Álvarez, and Christos Christodoulou, Machine Learning Applications in Electromagnetics and Antenna Array Processing, 1, Artech House,USA, 2021 ,9781630817756

Reference(s):

1. Harry L. Van Trees, Optimum Array Processing: Part IV of Detection, Estimation, and Modulation Theory, Wiley,New York, 2004 ,978-0-471-46383-2
2. Bkassiny, M., Y. Li, and S. K. Jayaweera, A survey on machine-learning techniques in cognitive radios, IEEE, 2013 ,10.1109/SURV.2012.100412.00017

Course Outcomes:

1. Explain Linear Support Vector Machines .
2. Illustrate the fundamental concept of deep learning .
3. Illustrate the various methods for arrival estimation .
4. Explain the fundamentals of beamforming in antenna .
5. Explain the basics of Reconfigurable Antennas and Cognitive Radio .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1												
2	2	2	1												
3	2	2	1	2									1	1	1
4	2	2	1												
5	2	2	1										1	1	1

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

<table>
<tr><td rowspan="2">24EECE4091</td><td rowspan="2">APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN VLSI DESIGN</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:

This course explores the integration of artificial intelligence (AI) techniques into Very Large Scale Integration (VLSI) design processes. Students will learn how AI methodologies, including machine learning and optimization, can enhance various stages of VLSI design, such as circuit optimization, layout generation, verification, and testing. The course aims to equip students with the knowledge and skills to leverage AI in VLSI design to improve efficiency, performance, and reliability.

Course Educational Objectives:

- To understand the key concepts of VLSI design and artificial intelligence.
- To explore the challenges and opportunities of integrating AI into VLSI design.
- To gain knowledge on machine learning techniques for circuit optimization and layout generation.
- To learnt AI-based verification and testing methods in VLSI design.
- To understand AI-driven solutions for VLSI design challenges.

MODULE 1 INTRODUCTION TO AI IN VLSI DESIGN 8 Hrs

Importance and applications of AI in VLSI design. Overview of VLSI design stages and challenges. Integration of AI and VLSI design methodologies.

MODULE 2 MACHINE LEARNING FOR CIRCUIT OPTIMIZATION 10 Hrs

Overview of machine learning algorithms. Performance optimization using AI-driven techniques. Circuit sizing and parameter tuning with machine learning. Case study involving machine learning for circuit optimization.

MODULE 3 LAYOUT GENERATION WITH AI 9 Hrs

AI-driven floor planning and placement. Routing optimization using machine learning. Constraint satisfaction and performance trade-offs. Case study involving AI-driven layout generation.

MODULE 4 AI IN VERIFICATION AND TESTING 10 Hrs

Functional verification and coverage analysis with AI. Automatic test pattern generation using machine learning. AI-based fault diagnosis and testing. Case study involving AI-driven verification and testing.

MODULE 5 FUTURE TRENDS AND CHALLENGES **8 Hrs**

AI-driven design space exploration. AI for power optimization in VLSI. Ethical and societal implications of AI in VLSI design. Course project: Proposal of an AI-based solution for VLSI design.

Textbook(s):

1. Sachin Sapatnekar, VLSI Physical Design: From Graph Partitioning to Timing Closure, 2, Springer Cham, 2022 ,978-3-030-96414-6
2. Andrew S. Glassner, Principles of Digital Image Synthesis, 1, Morgan Kaufmann Publishers, Inc. ,San Francisco, USA, , 1-55860-276-3
3. Jason Cong and Yici Cai, Digital Circuit Optimization via Geometric Programming,

Reference(s):

4. Abhishek Kumar, Suman Lata Tripathi, and K. Srinivasa Rao, Machine Learning for VLSI Chip Design, Scrivener Publishing LLC, 2023 ,9781119910398
5. Sandeep Saini, Kusum Lata,and G.R. Sinha. , VLSI and Hardware Implementations using Modern Machine Learning Methods, 1, CRC Press, 2021 , 9781032061719

Course Outcomes:

1. Explain the importance and application of AI in VLSI .
2. Apply machine learning for circuit optimisation.
3. Apply machine learning for layout generation.
4. Explain functional verification and coverage analysis with AI
5. Explain ethical and societal implications of AI in VLSI design .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2													
2	2	2	2	2									1	1	1
3	2	2	2	2									1	1	1
4	2	2													
5	2	2													

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4101	WIRELESS COMMUNICATIONS WITH ARTIFICIAL INTELLIGENCE	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 explores the synergies between wireless communication systems and artificial intelligence (AI) techniques. Students will learn how AI methodologies, including machine learning and deep learning, can enhance various aspects of wireless communication, including spectrum management, resource allocation, signal processing, and network optimization. The course aims to equip students with the knowledge and skills to leverage AI to improve efficiency, capacity, and performance in wireless communication systems

Course Educational Objectives:

- To understand the principles of wireless communication and artificial intelligence.
- To explore the benefits and challenges of integrating AI into wireless systems.
- To learn machine learning techniques for spectrum management and resource allocation.
- To explore AI-driven signal processing methods in wireless communication.
- To explore AI-driven solutions for wireless network optimization.

MODULE 1 INTRODUCTION TO WIRELESS COMMUNICATIONS AND AI 8 Hrs

Importance and applications of wireless communication with AI. Overview of wireless communication systems and challenges. Integration of AI methodologies in wireless systems.

MODULE 2 MACHINE LEARNING FOR SPECTRUM MANAGEMENT 9 Hrs

Cognitive radio and dynamic spectrum access. Spectrum sensing using machine learning. Dynamic spectrum allocation and sharing. Case study involving machine learning for spectrum management.

MODULE 3 RESOURCE ALLOCATION WITH AI 9 Hrs

Resource allocation in wireless networks. QoS-aware scheduling using machine learning. Power and bandwidth allocation optimization. Case study involving AI-driven resource allocation.

MODULE 4 WIRELESS NETWORK OPTIMIZATION WITH AI 9 Hrs

AI-driven mobility management and handover. Self-organizing networks using machine learning. Quality and capacity optimization in wireless networks. Case study involving network optimization simulations.

