GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT(GITAM)
(Deemed to be University)
VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^{++} Grade

CURRICULUM AND SYLLABUS

OF

UCHEM03: B.Sc. Chemistry

w.e.f. 2021-22 admitted batch

(Updated up to May 2024)

Academic Regulations

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

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

VISION AND MISSION OF THE UNIVERSITY

VISION

To become a global leader in higher education.

MISSION

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

UCHEM03: B.Sc. Chemistry

VISION AND MISSION OF THE SCHOOL

VISION

To develop science education in an intellectually vibrant atmosphere

MISSION

1. To transmit, expand and apply knowledge of science through teaching, interaction, research, and societal service.
2. Realising the full potential of science and attaining new heights in Science & Technology to impart quality scientific education.
3. To provide a flexible curriculum with more elective courses and allow a choice-based credit system for the students in a research-oriented teaching and learning environment.
4. To inculcate and create an environment of research and academic excellence by propagating the knowledge and cater the needs of the industry and society
5. To create excellent prospects for emerging entrepreneurs by disseminating the knowledge and tapping their potential skills

UCHEM03: B.Sc. Chemistry

(w.e.f. academic year 2021-22 admitted batch)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 GU Chemistry graduates will be well prepared for successful careers in the profession at an industry and/or in government in one or more of discipline of chemistry.

PEO 2 GU Chemistry graduates will be academically prepared to become licensed professional chemists in due course and will contribute effectively in serving the society.

PEO 3 GU Chemistry graduates will be engaged in professional activities to enhance their own achievement and simultaneously contribute in service of humankind.

PEO 4 GU Chemistry graduates will be successful in higher education in Chemistry.

PEO 5 GU Chemistry graduates will provide leadership quality to work in all kinds of circumstances, diverse environment such as interdisciplinary and multidisciplinary learning systems.

Mapping of the Mission of the School with the PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5
M1	M	L	M	L	H
M2	M	M		H	M
M3		H		L	H
M4	H	M	H	L	H
M5	L	M	M		H

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 **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2 **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3 **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4 **Effective Citizenship:** Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5 **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6 **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7 **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO1 GU Chemistry graduates will be able to understand the basic concepts related with organic chemistry covering various organic reagents and various types of reactions along with their mechanisms. Along with this student will also learn practical aspects of organic chemistry specially elemental analysis and functional groups.

PSO2 GU Chemistry graduates will understand various topics of inorganic chemistry which will be a base to improve their career in inorganic chemistry. Here student will learn various theories of inorganic chemistry and their application to define coordination complexes.

PSO3 GU Chemistry graduates will learn herein physical properties of various compounds through thermodynamics, electrochemical study, colligative properties etc.

PSO4 GU Chemistry graduates will learn herein basic concepts of analytical and green Chemistry.

Curriculum Structure

(Choice Based Credit System)

UNIVERSITY CORE (UC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Soft Skills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Soft Skills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Soft Skills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)	0	0	2	0	0	1
CLAD20XX	2	Soft skills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Soft skills 6A/6B/6C	0	0	2	0	0	1
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*
LANG1001	1	Communication Skills in English - Beginners	0	0	4	0	0	2*
LANG1011	1	Communication Skills in English	0	0	4	0	0	2
LANG1021	1	Advanced Communication Skills in English	0	0	4	0	0	2
MFST1001	1	Health & Wellbeing	0	0	2	0	0	1*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
VEDC1001	1	Venture Development	0	0	0	2	0	2

* Pass/Fail courses

Opt any three courses among the five

^ Online/Swayam/NPTEL Courses

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

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

Club Activity Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1001	1	Club Activity (Participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of the Club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of the Club)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2
Community Service courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1041	1	Community Services - Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services - Mobilizer	0	0	0	0	2	2

FACULTY CORE (FC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH1081	1	Mathematics for Science	3	0	0	0	0	3
PHYS1051	1	Physics I	3	0	0	0	0	3
MATH1111	1	Statistics	3	0	0	0	0	3
PHYS1061	1	Physics I Lab	0	0	2	0	0	1
PHYS1071	1	Physics II	3	0	0	0	0	3
CSCI1011	1	Programming with C	3	0	0	0	0	3
CSCI1021	1	Programming with C Lab	0	0	2	0	0	1
PHYS1081	1	Physics II Lab	0	0	2	0	0	1

PROGRAM CORE(PC)								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
CHEM1061	1	Inorganic Chemistry I	3	0	0	0	0	3
CHEM1071	1	Inorganic Chemistry I Lab	0	0	2	0	0	1
CHEM1081	1	Physical Chemistry I	3	0	0	0	0	3
CHEM1091	1	Physical Chemistry I Lab	0	0	2	0	0	1
CHEM2001	2	Organic Chemistry I	3	0	0	0	0	3
CHEM2011	2	Organic Chemistry I Lab	0	0	2	0	0	1
CHEM2021	2	Inorganic Chemistry II	3	0	0	0	0	3
CHEM2031	2	Inorganic Chemistry II Lab	0	0	2	0	0	1
CHEM2041	2	Physical Chemistry II	3	0	0	0	0	3
CHEM2051	2	Physical Chemistry II Lab	0	0	2	0	0	1
CHEM3001	3	Organic Chemistry II	3	0	0	0	0	3
CHEM3011	3	Organic Chemistry II lab	0	0	2	0	0	1
CHEM3021	3	Analytical Chemistry	3	0	0	0	0	3
CHEM3031	3	Analytical Chemistry lab	0	0	2	0	0	1
CHEM3041	3	Green Chemistry	3	0	0	0	0	3
CHEM3051	3	Green Chemistry Lab	0	0	2	0	0	1