MODULE 5 EMERGING TRENDS AND CHALLENGE **10 Hrs**

AI-driven millimetre-wave and massive MIMO systems. AI for Internet of Things (IoT) and 5G networks. Ethical considerations and security in AI-driven wireless systems. Course project: Proposal of an AI-based solution for a wireless communication scenario.

Textbook(s):

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005 ,978-0521837163
2. Simon S. Haykin, Neural Networks and Learning Machines,
3, Pearson Prentice Hall, 2008 ,978-0-13-147139-9 3. Tim O'Shea and Jakob Hoydis, An Introduction to Deep Learning for the Physical Layer, IEEE, 2017
4. R. Kanthavel, K. Ananthajothi, S. Balamurugan, and R. Karthik Ganesh , Artificial Intelligent Techniques for Wireless Communication and Networking, Willy,Scrivener Publishing LLC, 2022 ,9781119821274

Reference(s):

1. K. Suganthi, R. Karthik, G. Rajesh, and Peter Ho Chiung Ching, Machine Learning and Deep Learning Techniques in Wireless and Mobile Networking Systems, 1, CRC Press,Boca Raton, 2021 ,9781003107477
2. Karan Kumar, Applications of Artificial Intelligence in Wireless Communication Systems, IGI Global, 2023 , 9781668473481

Course Outcomes:

1. Explain integration of AI methodologies in wireless systems .
2. Apply machine learning for spectrum management
3. Explain how to allocate the resources with AI
4. Apply network optimization with AI .
5. Explain AI driven wireless communication systems.

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1															
2															
3															
4															
5															

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

24EECE4111	**EMBEDDED SYSTEMS WITH ARTIFICIAL INTELLIGENCE**	**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 explores the integration of artificial intelligence (AI) techniques into embedded systems design. Students will learn how to develop intelligent embedded systems capable of performing tasks such as image recognition, speech processing, and autonomous control. The course covers AI algorithms suitable for resource-constrained environments, as well as hardware-software co-design considerations. By the end of the course, students will be equipped to design and implement AI-powered embedded systems.

Course Educational Objectives:

- To understand the principles of embedded systems and artificial intelligence.
- To identify the challenges and benefits of integrating AI in embedded systems.
- To learn AI algorithms on resource-constrained embedded platforms.
- To explore Autonomous Control in Embedded AI
- To understand hardware-software co-optimized embedded AI systems.

MODULE 1 INTRODUCTION TO EMBEDDED SYSTEMS AND AI 9 Hrs

Overview of embedded systems design and applications. Introduction to artificial intelligence and machine learning. Challenges and considerations in integrating AI into embedded systems. Overview of AI algorithms suitable for embedded systems. Efficient implementations of algorithms: trade-offs and optimizations. Neural networks and deep learning on embedded platforms. Case study involving AI algorithm implementations on embedded platforms

MODULE 2 SPEECH AND AUDIO PROCESSING IN EMBEDDED AI 9 Hrs

Speech recognition and keyword spotting. Audio feature extraction and classification. Real-time audio processing on embedded systems. Case study involving speech and audio processing on embedded platforms.

MODULE 3 IMAGE AND VISION PROCESSING IN EMBEDDED AI 9 Hrs

Image recognition and object detection. Edge detection and feature extraction. Real-time image processing on embedded systems. Case study involving image and vision processing on embedded platforms.

MODULE 4 AUTONOMOUS CONTROL IN EMBEDDED AI **9 Hrs**

Sensor integration and data fusion. Motion planning and obstacle avoidance. Autonomous navigation and robotics. Case study involving autonomous control on embedded platforms.

MODULE 5 HARDWARE-SOFTWARE CO-DESIGN FOR EMBEDDED AI **9 Hrs**

System-level design considerations: power, memory, and latency. Hardware acceleration using FPGAs and GPUs. Model quantization and compression for embedded deployment. Course project: Implementation of an AI-powered embedded system.

Textbook(s):

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, 2, Morgan Kaufmann Publishers, 2008 ,978-0-12-374397-8
2. Peter K. Allen and Andrew G. Barto, Speech and Language Processing for Human-Machine Communication, 3. Chris McCool, Reinders James, and Robison Arch., Structured Parallel Programming: Patterns for Efficient Computation, Morgan Kaufmann Publishers, 2012 ,9780124159938

Reference(s):

Course Outcomes:

1. Explain the challenges and considerations in integrating AI into embedded systems .
2. Apply speech and audio processing on embedded platforms .
3. Apply image and vision processing on embedded platforms .
4. Explain autonomous control on embedded platforms .
5. Explain Hardware-Software Co-design for Embedded AI .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2													
2	2	2													
3	2	2	2	2	2								1	2	1
4	2	2											1	1	
5	2	2											1		

3 – High, 2 – Medium & 1 – Low Correlation

APPROVED IN MEETINGS HELD ON:

BOS : 12-02-2024 Academic Council Number: 27 Academic Council : 06-07-2023

Programme Elective (PE)

Track # : Software Defined Vehicles

24MECH2081	FUNDAMENTALS OF AUTOMOTIVE ENGINEERING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This Automotive Engineering course provides a comprehensive overview of the automotive industry, covering historical developments, vehicle components (chassis, body, suspension, brakes, steering, electrical systems), powertrain systems (internal combustion engines, transmissions, hybrid, and electric propulsion), vehicle safety and crashworthiness, manufacturing processes, materials selection, and emerging trends (autonomous vehicles, electric and alternative fuel vehicles, vehicle-to-vehicle communication). With a focus on safety, sustainability, and cutting-edge technologies, the course prepares students for a dynamic career in automotive engineering.

Course Educational Objectives:

- Understand the key components and systems in an automotive vehicle.
- Explain the principles of vehicle propulsion and powertrain systems.
- Identify safety considerations in automotive design and manufacturing.
- Recognize emerging trends and technologies in the automotive industry.
- Apply basic engineering concepts to automotive engineering challenges.