PROGRAM ELECTIVE(PE)								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
CHEM2061	2	Concepts of Medicinal Chemistry	3	0	0	0	0	3
CHEM2071	2	Concepts of Medicinal Chemistry lab	0	0	2	0	0	1
CHEM2081	2	Fundamentals of Instrumental Methods of Analysis	3	0	0	0	0	3
CHEM2091	2	Fundamentals of Instrumental Methods of Analysis Lab	0	0	2	0	0	1
CHEM2101	2	Pharmaceutics 1	3	0	0	0	0	3
CHEM2111	2	Pharmaceutics 1 Lab	0	0	2	0	0	1
CHEM2121	2	Unit Operations in Chemical Engineering	3	0	0	0	0	3
CHEM2131	2	Industrial Chemicals and the Environment	3	0	0	0	0	3
CHEM2141	2	Industrial Safety, Chemical Technology & Society	3	0	0	0	0	3
CHEM2151	2	Concepts of Organometallic Chemistry & Catalysis	3	0	0	0	0	3
CHEM2161	2	Electrochemistry	3	0	0	0	0	3
CHEM2171	2	Regulatory affairs and Quality assurance	3	0	0	0	0	3
CHEM2181	2	Chemical Process Calculations	3	0	0	0	0	3
CHEM3061	3	Nano chemistry	3	0	0	0	0	3
CHEM3071	3	Chemistry of Materials	3	0	0	0	0	3
CHEM3081	3	Bioorganic and bioinorganic chemistry	3	0	0	0	0	3

CHEM3091	3	Pharmaceutics 2	3	0	0	0	0	3

**Students can choose any 5 courses from the program elective and should acquire a minimum of 16 credits.*

** If student opt from CHEM2061, CHEM2081 and XXXXXXXXX must choose corresponding lab course also*

MINOR COURSES								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
CHEM1061	1	Inorganic Chemistry I	3	0	0	0	0	3
CHEM1071	1	Inorganic Chemistry 1 Lab	0	0	1	0	0	1
CHEM1081	1	Physical Chemistry I	3	0	0	0	0	3
CHEM2001	2	Organic Chemistry – I	3	0	0	0	0	3
CHEM2021	2	Inorganic Chemistry-II	3	0	0	0	0	3
CHEM2041	2	Physical Chemistry II	3	0	0	0	0	3
CHEM1091	1	Physical Chemistry 1 Lab	0	0	1	0	0	1
CHEM3001	3	Organic Chemistry – II	3	0	1	0	0	3
CHEM2011	2	Organic Chemistry 1 Lab	0	0	1	0	0	1
CHEM3021	3	Analytical Chemistry	3	0	1	0	0	3

* Eligibility: These minor courses are offered to the students of B.Sc. Physics/Electronics/Mathematics/Statistics

Eligible MINOR courses to be offered to the students of B.Sc. Chemistry Program		
Stream	**Major course**	**Minor course (Select one)**
Chemical Science	Chemistry	Electronics
		Data Science
		Statistics
		Biotechnology
		Microbiology
		Biochemistry
		Mathematics
		Bioinformatics
		Food Science & Technology
		Environmental Science
***Note 1:** Students with a Mathematics background can choose any one of the minor from Electronics /Data Science/Mathematics/ Statistics/Environmental science		
***Note 2:** Students with a Biology background can choose any one of the minor from Biochemistry/Biotechnology/Microbiology/Food Science and Technology/ Bioinformatics /Environmental Science.		

Students pursuing 4th year of the B.Sc. Chemistry programme need to choose either Honours or Honours with Research courses from the following tables respectively.

Honours Courses

Minimum number of credits to be earned is 40, out of which 8 credits must be earned through Minor Enhancement courses.

Minor Enhancement course to be chosen in the specialization the student has studied the Minor.

Course Code	Category	Level	Course Title	L	T	P	S	J	C
CHEM4001	PC	400	Advanced Inorganic Chemistry-1	3	0	2	0	0	4
CHEM4011	PC	400	Advanced Organic Chemistry -1	3	0	2	0	0	4
CHEM4021	PC	400	Advanced Physical Chemistry -1	3	0	2	0	0	4
CHEM4031	PC	400	Advanced Analytical Chemistry -1	3	0	2	0	0	4
Advanced Major (Any One)									
CHEM4041	PC	400	Advanced Inorganic Chemistry-2	3	0	2	0	0	4
CHEM4051	PC	400	Advanced Organic Chemistry-2	3	0	2	0	0	4
CHEM4061	PC	400	Advanced Physical Chemistry-2	3	0	2	0	0	4
CHEM4071	PC	400	Advanced Analytical Chemistry-2	3	0	2	0	0	4
Programme Electives (Any Two)									
CHEM4081	PE	400	Medicinal Chemistry	3	0	2	0	0	4
CHEM4091	PE	400	Unit Operations in Chemical Engineering	3	0	0	0	0	3
CHEM4101	PE	400	Industrial Safety, Chemical Technology and Society	3	1	0	0	0	4
CHEM4111	PE	400	Modelling and Drug Design	3	0	2	0	0	4
CHEM4121	PE	400	Application of Computer in Chemistry	3	0	2	0	0	4
CHEM4131	PE	400	Regulatory affairs and Quality assurance	3	1	0	0	0	4
CHEM4141	PE	400	Industrial Chemicals and the Environment	3	0	2	0	0	4
CHEM4151	PE	400	Nuclear Chemistry	3	0	0	0	0	3
CHEM3231	FC	300	Project Work	0	0	8	0	0	4
			Total						**32**

Honours with Research Courses

Minimum number of credits to be earned is 40 out of which 20 credits must be earned through Research Project / Dissertation and 8 credit must be earned through Minor Enhancement course.

Minor Enhancement course to be chosen in the specialization the student has studied the Minor.