MODULE 1 INTRODUCTION TO AUTOMOTIVE ENGINEERING 9 Hrs

Importance and scope of automotive engineering, Historical development of the automotive industry, Vehicle chassis, body, and suspension systems. Braking and steering systems. Electrical and electronic systems in vehicles.

MODULE 2 POWERTRAIN SYSTEMS AND PROPULSION 9 Hrs

Principles of internal combustion engines, Transmission systems and drivetrain components, Hybrid, and electric propulsion systems.

MODULE 3 VEHICLE SAFETY AND CRASHWORTHINESS 9 Hrs

Crash test standards and safety regulations, Vehicle structural design for crashworthiness, Active and passive safety systems.

MODULE 4 AUTOMOTIVE MANUFACTURING AND MATERIALS 9 Hrs

Vehicle manufacturing processes and assembly lines, Materials selection for automotive components, Lightweighting and sustainable manufacturing practices.

MODULE 5 EMERGING TRENDS AND FUTURE OF AUTOMOTIVE ENGINEERING 9 Hrs

Autonomous and connected vehicles, Electric and alternative fuel vehicles, Vehicle-to-vehicle, and vehicle-to-infrastructure communication.

Textbook(s):

1. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals, Society of Automotive Engineers, 2004
2. David Crolla, Hua Zhao, Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann, 2011

Reference(s):

1. Reza N. Jazar, Vehicle Dynamics: Theory and Application, Springer, 2008
2. Tom Denton, Automotive Electrical and Electronic Systems, Butterworth-Heinemann, 2013
3. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw-Hill Education, 1998

Course Outcomes:

1. Demonstrate a comprehensive understanding of the key components and systems in automotive engineering.
2. Able to Analyze Powertrain Systems and Propulsion Technologies.
3. Apply knowledge of crash test standards, safety regulations, and vehicle structural design.
4. Explore the various processes involved in vehicle manufacturing and assembly lines.
5. Assess and critically evaluate emerging trends in the automotive industry.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

24EECE3221	INTRODUCTION TO AUTOMOTIVE ELECTRONICS AND VEHICLE ARCHITECTURE	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 equips students with a comprehensive understanding of automotive electronics, preparing them for the integration of cutting-edge technologies in modern vehicles and addressing future trends in the automotive industry.

Course Educational Objectives:

- Understand the significance of electronics in modern vehicles.
- Explain the role of electronic control units (ECUs) in vehicle systems.
- Identify various automotive sensors and actuators and their applications.
- Describe communication networks used in vehicle architecture.
- Analyze the integration of electronics into the overall vehicle design.

MODULE 1 INTRODUCTION TO AUTOMOTIVE ELECTRONICS 9 Hrs

Importance of electronics in modern vehicles, Historical development of automotive electronics, Ethical considerations in automotive electronics.

MODULE 2 ELECTRONIC CONTROL UNITS (ECUS) 9Hrs

Role and functions of ECUs in vehicle systems, Engine control, transmission control, and chassis control ECUs.

MODULE 3 AUTOMOTIVE SENSORS AND ACTUATORS 9 Hrs

Types of sensors in vehicles: temperature, pressure, position, etc., Actuators: motors, solenoids, and servos, Sensor fusion and data interpretation.

MODULE 4 COMMUNICATION NETWORKS IN VEHICLES 9 Hrs

Controller Area Network (CAN) bus architecture, LIN, FlexRay, and Ethernet communication networks, In-vehicle communication protocols.

MODULE 5 VEHICLE ELECTRONICS INTEGRATION AND FUTURE TRENDS **9 Hrs**

Integration of ECUs and sensors into vehicle architecture, Power distribution and grounding in vehicles, Electromagnetic compatibility (EMC) considerations, Electric and hybrid vehicle electronics, Connected vehicle technology, autonomous driving, and vehicle-to-vehicle communication.

Textbook(s):

1. Jurgen, R. K. (Ed.), Automotive Electronics Handbook, CRC Press, 2018
2. Zaman, N, Automotive Electronics Design Fundamentals, 1/e, CRC Press., 2015
3. Santini, E., & Manfredini, G., Introduction to Automotive Electronics, Springer, 2017
4. Denton, T, Automotive Electrical and Electronic Systems, Routledge, 2013
5. Navet, N., & Simonot-Lion, F. (Eds.), Automotive Embedded Systems Handbook, CRC Press, 2013 6. Bonnick, A. W, Automotive Computer Control Systems, Butterworth-Heinemann., 2014

Reference(s):

1. Daum, J, Embedded Systems in Automotive, Springer, 2019
2. Turner, J, Automotive Sensors, Springer, 2017
3. Concepcion, M, Automotive Sensor Testing, Createspace Independent Publishing Platform., 2015
4. Concepcion, M., Automotive Actuators and EVAP Systems, Createspace Independent Publishing Platform., 2015
5. Valente, T, Automotive Networking, CRC Press, 2016
6. Matheus, K, Automotive Ethernet, Springer, 2015
7. Smith, C, The Car Hacker's Handbook, No Starch Press, 2016
8. Concepcion, M, Automotive Electronics Design Fundamentals, Createspace Independent Publishing Platform., 2014
9. Maleika, W, Automotive Power Distribution Systems, Springer., 2019
10. Rybak, T, Automotive Electromagnetic Compatibility (EMC). , Springer., 2014
11. Bonnick, A. W. M, Automotive Computer Controlled Systems: Diagnostic Tools and Techniques , 1/e, Butterworth-Heinemann, 2001

Course Outcomes:

1. Develop a thorough understanding of the importance of electronics in modern vehicles.
2. Gain proficiency in understanding the role and functions of the Electronic Control Unit (ECU).
3. Acquire knowledge about the various types of sensors used in vehicles, such as temperature, pressure, and position sensors.
4. Master different communication networks used in vehicles.
5. Learn to integrate ECUs and sensors into vehicle architecture.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24CSEN2341	SOFTWARE ENGINEERING FOR AUTOMOTIVE APPLICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	Object-oriented Programming						

Course Description:

This course equips students with the knowledge and skills needed to navigate the complexities of software engineering in the automotive industry. Students will gain insights into software design, testing, integration, and deployment practices, preparing them for the challenges and advancements in this rapidly evolving field.

Course Educational Objectives:

- Understand the unique challenges and considerations in automotive software engineering.
- Apply software requirements engineering techniques for automotive applications.
- Design and implement software architectures for automotive systems.
- Apply testing and validation techniques specific to automotive software.
- Demonstrate knowledge of automotive software integration and deployment.

MODULE 1 INTRODUCTION TO SOFTWARE ENGINEERING FOR AUTOMOTIVE APPLICATIONS 9 Hrs

Importance of software in modern vehicles, Unique challenges in automotive software development, Ethical considerations in automotive software engineering, Gathering and documenting software requirements. Use case modeling and requirements analysis. Creating requirement specifications for automotive software.

MODULE 2 SOFTWARE DESIGN FOR AUTOMOTIVE SYSTEMS 9 Hrs

Software architecture and design principles, Component-based design for automotive applications, Design patterns in automotive software.

MODULE 3 SOFTWARE TESTING AND VALIDATION 9 Hrs

Testing levels: unit, integration, and system testing, Validation techniques for safety-critical systems, Model-based testing in automotive software.

MODULE 4 AUTOMOTIVE SOFTWARE INTEGRATION AND DEPLOYMENT 9 Hrs

Integration of software components into vehicle systems. Real-time and embedded systems considerations. Continuous integration and deployment practices.

MODULE 5 ADVANCED TOPICS AND FUTURE TRENDS 9Hrs

Autonomous vehicle software challenges, Over-the-air software updates. Ethical considerations in automotive software.

Textbook(s):

1. Nicolas Navet, Françoise Simonot-Lion, Automotive Embedded Systems Handbook, 1st Edition, CRC PresS, 2008 ,978-0849380266
2. Robert Oshana, Mark Kraeling, Software Engineering for Embedded Systems: Methods, Practical Techniques, and Applications, Newnes publisher, 2013 ,978-0124159174

Course Outcomes:

1. able to articulate the importance of software in modern vehicles. (L3)
2. identify and address the distinctive challenges in automotive software development. (L4)
3. develop a strong ethical foundation and be capable of making informed decisions regarding the ethical implications in automotive software. (L5)
4. demonstrate proficiency in software architecture and design principles. (L6)
5. gain practical skills in various testing levels, including unit, integration, and system testing, and apply validation techniques suitable for safety-critical automotive systems. (L3)

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE3231	VEHICLE NETWORKS AND COMMUNICATION PROTOCOLS	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 students with a comprehensive understanding of vehicle communication networks, covering protocols, diagnostics, standards, security, and emerging trends. Students will gain practical experience through hands-on simulations, preparing them for the dynamic and evolving field of automotive communication systems.

Course Educational Objectives:

- Understand the importance of communication networks in vehicles.
- Describe the principles and architecture of vehicle communication networks.
- Identify different communication protocols used in the automotive industry.
- Analyze and troubleshoot communication issues in automotive systems.
- Apply communication network design principles to automotive applications.

MODULE 1 INTRODUCTION TO VEHICLE NETWORKS AND COMMUNICATION 9 Hrs

Importance of communication networks in automotive systems, Historical development of vehicle communication networks, Ethical considerations in vehicle network design. Controller Area Network (CAN) architecture and features. LIN (Local Interconnect Network) and FlexRay. Ethernet and MOST (Media Oriented Systems Transport) networks.

MODULE 2 COMMUNICATION PROTOCOLS IN AUTOMOTIVE SYSTEMS 9 Hrs

Introduction to communication protocols: SPI, I2C, UART, Introduction to TCP/IP and ISO/OSI network model, Automotive Ethernet protocols: AVB, TSN.

MODULE 3 COMMUNICATION PROTOCOLS IN AUTOMOTIVE SYSTEMS 9Hrs

On-board diagnostics (OBD) and fault detection, CAN bus diagnostics: OBD-II and UDS, Network scanning and diagnostic tools.

MODULE 4 AUTOMOTIVE COMMUNICATION STANDARDS AND SECURITY **9 Hrs**

ISO 11898 and other relevant standards, Security challenges in vehicle networks, Secure communication protocols and encryption techniques. Hands-on involving secure communication simulations.

MODULE 5 EMERGING TRENDS AND FUTURE OF VEHICLE NETWORKS **9 Hrs**

Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, Connected vehicle technology and vehicle-to-cloud communication, Ethical considerations in vehicle communication networks.

Textbook(s):

1. Matheus, K, Automotive Ethernet, CRC Press., 2015
2. Voss, W, Controller Area Network (CAN) Bus J1939, OBD2, J1708, J1587, Copperhill Technologies Corporation., 2018
3. King, P, FlexRay and its Applications: Real Time Multiplexed Network., Springer, 2010
4. Navet, N., & Simonot-Lion, F. (Eds) , Automotive Embedded Systems Handbook, CRC Press, 2013
5. Wyglinski, A. M., Khan Malek, C. Y., & Stefanopoulou, A. G, Automotive Networking: Principles and Practice, Artech House, 2016.

References(s):

1. Paret, D, Introduction to Automotive E/E Architectures and Standardization. , Springer, 2016
2. Sommer, C., & Dressler, F. (Eds.), Vehicle-to-Vehicle Communication and Cooperative Driving., CRC Press, 2017
3. Valvano, J. W, Introduction to Embedded Systems: Using Microcontrollers and the MSP430., CreateSpace Independent Publishing Platform, 2012
4. Rathgeb, C., & Meuschke, N, Automotive Cybersecurity, Springer, 2019
5. Smith, C, The Car Hacker's Handbook: A Guide for the Penetration Tester, No Starch Press, 2014

Course Outcomes:

1. comprehensive understanding of the importance of communication networks.
2. proficient in various communication protocols used in automotive systems.
3. acquire expertise in on-board diagnostics (OBD) and fault detection techniques.
4. deep understanding of automotive communication standards.
5. gain awareness of emerging trends in vehicle networks, including vehicle-to-vehicle (V2V) .