Course Code	Category	Level	Course Title	L	T	P	S	J	C
Advanced Major – 1 (Any One)									
CHEM4001	PC	400	Advanced Inorganic Chemistry-1	3	0	2	0	0	4
CHEM4011	PC	400	Advanced Organic Chemistry -1	3	0	2	0	0	4
CHEM4021	PC	400	Advanced Physical Chemistry -1	3	0	2	0	0	4
CHEM4031	PC	400	Advanced Analytical Chemistry -1	3	0	2	0	0	4
Programme Elective (Any One)									
CHEM4081	PE	400	Medicinal Chemistry	3	0	2	0	0	4
CHEM4091	PE	400	Unit Operations in Chemical Engineering	3	0	0	0	0	3
CHEM4101	PE	400	Industrial Safety, Chemical Technology and Society	3	1	0	0	0	4
CHEM4111	PE	400	Modelling and Drug Design	3	0	2	0	0	4
CHEM4121	PE	400	Application of Computer in Chemistry	3	0	2	0	0	4
CHEM4131	PE	400	Regulatory affairs and Quality assurance	3	1	0	0	0	4
CHEM4141	PE	400	Industrial Chemicals and the Environment	3	0	2	0	0	4
CHEM4151	PE	400	Nuclear Chemistry	3	0	0	0	0	3
DIST4888	FC	400	Dissertation - I / Minor Project	0	0	0	0	16	8
Advanced Major - 2 (Any One)									
CHEM4041	PC	400	Advanced Inorganic Chemistry-2	3	0	2	0	0	4
CHEM4051	PC	400	Advanced Organic Chemistry-2	3	0	2	0	0	4
CHEM4061	PC	400	Advanced Physical Chemistry-2	3	0	2	0	0	4
CHEM4071	PC	400	Advanced Analytical Chemistry-2	3	0	2	0	0	4
DIST4999	FC	400	Dissertation – II	0	0	0	0	24	12
			Total						**32**

Minor Enhancement Courses

Bioinformatics

Course code	Level	Course Title	L	T	P	S	J	C
BCBI4241	400	Statistics for Biology	4	0	0	0	0	4
BCBI4281	400	Omics Technologies	4	0	0	0	0	4

Biotechnology

Course code	Level	Course Title	L	T	P	S	J	C
BTSC4161	400	Genomes and Genomics	4	0	0	0	0	4
BTSC4211	400	Proteins and Proteomics	4	0	0	0	0	4

Chemistry (Opt Any Two Courses)								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
CHEM4001	400	Advanced Inorganic Chemistry-1	3	0	2	0	0	4
CHEM4011	400	Advanced Organic Chemistry -1	3	0	2	0	0	4
CHEM4021	400	Advanced Physical Chemistry -1	3	0	2	0	0	4
CHEM4031	400	Advanced Analytical Chemistry -1	3	0	2	0	0	4
CHEM4041	400	Advanced Inorganic Chemistry-2	3	0	2	0	0	4
CHEM4051	400	Advanced Organic Chemistry-2	3	0	2	0	0	4
CHEM4061	400	Advanced Physical Chemistry-2	3	0	2	0	0	4
CHEM4071	400	Advanced Analytical Chemistry-2	3	0	2	0	0	4
CHEM4081	400	Medicinal Chemistry	3	0	2	0	0	4
CHEM4131	400	Regulatory affairs and Quality assurance	3	1	0	0	0	4

Mathematics								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH4521	400	General Operations Research	4	0	0	0	0	4
MATH4421	400	Optimization Techniques and Decision Modelling	4	0	0	0	0	4

Statistics								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH4431	400	Advanced AI Techniques	4	0	0	0	0	4
MATH4451	400	Visual Analytics and Dashboard Design	4	0	0	0	0	4

Microbiology								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
MFST4441	400	Microbial Products and Applications	4	0	0	0	0	4
MFST4451	400	Air and Waterborne Diseases	4	0	0	0	0	4

Food Science and Technology								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
MFST4381	400	Applied Beverage Technology	4	0	0	0	0	4
MFST4431	400	Bioorganic Cultivation of Food Crops	4	0	0	0	0	4

Allocation of credits for 3-year and 4-year B.Sc. Program						
	3-year B.Sc. Program		4-year B.Sc. Program (Honours)		4-year B.Sc. Program (Honours with Research)	
Type of Course	**Credits**	**% Of Program (in credits)**	**Credits**	**% Of Program (in credits)**	**Credits**	**% Of Program (in credits)**
University Core	12	10%	12	7.50%	12	7.50%
Faculty Core	18	15%	22	13.75%	38	23.75%
Major Core	32	26%	52	32.50%	40	25%
Major Electives	16	14%	24	15%	20	12.50%
Program Minor	24	20%	32	20%	32	20%
Open elective	18	15%	18	11.25%	18	11.25%
Total	**120**	**100%**	**160**	**100%**	**160**	**100%**