Course Articulation Matrix:

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE3241	AUTOMOTIVE EMBEDDED SYSTEMS AND OPERATING SYSTEMS	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 equips students with a deep understanding of automotive embedded systems, from their historical development to emerging trends. Students will gain practical knowledge of real-time operating systems, software architecture, performance optimization, and the integration of cutting-edge technologies, preparing them for the dynamic field of automotive embedded systems.

Course Educational Objectives:

- Understand the principles and significance of embedded systems in automotive applications.
- Describe the components and architecture of automotive embedded systems.
- Explain the role of real-time operating systems in managing automotive tasks.
- Analyze the challenges of real-time performance and integration in embedded systems.
- Apply software development techniques to create efficient and reliable automotive embedded systems.

MODULE 1 INTRODUCTION TO AUTOMOTIVE EMBEDDED SYSTEMS 9 Hrs

Importance of Embedded Systems in Automotive Applications, Historical Development of Automotive Embedded Systems, Microcontrollers and Microprocessors in Vehicles, Sensors and Actuators Integration in Embedded Systems, Communication Interfaces: CAN, LIN, etc.

MODULE 2 REAL-TIME OPERATING SYSTEMS (RTOS) 9 Hrs

Introduction to Real-Time Systems and RTOS, Tasks and Scheduling in RTOS, Memory Management and Inter-Task Communication

MODULE 3 AUTOMOTIVE SOFTWARE ARCHITECTURE 9 Hrs

Layered Software Architecture for Embedded Systems, AUTOSAR (Automotive Open System Architecture) Framework, Challenges of Integrating Software and Hardware

MODULE 4 REAL-TIME PERFORMANCE AND OPTIMIZATION 9 Hrs

Timing Analysis and Worst-Case Execution Time, Performance Optimization Techniques for Embedded Systems, Real-Time Debugging and Profiling

MODULE 5 EMERGING TRENDS AND FUTURE OF AUTOMOTIVE EMBEDDED SYSTEMS 9 Hrs

Autonomous Driving and ADAS (Advanced Driver Assistance Systems) Challenges, Integration of AI and Machine Learning in Automotive Systems

Textbook(s):

1. Bengtsson, L., Mårtensson, J., & Rasmusson, A, Embedded Systems in Automobiles, Springer, 2015
2. Navet, N., & Simonot-Lion, F, Automotive Embedded Systems Handbook. , CRC Press., 2014
3. Burns, A., & Wellings, A, Real-Time Systems and Programming Languages: Ada, Real-Time Java and C/Real-Time POSIX, Pearson Education., 2001
4. Barry, R., Mastering the FreeRTOS Real Time Kernel: A Hands-On Tutorial Guide, Packt Publishing, 2018
5. Navet, N., & Simonot-Lion, F, Automotive Embedded Systems Handbook. , CRC Press., 2014
6. Lesiecki, J, AUTOSAR Compendium - Part 1: Application & RTE, Springer., 2013
7. Bertolotti, I. C., & Esposito, F., Real-Time Embedded Systems: Open-Source Operating Systems Perspective, Springer., 2016
8. Li, Q., & Yao, C, Real-Time Concepts for Embedded Systems, CMP Books, 2003
9. Maurer, M., Gerdes, J. C., Lenz, B., & Winner, H, Autonomous Driving: Technical, Legal and Social Aspects, Springer., 2015
10. Czarnecki, K., Bredenfeld, A., & Osendorfer, C, Machine Learning for Autonomous Driving, Springer., 2019

Course Outcomes:

1. articulate the importance of embedded systems in automotive applications.
2. demonstrate proficiency in understanding real-time systems and RTOS.
3. gain competence in designing layered software architectures for embedded systems.
4. acquire expertise in conducting timing analysis, estimating worst-case execution time.
5. develop awareness of emerging trends in automotive embedded systems.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE3251	MODEL BASED SYSTEM DESIGN	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 familiarizes the Introduction to Model-Based System Design: Model-in-the-Loop (MIL), Software-in-The-Loop Simulations (SIL), Hardware-in-the-Loop (HIL), Real-Time Simulations, Targeting, Verification and Validation, Design of Experiments, Model Refinement.

Course Educational Objectives:

- To illustrates need of Model-Based Design for a small system & Simulink Simulations.
- To understand the concept of systems engineering.
- To illustrate the concepts of system system modeling language
- To analyze model development cycle
- To implement Model Refinement and re-verification.

MODULE 1 MODEL-BASED DESIGN FOR A SMALL SYSTEM & SIMULINK SIMULATIONS 9 Hrs

Model-Based Design for a small system, Motor Model, Generator Model, Controller Model, Sim Driveline Intro, Simulink Simulations, Explore the system response using different control methods. Tune the system, explore system limitations, Understand, and refine motor models.

MODULE 2 SYSTEMS ENGINEERING 9Hrs

Introduction to systems engineering, lifecycle stages and kinds of system requirements, introduction to MBSE.

MODULE 3 SYSTEM MODELING LANGUAGE (SYSML) 9 Hrs

MBSE basics, SysML basics, engineering a system with SysML, SysML structural diagrams, SysML parametric diagrams, modeling behaviour with SysML

MODULE 4 MBSE DEVELOPMENT CYCLE 9 Hrs

Standards and guidelines compliance, AUTOSAR compliance, ISO compliance, auto-code generation framework, unit testing framework

MODULE 5 VERIFICATION AND VALIDATION **9 Hrs**

Basic testing requirements, model in the loop (MIL), software in the loop (SIL), processor in the loop (PIL) and Hardware in the loop (HIL): examples and applications.

Textbook(s):

1. Herniter, M.E. and Chambers, Z, Introduction to Model-Based System Design, Rose Hulman Institute of Technology., 2010
2. Delligatti, L, SysML distilled: A brief guide to the systems modeling language. , Addison-Wesley., 2013
3. Wymore, A.W, Model-based systems engineering (Vol. 3), CRC press., 2018

Course Outcomes:

1. Visualizing the mathematical models for components in a system.
2. Connect component models together to model a larger more complex system.
3. Applying the concepts of SysML to engineering applications
4. Development cycle design for MBSEt.
5. Experimenting Hardware-in-the-Loop Simulations (HIL).

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24CSEN3291	AUTOMOTIVE CYBER SECURITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	Computer Networks						

Course Description:

This course equips students with the knowledge and skills needed to understand, assess, and mitigate cyber security risks in automotive systems. With a focus on practical applications and emerging trends, students will be prepared to address the evolving challenges of securing connected and autonomous vehicles.

Course Educational Objectives:

- Understand the importance of cyber security in modern vehicles.
- Identify vulnerabilities and potential cyber threats to automotive systems.
- Describe techniques for threat modeling and risk assessment in vehicles.
- Apply intrusion detection and prevention strategies in automotive cyber security.
- Analyze and implement mitigation strategies to protect vehicles from cyber-attacks.

MODULE 1 INTRODUCTION TO AUTOMOTIVE CYBER SECURITY 9 Hrs

Importance of cyber security in automotive systems, Historical examples of vehicle cyber-attacks, Ethical considerations in automotive cyber security. Vulnerabilities in vehicle components: ECUs, sensors, communication networks, Attack surfaces: entry points for cyber-attacks, Potential consequences of cyber-attacks on vehicles.

MODULE 2 THREAT MODELING AND RISK ASSESSMENT 9 Hrs

Threat modeling methodologies for automotive systems, Identifying attack vectors and potential threats, Quantifying risks, and impact assessment.

MODULE 3 INTRUSION DETECTION AND PREVENTION 9 Hrs

Techniques for detecting abnormal behavior in vehicles, Anomaly and signature-based intrusion detection, Intrusion prevention systems (IPS) for vehicles. Hands-on involving intrusion detection simulations.

MODULE 4 AUTOMOTIVE SECURITY FRAMEWORKS AND REGULATIONS 9 Hrs

Overview of ISO/SAE 21434 standard, NHTSA cybersecurity guidelines, Automotive security best practices and frameworks, Hands-on involving security framework assessment.

MODULE 5 EMERGING TRENDS AND FUTURE OF AUTOMOTIVE CYBER SECURITY 9 Hrs

Connected and autonomous vehicle security challenges, Over-the-air updates and remote attack prevention, Ethical considerations in automotive cyber security.

Textbook(s):

1. David Ward; Paul Wooderson, Automotive Cybersecurity: An Introduction to ISO/SAE 21434, 1st Edition, SAE International, 2021 ,9781468600803.
2. Craig Smith, Automotive Cybersecurity and Privacy: A Practical Guide, 1st Edition, A press., 2020
3. Brian D. Hammond, Tim Mather, Shahed Latif, ractical Cybersecurity Architecture: From Requirements to Deployment, 1st Edition, Pearson, 2016

Course Outcomes:

1. Recognize the critical importance of cybersecurity in automotive systems. (L2)
2. Acquire the skills to quantify cybersecurity risks and assess their impact on automotive systems. (L3)
3. Gain hands-on experience through simulations involving intrusion detection, reinforcing their understanding of practical aspects. (L4)
4. Apply automotive security best practices and frameworks, demonstrating the ability to assess and enhance security in automotive systems. (L3)
5. Explore preventive measures, such as over-the-air updates and remote attack prevention. (L6)

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE4121	ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) SYSTEM DESIGN	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 students with a comprehensive understanding of ADAS technologies, from the fundamental principles to advanced features and emerging trends. Students will gain insights into the challenges and considerations involved in designing and implementing systems aimed at improving vehicle safety and driving experiences.

Course Educational Objectives:

- Understand the significance of ADAS in modern vehicle safety.
- Describe the components and functionalities of ADAS systems.
- Explain the working principles of key ADAS technologies.
- Design and integrate ADAS features into vehicle systems.
- Analyze the challenges and limitations of ADAS system design.

MODULE 1 INTRODUCTION TO ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) 9 Hrs

Importance of ADAS in enhancing vehicle safety, Overview of different ADAS technologies and features, Ethical considerations in ADAS system design, Types of sensors used in ADAS: cameras, radar, LiDAR, etc., Sensor fusion and data processing for perception, Object detection, tracking, and classification algorithms.

MODULE 2 ADAPTIVE CRUISE CONTROL AND COLLISION AVOIDANCE 9 Hrs

Working principles of adaptive cruise control (ACC), Collision detection and avoidance algorithms, Integration of ACC and collision avoidance systems.

MODULE 3 LANE DEPARTURE WARNING AND LANE KEEPING ASSIST 9 Hrs

Lane departure detection algorithms, Lane keeping assist system design and control, Challenges of lane detection in different scenarios

MODULE 4 AUTOMATED PARKING AND AUTONOMOUS DRIVING **9 Hrs**

Automated parking technologies and algorithms, Levels of autonomous driving and their challenges, Sensor fusion for autonomous driving

MODULE 5 FUTURE TRENDS AND CHALLENGES IN ADAS **9 Hrs**

Emerging ADAS technologies: pedestrian detection, traffic sign recognition, etc. Ethical considerations in ADAS design, Limitations, and potential risks of ADAS systems

Textbook(s):

1. Jurgen, R. K, Advanced Driver Assistance Systems: Principles, Modeling, and Testing., Springer., 2019
2. Vanghi, V., & Rondini, R, Automotive Radar Sensors in Silicon Technologies, CRC Press., 2017
3. Dong, P, LiDAR Remote Sensing and Applications, CRC Press., 2016.
4. Del Re, L., & Ferrara, A., Adaptive Cruise Control Systems: Methodologies and Applications. , Springer, 2015
5. Corno, M., & Ferrara, A, Collision Avoidance Systems, Springer, 2018
6. Godinez, D., & Ferrara, A. , Lane Departure Warning System: Algorithms, Technology, and Applications, Springer, 2017

References:

1. Stiller, C., & van der Auweraer, H, Lane Keeping Assist Systems: Algorithms, Functionality, and Implementation, Springer, 2016
2. Celebi, M. E., & Ferrara, A. , Automated Parking Systems: Challenges, Technologies, and Implementation., Springer, 2017
3. Maurer, M., Gerdes, J. C., Lenz, B., & Winner, H, Autonomous Driving: Technical, Legal and Social Aspects, Springer, 2016
4. Mian, S., Future Trends in Automotive Technology: Tomorrow's Cars. , IGI Global., 2018
5. Roli, F., & Marcialis, G. L, Challenges in Future Automotive Systems: Autonomous Vehicles and Software Architectures, Springer., 2019

Course Outcomes:

1. demonstrate a thorough understanding of the importance of ADAS in enhancing vehicle safety and be able to explain various ADAS technologies.