Course PO Mapping

Course Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
MATH1081	Mathematics for Science	2	1	1	1	1	1	1	1	1	1	1
PHYS1051	Physics I	2	2	2	2	2	2	2	2	1	1	1
MATH1111	Statistics	3	2	2	2	1	2	3	1	1	1	1
PHYS1061	Physics I Lab	2	1	1	1	1	1	1	2	1	1	1
PHYS1071	Physics II	1	2	2	2	2	2	2	2	1	1	1
CSCI1011	Programming with C	3				3		3				
CSCI1021	Programming with C Lab	3				3		3				
PHYS1081	Physics II Lab	2	1	1	1	1	1	1	2	1	1	1
CHEM1061	Inorganic Chemistry I	3	2	1	1	2	1	3	2	3	2	1
CHEM1071	Inorganic Chemistry I Lab	3	1	1	1	1	1	3	1	3	2	1
CHEM1081	Physical Chemistry I	3	2	2	3	1	2	3	2	3	2	1
CHEM1091	Physical Chemistry I Lab	2	1	3	2	2	2	3	2	3	2	1
CHEM2001	Organic Chemistry I	3	1		3		3		3			1
CHEM2011	Organic Chemistry I Lab	3	3	3	2				3	2		1
CHEM2021	Inorganic Chemistry II	3	2				2	2		3	2	
CHEM2031	Inorganic Chemistry II Lab		3				3	1		3	2	
CHEM2041	Physical Chemistry II	3	1	1	1	2	1	2			3	
CHEM2051	Physical Chemistry II Lab	3	1	1	1	2	1	2			3	1
CHEM3001	Organic Chemistry II	3	3	2	2	2	2	3	3			
CHEM3011	Organic Chemistry II lab	3	3	3	3	3	3	3	3			1
CHEM3021	Analytical Chemistry	3				2		1			1	3
CHEM3031	Analytical Chemistry lab	2			3	1	3				1	3
CHEM3041	Green Chemistry	1					3		3	1		3
CHEM3051	Green Chemistry Lab	2			3							3

CHEM2061	Concepts of Medicinal Chemistry	3	1	1	1	2	1	1	3	1	1	2
CHEM2071	Concepts of Medicinal Chemistry lab	3	1	1	1	2	1	1	3	1	1	2
CHEM2081	Fundamentals of Instrumental Methods of Analysis	3				2		1			1	3
CHEM2091	Fundamentals of Instrumental Methods of Analysis Lab	3				3		2			1	3
CHEM2101	Pharmaceutics 1	3	2	1		1	3					1
CHEM2111	Pharmaceutics 1 Lab	2	1	1		1	2					1
CHEM2121	Unit Operations in Chemical Engineering	3				3						2
CHEM2131	Industrial Chemicals and the Environment				2	2	3					1
CHEM2141	Industrial Safety, Chemical Technology & Society				1		3					1
CHEM2151	Concepts of Organometallic Chemistry & Catalysis	3	1	2	2	3	3	3	3	3	1	2
CHEM2161	Electrochemistry	2	3	2	1	3	2	3		2	3	2
CHEM2171	Regulatory affairs and Quality assurance	2	2	2	2	2	1	1	1	1	2	2
CHEM2181	Chemical Process Calculations	3	1	2	2	2	3	3	2	2	3	1
CHEM3061	Nano chemistry	3	1	2	1	2	3	3	3	2	1	3
CHEM3071	Chemistry of Materials	3	2	1	1	2	2	3	2	2	1	2
CHEM3081	Bioorganic and bioinorganic chemistry	3	1	1	2	3	2	3	3	3	1	2
CHEM3091	Pharmaceutics 2	3	2	1		1	3					2

SYLLABUS

UNIVERSITY CORE

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

Course Description:

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

Course Educational Objectives:

- to impart the skill in preparing technical documents of professional quality using docs, sheets and forms
- to involve the student in preparation of websites, analyzing data and acquaint the student with the skill of processing audio, images, documents etc.

10 hours

List of Experiments:

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

Text Books:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More

3. https://drawio-app.com/tutorials/video-tutorials/
   Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics Fourth Edition ISBN-13: 978-1449319274

References

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

Course Outcomes:

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

Co-Po Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1					2				1	1	
CO2					2				1	1	
CO3	2	1	1		2				1	1	
CO4					2				1	1	
CO5					2				3	3	

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

APPROVED IN:
BOS :06-09-2021 **ACADEMIC COUNCIL:17-09-201**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

CLAD1001	EMOTIONAL INTELLIGENCE & REASONING SKILLS (SOFT SKILLS 1)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1		3	3				3				
CO2		3	3				3				
CO3		3	3				3				
CO4	3						3				
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

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

References:

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

Course Outcomes:

1. Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
2. Students will be able to apply the rational model of problem solving and decision makingin their problem solving and decision-making efforts.
3. Students will be able to solve questions based on numbers and arithmetic given in various competitive examinations
4. Students will be able to solve questions based on data interpretation, progressions, and series.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1		3	3				3				
CO2		3	3				3				
CO3	3						2				
CO4	3						2				
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
SDG Justification:
Leadership and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1		2					2				
CO2		2					2				
CO3	3						2				
CO4	3						2				
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1							3				
CO2							3				
CO3	3						3				
CO4	3						3				
CO5											

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

APPROVED IN:

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

SDG No. & Statement:4

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

SDG Justification:

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1		1					3				
CO2		3					3				
CO3	3						3				
CO4	3						3				
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3			2			3				
CO2	3			2			3				
CO3											
CO4											
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

CLAD2021	PREPARATION FOR CAT/ MAT – 1 (SOFT SKILLS 5C)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3			2			3				
CO2	3			2			3				
CO3											
CO4											
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1		3	3				3				
CO2							3				
CO3							3				
CO4											
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2						3				
CO2	2						3				
CO3											
CO4											
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities & Tasks for Assessment:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2			2			3				
CO2	2			2			3				
CO3											
CO4											
CO5											

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

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

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

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

Course Description:

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

Course Educational Objectives:

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

List of Student Club Activities:

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

List of Activities:

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

Textbooks:

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

References:

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

Course Outcomes:

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

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2		2				
CO2	3		3		2		2				
CO3		3	2		3	2					
CO4		3	3		2		3				
CO5	3		3		2		3				

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

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

SDG No. & Statement:
SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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

DOSL1011	CLUB ACTIVITY – MEMBER OF THE CLUB	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

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

Course Educational Objectives:

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

List of Student Club Activities:

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

List of Activities:

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

Textbooks:

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

References:

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

Course Outcomes:

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

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2		2				
CO2	3		3		2		2				
CO3		3	2		3	2					
CO4		3	3		2		3				
CO5	3		3		2		3				