2. proficient in the working principles of Adaptive Cruise Control (ACC), possess a deep understanding of collision detection. 3. acquire competence in lane departure detection algorithms, gain practical experience in lane keeping assist system design.

4. in-depth understanding of automated parking technologies and algorithms, be familiar with the levels of autonomous driving and associated challenges.

5. aware of emerging ADAS technologies such as pedestrian detection and traffic sign recognition.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

<table>
<tr><td rowspan="2">24EECE3261</td><td rowspan="2">INTRODUCTION TO AUTOSAR</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:

This course equips students with a deep understanding of AUTOSAR, covering architecture, components, methodologies, and practical implementation through hands-on activities. Students will gain insights into the challenges and benefits of adopting AUTOSAR, preparing them for real-world applications in automotive software development.

Course Educational Objectives:

- Understand the significance of AUTOSAR in automotive software development.
- Describe the architecture and components of AUTOSAR.
- Explain the benefits and challenges of using AUTOSAR.
- Apply AUTOSAR methodologies in automotive software design.
- Analyze real-world applications and case studies of AUTOSAR implementation.

MODULE 1 INTRODUCTION TO AUTOSAR 9 Hrs

Importance of AUTOSAR in automotive software development, Overview of AUTOSAR architecture and goals, Ethical considerations in adopting AUTOSAR.

MODULE 2 AUTOSAR ARCHITECTURE AND COMPONENTS 9 Hrs

Basic software architecture - RTE, BSW, and Application Layer, Communication stacks - CAN, LIN, Ethernet, etc. Sensor and actuator abstraction, Hands-on involving basic AUTOSAR components.

MODULE 3 AUTOSAR METHODOLOGY AND WORKFLOWS 9 Hrs

AUTOSAR methodology and development workflow, Configuration and integration of software components, Application software design and mapping, Hands-on involving software component configuration.

MODULE 4 AUTOSAR COMMUNICATION AND DIAGNOSTIC SERVICES 9 Hrs

AUTOSAR communication mechanisms, Diagnostic communication and error handling, Implementation of diagnostic services, Hands-on involving communication, and diagnostic services.

MODULE 5 CHALLENGES, FUTURE TRENDS, AND REAL-WORLD APPLICATIONS 9 Hrs

Challenges in migrating to AUTOSAR, Benefits of AUTOSAR for software development, Future trends in AUTOSAR development, Case studies of AUTOSAR implementation in industry.

Textbook(s):

1. Happel, A., Hoff, C., & Roser, S, AUTOSAR Compendium - Part 1: Application & RTE, Springer., 2014

2. Happel, A., Hoff, C., & Roser, S, AUTOSAR Compendium - Part 2: Basic Software & Communication., Springer., 2015

3. Scheid, O., & Bauer, G, AUTOSAR: Automotive Software Architecture - An Introduction, Springer, 2012

References(s):

1. Heinrich, G., Happel, A., & Roser, S, AUTOSAR Explored: Practical Experience with the Automotive Software Architecture, Springer., 2017

Course Outcomes:

1. articulate the significance of AUTOSAR in automotive software development.
2. engage in hands-on activities involving basic AUTOSAR components.
3. able to design and map application software within the AUTOSAR framework.
4. develop hands-onskills in implementing diagnostic services and working with communication mechanisms in the context of AUTOSAR.
5. analyze real-world case studies of AUTOSAR implementation in industry, drawing insights into practical applications and success stories.

Course Articulation Matrix:

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2			2	1						3	2	
2	2	2	2			2	1						3	2	
3	2	2	2			2	1						3	2	
4	2	2	2			2	1						3	2	
5	2	2	2			2	1						3	2	

3 – High, 2 – Medium & 1 – Low Correlation

24EECE4131	VEHICLE-TO-EVERYTHING (V2X) COMMUNICATION	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This advanced course in V2X (Vehicle-to-Everything) Communication offers an in-depth exploration of the rapidly evolving field that intersects transportation and communication technologies. The course is designed to equip participants with a comprehensive understanding of V2X communication, covering its importance, protocols, applications, challenges, and future trends.

Course Educational Objectives:

- Understand the principles and importance of V2X communication.
- Describe the different types of V2X communication and their applications.
- Explain the technologies and protocols used in V2X communication.
- Analyze the challenges and opportunities of deploying V2X systems.
- Design and evaluate V2X communication solutions for real-world scenarios.

MODULE 1 INTRODUCTION TO V2X COMMUNICATION 9 Hrs

Importance of V2X communication in transportation, Overview of V2V, V2I, V2N, and V2P communication. Ethical considerations in V2X communication, Wireless communication technologies: DSRC, LTE-V2X, 5G, etc. Challenges of reliable and low-latency communication, Wireless propagation, and channel modeling.

MODULE 2 V2X COMMUNICATION PROTOCOLS AND STANDARDS 9 Hrs

DSRC and IEEE 802.11p standard, LTE-V2X and Cellular V2X (C-V2X) protocols, Security and privacy, considerations in V2X communication.

MODULE 3 V2V AND V2I COMMUNICATION 9 Hrs

Vehicle-to-Vehicle (V2V) communication concepts and applications, Vehicle-to-Infrastructure (V2I) communication use cases, Cooperative awareness messages and safety applications.

MODULE 4 V2X APPLICATIONS AND USE CASES **9 Hrs**

Traffic management and congestion reduction, Autonomous vehicle communication and platooning, Pedestrian and vulnerable road user safety, Hands-on involving V2X applications simulations.

MODULE 5 CHALLENGES AND FUTURE OF V2X COMMUNICATION **9 Hrs**

Challenges in V2X deployment and interoperability, Future trends in V2X communication technology, Ethical considerations in V2X communication

Textbook(s):

1. Vinel, A., Andreev, S., & Koucheryavy, Y., Vehicular Communications and Networks: Architectures, Protocols, Operation and Deployment , 1/e, Wiley, 2009
2. Sheng, M., Zhang, Y., & Yang, L. T, Connected Vehicles: Intelligent Transportation Systems and Vehicular Networks , 1/e, Press., 2009
3. Mohan, U., & G., T, Vehicular Ad Hoc Networks: Standards, Solutions, and Research, Springer, 2019
4. Sommer, C., & Dressler, F, Vehicular Networking: Automotive Applications and Beyond, Wiley, 2014
5. Zhang, L., Zhang, X., & Song, H, V2X Communications for Cooperative Autonomous Driving, Wiley-IEEE Press., 2020
6. Zhang, L., & Zhang, Y. , Security and Privacy in V2X Communication, CRC Press., 2018
7. Buratti, C., Verdone, R., & Cusani, R, Vehicular Communications and Networks: Architectures, Protocols, Operation and Deployment, Academic Press, 2015

Reference(s):

1. Liberg, O., Sundberg, M., & Wang, E, Cellular Internet of Things: Technologies, Standards, and Applications, Academic Press., 2019
2. Geneson, G., & Ashley, P, Vehicle-to-Vehicle Communications: Standards, Protocols, and Applications., Artech House, 2016
3. Song, H., Fujii, T., & Jeschke, S, Intelligent Transportation Systems: V2X Communication Technologies for Cooperative Strategies. , Wiley-IEEE Press, 2019
4. Youssef, S. M., & Guizani, M. , Vehicle-to-Infrastructure Communications: Protocols, Security, and Privacy, Wiley., 2018
5. Stavrakakis, I., & Papavassiliou, S, Connected Vehicles: Intelligent Transportation Systems and Vehicular Networks, Wiley-IEEE Press, 2019
6. Zhang, W., Song, H., & Jiang, J,). Traffic Engineering and QoS Optimization of Integrated V2X Communication Networks., Springer., 2017
7. Anderson, J. M., Kalra, N., Stanley, K. D., & Sorensen, P, Autonomous Vehicle Technology: A Guide for Policymakers, Rand Corporation., 2014

8. Mouftah, H. T., Erol-Kantarci, M., & Soyata, T, V2X for Connected and Autonomous Vehicles: Technologies for Intelligent Transportation Systems, Wiley., 2017
9. Jacobsson, M., & Wedlund, E, Inter-Vehicle Communications, Springer., 2013
10. Shen, X. (Sherman)., Cheng, L., & Shi, W, Vehicular Ad Hoc Network Security and Privacy. , CRC Press., 2015

Course Outcomes:

1. demonstrate a comprehensive understanding of the importance of V2X communication in transportation.
2. be proficient in DSRC and IEEE 802.11p standard, LTE-V2X, and Cellular V2X (C-V2X) protocols.
3. acquire competence in understanding Vehicle-to-Vehicle (V2V) communication concepts and applications.
4. able to apply V2X communication principles to real-world scenarios, including traffic management and congestion reduction, autonomous vehicle communication.
5. gain awareness of challenges in V2X deployment and interoperability.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

24EECE2061	INTRODUCTION TO ELECTRIC VEHICLE TECHNOLOGIES	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 in-depth introduction to the technology behind electric vehicles (EVs). Students will gain a solid foundation in the principles, components, and systems that make up EVs, as well as the environmental and societal implications of adopting electric transportation.

Course Educational Objectives:

- To explain the fundamental principles of electric vehicle technology.
- To describe the components and systems that make up an electric vehicle.
- To analyse the environmental and societal impacts of electric vehicles.
- To identify and discuss emerging trends and technologies in the electric vehicle industry.
- To interpret communication systems in electric vehicles.

MODULE 1 INTRODUCTION 9 Hrs

Air pollution, global warming, petroleum resources, induced costs, and development strategies for future oil supply, Overview of Past, current and future of electric vehicles.

MODULE 2 VEHICLES' CLASSIFICATION 9 Hrs

Classification of vehicles: Conventional IC engines, electric vehicles, hybrid electric vehicles, plug-in hybrid vehicles, and fuel cell vehicles. Basic principles and operation of electric vehicles.

MODULE 3 CONFIGURATION AND ARCHITECTURE 9 Hrs

Configuration of electric vehicles, performance of electric vehicles: traction motor characteristics, requirement of tractive and transmission effort and energy consumption. Architecture of hybrid vehicles: series and parallel

MODULE 4 BASIC ELECTRIC PROPULSION SYSTEMS 9 Hrs

(Elementary treatment only) Principle, operation and performance of DC motors, induction motors, brushless DC motors and switched reluctance motors.

MODULE 5 OVERVIEW OF COMMUNICATION IN EVS **9 Hrs**

Vehicle to grid communication, vehicle to vehicle communications, and grid to vehicle communication.

Textbook(s):

1. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M, Modern electric, hybrid electric, and fuel cell vehicles, CRC press., 2018
2. Larminie, J. and Lowry, J, Electric vehicle technology explained, John Wiley & Sons., 2012

Reference(s):

1. Lu, J. and Hossain, J, Vehicle-to-grid: linking electric vehicles to the smart grid. , Institution of Engineering and Technology., 2015

Course Outcomes:

1. Illustrates the need of electric vehicles to replace conventional vehicles .
2. Highlight the constructional features and working principle of various types of vehicles .
3. Understand the architecture and vehicle dynamics of electric and hybrid vehicles .
4. Examine the electric propulsion systems .
5. Integration of communication systems in electric vehicles.

Course Articulation Matrix:

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

3 – High, 2 – Medium & 1 – Low Correlation

GITAM School of Technology

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