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

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

SDG No. & Statement:
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

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

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

Course Description:

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

Course Educational Objectives:

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

List of Student Club Activities:

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

List of Activities:

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

Textbooks:

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

References:

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

Course Outcomes:

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

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2		2				
CO2	3		3		2		2				
CO3		3	2		3	2					
CO4		3	3		2		3				
CO5	3		3		2		3				

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

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

SDG No. & Statement:
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

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

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

Course Description:

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

Course Educational Objectives:

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

List of Student Club Activities:

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

List of Activities:

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

Textbooks:

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

References:

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

Course Outcomes:

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

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2		2				
CO2	3		3		2		2				
CO3		3	2		3	2					
CO4		3	3		2		3				
CO5	3		3		2		3				

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

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

SDG No. & Statement:
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

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

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

Course Description:

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

Course Educational Objectives:

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

List of Community Service Activities:

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

List of Activities:

1. Participation in various community service activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Textbooks:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3					2				
CO2		3	3				2				
CO3				3	3	2	2				
CO4		3	3								
CO5	3		3				3				

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

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

SDG No. & Statement:
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

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

DOSL1051	COMMUNITY SERVICES - MOBILIZER	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

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

Course Educational Objectives:

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

List of Community Service Activities:

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

List of Activities:

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper
3. Portfolio (on social media using an 44nstagram account)
4. Two learning papers (one per semester)

Textbooks:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3					2				
CO2		3	3				2				
CO3				3	3	2	2				
CO4		3	3								
CO5	3		3				3				

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

APPROVED IN:

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

SDG No. & Statement:

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

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

SDG Justification:

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. Handbook of the Badminton World Federation (BWF)

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. International Chess Federation (FIDE) Handbook

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. Indian Carrom Federation Handbook - Laws

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. FIFA Laws of the Game

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. FIVB - Official Volleyball Rules

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4

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

SDG Justification:

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

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. Khelo India Official Rulebook of Kho Kho

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1081	HANDBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. FIBA Basketball Official Rules

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. Handbook of the International Tennis Federation (ITF)

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3							2				
CO4		3	3		2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

List of Activities:

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

Instructional Plan:

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

References:

1. World Throwball Federation - Rules of the Game

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				3				
CO2							2				
CO3		3	3				2				
CO4					2		2				
CO5				3	2		3				

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

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

SDG No. & Statement:4
Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.
SDG Justification:
The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

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

Course Description:

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

Course Educational Objectives:

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

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

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

Activity:

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

UNIT 2 Ecosystem and biodiversity 10 hours

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

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

Activity:

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

UNIT 3 Environmental Pollution 10 hours

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

Activity:

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

UNIT 4 Social Issues and the Environment 10 hours

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

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

Activity:

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

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

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

Activity:

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

Text Book(s):

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

Additional Reading:

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

Reference Book(s):

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

Journal(s):

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

Website(s):

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

Course Outcomes:

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).
4. Function of green building concept.
5. Adapt value education

CO-PO Mapping:

	PO2	PO1	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2							2		
CO2		2				1		2		
CO3			1						1	
CO4				2						1
CO5	1								1	
CO6					2					1

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

APPROVED IN: BOS

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

SDG No. & Statement:

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

SDG Justification:

1. The learner will understand the importance of clean water and sanitation through this course and apply in their daily activities – SDG-6
2. The learner will make use of renewable resources to reduce pollution achieves SDG-7
3. The learner will understand present situation in climate change and takes appropriate steps to combat climate change – SDG-13
4. The learner will understand the existence of life below water – SDG-14
5. The learner will understand to promote sustainable terrestrial ecosystem – SDG15

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

Course Description:

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

Course Educational Objectives:

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

UNIT 1 Basics of Financial Planning

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

UNIT 2

Risk and Insurance Management

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

UNIT 3

Investment Products and Measuring Investment Returns

Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate Investments, Direct Equity

Measuring Investment Returns: Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

UNIT 4 Retirement Planning

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

UNIT 5 Tax Planning

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

Textbooks:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	1	0	0	1	0	0	3	1	1	3
CO2	2	2	0	0	1	1	1	3	1	1	2
CO3	3	2	1	0	1	0	0	3	2	2	3
CO4	3	2	0	1	1	0	1	2	2	3	2
CO5	3	3	0	1	1	1	2	1	2	2	3

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

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

SDG No. & Statement:

SDG Justification:

LANG1001	COMMUNICATION SKILLS IN ENGLISH - BEGINNERS	L	T	P	S	J	C
		0	0	4	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Communication Skills in English (Beginner) is the first of the three-level courses for a developmental enhancement of learners' communication skills in English. This course focuses on giving learners exposure to factual level of comprehension (listening and reading) and application of the learning (Speaking/Writing) with an awareness for social and personality-based variationsin communication. In addition to the LSRW skills, the focus of the course is on schematic thinking skills. This course is activity-based and practice-oriented in terms of procedural knowledge of vocabulary and grammatical structure. This syllabus is carefully developed to enable learners to engage in communication in English avoiding errors and be prepared for next level of learning English.

Course Educational Objectives:

- Train learners to listen actively, follow what is spoken in standard English, and answer questions to demonstrate their understanding of the main points of the speech, repeat part of what someone has said to confirm mutual understanding, though occasionally, there may be a need to ask for repetition or clarification. (Bloom's Taxonomy Level/s: 2 & 3)
- Equip learners with the skills to read and comprehend straightforward texts and simple argumentative writing to identify the topic, the desired/relevant information, the main points of the argument, and the major conclusion/s. (Bloom's Taxonomy Level/s: 2 & 4)
- Help learners apply their knowledge and language skills to make mini oral presentations and produce short coherent written texts using appropriate cohesive devices, suitable vocabulary, and grammatical structures. (Bloom's Taxonomy Level/s:3)
- Enable learners to communicate with reasonable accuracy in familiar contexts with adequate fluency and generally good control by equipping them with a repertoire of frequently used vocabulary, structures, and speech patterns. (Bloom's Taxonomy Level/s: 2 & 3)

List of Activities & Tasks for Assessment:

1. Listening to others and getting to know their experiences, interests and opinions
2. Introducing oneself: Salutation, basic information, relating to the context
3. Starting a conversation: Salutation, expressing purpose, expressing gratitude
4. Sharing one's experiences, interests and opinions
5. Reading short newspaper articles for gist
6. Picking new words from an article and working on them to know the meaning and usage
7. Using the new (unknown) words in own sentences
8. Sharing news with others - initiate, sustain and conclude
9. Understanding the relevance of intonation to meaning from recorded conversations, and applying the learning in pair work (role play)
10. Writing a summary of a story/personal narrative after listening to it twice and making individual notes
11. Reading graphs, charts and maps for specific information, making note of the important information and talking briefly about it within a small peer group
12. Writing a paragraph about oneself: a brief profile including major successes, failures, and goals. Giving compliments/gratitude to others
13. Writing a paragraph (descriptive, complimentary) about others (Family, friends, role model, etc.)
14. Correcting each other's' drafts: errors in language - word choice, structure, and conventions/etiquette
15. Writing a short structured descriptive/narrative essay in 3 paragraphs, reading others' essays, and sharing feedback

References:

1. V. Sasikumar, P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Listening and Speaking - Foundation Books Cunninhum, S. & Moor, P. (nd). New Cutting Hedge (Intermediate). Longman
2. Cambrdige Academic English: An Integrated Skills Course for EAP (Intermediate) By Craig Thaine, CUP (2012)
3. Rutherford, Andrea J. (2007). Basic Communication Skills for Technology: Second Edition. Delhi: Pearson Education.
4. McCarthy, M., O'Dell, F., Mark, G. (2005). English Vocabulary in Use. Spain: Cambridge University Press.
5. New Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-1 by Sarah Philpot. OUP

6. Philpot, S. & Curnick, L. (2017). Headway: Academic Skills: Reaing, Writing, and Study Skills. Introductory Level. OUP.
7. Thaine, C. (2012). Cambridge Academic English: An Integrated Skills for EAP. Intermediate. CUP.

Online References:

- www.teachingenglish.org.uk
- learnenglishteens.britishcouncil.org
- https://eslflow.com/
- https://www.englishclub.com/
- https://www.oxfordlearnersdictionaries.com/
- https://dictionary.cambridge.org/
- learnenglishteens.britishcouncil.org
- https://freerice.com/categories/english-vocabulary

Course Outcomes:

1. Listen actively, understand and extract the essential information from short talks/conversations/discussions that are delivered in clear, standard speech. (Bloom's Taxonomy Level/s: 2 & 3)
2. Read, understand, and extract specific information from straightforward factual and simple argumentative texts on general topics and subjects of interest. (Bloom's Taxonomy Level/s: 2 & 3)
3. Speak clearly with some confidence on matters related to his/her interests and academic work and make short structured oral presentations on topics of personal interest. (Bloom's Taxonomy Level/s: 3)
4. Write short straightforward connected texts on a range of familiar/general topics using appropriate linking devices to achieve a clear sequence of ideas. (Bloom's Taxonomy Level/s: 3)
5. Acquire sufficient language competency to express oneself in speech and writing with some confidence, using appropriate vocabulary and simple grammatical structures though lexical limitations and/or difficulty with formulation might be evident at times. (Bloom's Taxonomy Level/s: 2 & 4)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	0	2	2	3	0	0	0				
CO2	0	2	2	3	0	0	0				
CO3	0	0	0	3	0	0	0				
CO4	0	0	0	3	0	0	0				
CO5	0	4	2	0	2	2	4				

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

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG No. 4: Statement: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The course aims to remove inequalities among admitted students with regard to basic communication skills in English and provide them communication as well as learning skills that are useful throughout their lives.

LANG1011	COMMUNICATION SKILLS IN ENGLISH	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

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

Course Educational Objectives:

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

(Bloom's Taxonomy Level/s: 2 & 3)

List of Tasks and Activities:

S.No.	Tasks	Activities
1	Listening to subject related short discussions/explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection / Presentation
2	Asking for information: asking questions related to the content, context maintaining modalities	Group role-play in a con text (i.e. Identifying the situation and different roles and enacting theirroles)
3	Information transfer: Verbal to visual (familiar context), demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pair work for discussion & feedback, Presentations, question-answer
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in small groups, individual writing, and feedback
5	Introducing officials to peers and vice versa -Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
6	Introducing friends to family and vice versa -Informal context	Teacher modelling/AV support, noticing structure & note-taking, Introducing friends andfamily in an informal context
7	Vocabulary in context: Find clues in a text and use them to guess the meaning of words/ phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts and listening to discussions/talks
8	A five-day journal (diary) writing based on learners reading from newspaper on a single relevant/ current social issue. Individual oral presentation and feedback from peers andinstructor.	Note-making (group work), Discussion, Feedback
9	Follow the essentials of lectures, talks, discussions, reports and other	Making power point presentation aided with images, audio, video, etc. with a

	forms of academicpresentations and mak2 individual and group presentations aided with images, audio, video, tabular data, etc.	small group by listening to academic lectures/talks/ discussions,etc.
10	Self-reflection: Re-reading one's own drafts, identifying errors, correcting the errors, and givingrationalize the changes	Pre-task discussion/modelling, Editing the texts by careful reading and identifying the errors, peer-exchange (Pair work),feedback/consolidation
11	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/ discipline-specific topic: creating outline, assigning specific roles to members of the group; and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
12	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual), oral questioning, discussion
13	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context, coordinating with situational clues and fellowspeakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
14	Writing instructions: Guidelines - Flowcharts - Procedures to be followed	Pre-task reading, pair work, teacher/peer-discussion, feedback
15	Speaking spontaneously on topics of interest and writing short structured essays on the same topics adopting appropriate academic conventions andgrammatical accuracy.	Reading for task preparation, note-making, speaking, reflection and corrective peer and teacher feedback

Reference Books:

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. FoundationBooks. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.

4. Cambridge IGCSE: English as a Second Language Teacher's Book Fourth Edition.By Peter Lucantoni. CUP (2014).
5. Cambrdige Academic English: An Integrated Skills Course for EAP (Upper Intermediate) By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 bySarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxfor: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

Online Resources:

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

Course Outcomes:

1. Understand the speaker's point of view in fairly extended talks on general or discipline-specifictopics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)
2. "Read and demonstrate understanding of articles and reports on limited range of contemporary issues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"
3. Make short presentations on a limited range of general topics using slides, and engage in smallgroup discussions sharing experiences/views on familiar contemporary issues and give reasonsfor choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)
4. Write clear, fairly detailed text (a short essay) on a limited range of general topics, and subjectsof interest, and communicate clearly through email/letter to seek/pass on information or give reasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)
5. Reflect on others' performance, give peer feedback on fellow learners' presentations, responsesto writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	0	3	0	3	0	3	0				
CO2	0	2	0	3	2	2	0				
CO3	4	3	3	3	3	3	4				
CO4	0	3	3	3	3	3	0				
CO5	5	0	5	0	0	0	0				

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

APPROVED IN:
BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG No. 4: Statement: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
The course aims to remove inequalities among admitted students with regard to basic communication skills in English and provide them communication as well as learning skills that are useful throughout their lives.

LANG1021	ADVANCED COMMUNICATION SKILLS IN ENGLISH	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

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

Course Educational Objectives:

- Enable learners to listen actively become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of tone and attitude in written texts, and demonstrate theircomprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skillsand strategies. (Bloom's Taxonomy Level/s:2 & 3)
- Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument. (Bloom's Taxonomy Level/s:3 & 4)
- Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their communication skills in real life situations. (Bloom's Taxonomy Level/s:3 & 5)

List of Activities & Tasks for Assessment:

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a longtext/short texts on a current topic related to technology and society, identifying and questioning the author's intention, post- reading discussion in small groups, maintaining group dynamics, arriving at a consensus	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflection and brief presentation of thoughts/ideas/opinions on the themeof the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well- known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening, student checklist for noticing key words/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Verbal to visual (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer (among students), modification and feedback before the final version is done	Pair work for discussion and feedback, presentations, question-answer	2
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification, editing, proofreading, and feedback before the final version is done	Pre-reading game/ modelling, discussion in small groups, independent writing and feedback	4
5	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions of formal and polite speech, and managing bias	Listening to group discussions/ debates, reading news-paper articles on the current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentativeessays).	3
6	Role-play (complex social and academic/professional situations): Focus on significant aspects of delivery including clarity, tone, and use of contextually appropriate	Reading newspaper/ magazine articles/ blog posts on current social issues, listening to talks/ discussions/ debates etc. and participating in role-plays using	1

	vocabulary and conventions, observation, reflective discussion, and self-reflective writing	expressions appropriate to the context.	
7	Collaborative writing in groups of 3 - 4 on topics that would require data collection and reading followed by recorded peer-reflection and peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work (collaboration), presnetation, peer feedback, Open-class discussion	5
8	Formal Group Discussion on topics of currentinterest and relevance; focus on effective participation, reflection on control over argument/ counter argument, and adherence to the conventions of formal GD	Noticing strategies from AV modelling, teacher scafolding though open-house discussion, Note-making (Group work), Group Discussion (free), post perfromance discussion, Feedback	2
9	Mind-mapping for advanced reading, making correlations across texts, extending author's point of view	Reading texts on abstract topics and comprehending the author's perspective by inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
10	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disgreeing with rationale	Listening to some lectures, talks, and presentations in the academic seminars and adapting some strategies to handle the Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
11	Modelling an interview: with a panel of fourjudges (peers)	Pre-task activity for orientation/ strategies (controlled/guided), Model interview (AV support), Group work (role play), interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/ teacher)	2
12	Writing a short reflective report of an event - incident/ meeting/ celebration	Writing a report on meetings/ celebrations/ events etc. by actively involving in such events and giving a short oral presentation on the same.	4
13	Speaking on abstract and complex topics beyond his/her own area of interest/field of study, using the language flexibly and effectively.	Reading texts on abstract topics and comprehending the author's perspectives. Similarly, listening to talks and discussions on an abstract	3

		topic of other discipline and making short oral presentation by sharing views and opinions.	
14	Self-relfection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas toothers	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some general topic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance of the content, etc.	1
15	Collaborative and individual task: planning, preparing (preparing an outline, structure, setting objectives and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), oral corrective, task distribution, presentation, feedback	5

Reference Books:

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

Online Resources:

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

Course Outcomes:

1. Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
2. Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widelyaccepted conventions. (Bloom's Taxonomy Level/s: 3)
3. Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
4. Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)
5. Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	0	2	2	0	2	2	0				
CO2	3	3	0	3	0	0	3				
CO3	2	4	0	4	2	2	0				
CO4	3	4	0	4	0	0	3				
CO5	0	4	0	4	0	0	0				

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

APPROVED IN:
BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG No. 4: Statement: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
The course aims to remove inequalities among admitted students with regard to basic communication skills in English and provide them communication as well as learning skills that are useful throughout their lives.

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

Course Description:

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how 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

UNIT 1

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

UNIT 2

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

UNIT 3

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

UNIT 4

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

Course Outcomes:

By the end of the course, student will

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

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

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

Course Description:

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

Course Educational Objectives:

The objectives of the course are;

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

UNIT 1 MK Gandhi: Childhood and Education

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

UNIT 2 From Mohan to Mahatma-South African Experiences

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

UNIT 3 Gandhi and Indian National Movement

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

UNIT 4 Gandhi and Sustainable Development

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

UNIT 5 Gandhi and Contemporary Issues

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

References:

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

Course Outcomes:

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

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	2	3	2	3	3	3	3	2	3
CO3	3	3	3	2	3	2	2	3	3	2	2
CO4	3	2	2	3	3	2	2	3	3	2	3
CO5	3	3	2	2	3	3	3	3	3	3	2

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

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

POLS1001	INDIAN CONSTITUTION AND HISTORY	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

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

Course Educational Objectives:

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

UNIT 1 **India as a Nation** **6 hours**

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

pp. 1-15.

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

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

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

UNIT 2 **Understanding the Constitution** **6 hours**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

UNIT 5 Separation and Distribution of Powers 6 hours

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

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

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

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

Economic and Political Weekly, Vol 51, Issue 15

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

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

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

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

Recommended Readings:

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

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

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

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

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

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

Course Outcomes:

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

1. Demonstrate an understanding of the Constitution of India and how constitutional governance is carried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as the Obligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the Constitution and amended it from time to time.
4. Equip themselves to take up other courses in law after having done a foundation course on Indian Constitution

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	2	3	3	2	3	1	2
CO2	1	1	2	1	2	2	3	2	3	1	2
CO3	1	2	1	2	2	2	3	1	3	1	1
CO4	1	1	1	2	2	2	3	1	3	1	1
CO5	1	1	1	2	2	2	3	2	3	1	2

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

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

VEDC1001	VENTURE DEVELOPMENT	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

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

Course Educational Objectives:

Students have the opportunity to:

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

UNIT 1	PERSONAL DISCOVERY	4 hours

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

UNIT 2	IDEATION	10 hours

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

UNIT 3	SOLUTION DISCOVERY	8 hours

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

UNIT 4	BUSINESS MODEL DISCOVERY	4 hours

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

UNIT 5	DISCOVERY INTEGRATION	4 hours

Define Company Impact, Create Value, Tell Your Story

Textbooks:

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

References:

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

Course Outcomes:

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1						3	1				
CO2		3		3	1	3	2				
CO3	1	3	3		3		3				
CO4					1	1	3				
CO5					3	3					

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

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

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

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

SDG Justification:

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

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

Faculty Core

MATH1081	MATHEMATICS FOR SCIENCE	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Engineering and Science"						

Course Description:

This course is introduced to learn fundamental topics in mathematics for chemistry students in the undergraduate level such as trigonometry, limits, continuity, differentiation, and integration.

Course Educational Objectives:

- To understand trigonometry and their uses in real life problems
- To learn the basic concept and applications of limits
- To identify and estimate the continuity of the function and type of discontinuity
- Ability to differentiate all the functions such as polynomials, trigonometric and logarithmic etc.
- Ability to integrate different types of functions definitely and indefinitely.

UNIT 1 **Trigonometry** **8 hours**

Measurement of angles, Trigonometric ratios of any angle, signs of the trigonometric ratios of allied angles, trigonometric identities, and trigonometric ratios of compound angles

UNIT 2 **Trigonometry** **8 hours**

Trigonometric ratios of multiple and sub multiple angles, transformations, Inverse trigonometric functions, Hyperbolic functions.

UNIT 3 **Limits** **8 hours**

Real numbers, Intervals, Functions, Limit, and One-sided limits, Infinite limits, standard limits, indeterminate forms, problems on limits
Continuity- definition and simple illustrations.

UNIT 4 **Differentiation** **8 hours**

Derivative of a function, Derivative from first principles, Product and Quotient rule for derivatives, Derivatives of some standard functions, Derivatives of trigonometric functions, composite functions, hyperbolic functions Derivatives of inverse trigonometric functions, inverse hyperbolic functions, Implicit differentiation, Logarithmic differentiation, derivatives by trigonometric substitution.

UNIT 5 **Indefinite integration and Definite integration** **8 hours**

Indefinite integration: Indefinite integral, methods of integration, integration by substitution, integration of some standard functions, integration by parts, integration of rational functions

Definite integration: Definite integrals, Properties of definite integrals.

Textbooks:

1. A textbook of Intermediate Mathematics: Vol I, V. Venkateswara Rao, N. Krishna Murty, B.V.S.S. Sarma, S.Chand& Co

References:

2. A textbook of Intermediate Mathematics: Vol II, V. Venkateswara Rao, N. Krishna Murty, B.V.S.S. Sarma, S.Chand& Co

Course Outcomes:

On successful completion of this course, students will be able to:

- solve trigonometry problems
- learn the uses of trigonometry in real life problems
- understand the basic concepts and applications of limits , continuity and discontinuity
- differentiate all the functions such as polynomials, trigonometric and logarithmic etc.
- integrate different types of functions definitely and indefinitely.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	-	1	1	1	1	1	-	-
CO2	2	1	-	-	1	1	1	1	1	-	-
CO3	2	1	-	-	1	1	1	1	1	-	-
CO4	2	1	-	-	1	1	1	1	1	-	-
CO5	2	1	-	-	1	1	1	1	1	-	-

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

APPROVED IN:

BOS : 13-09-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHYS1051	PHYSICS I	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Understanding elementary concepts of physics with measurement"						

Course Description:

This course is introduced to learn fundamental topics in physics for chemistry students in the undergraduate level such as measurement, mechanics, wave nature and laser.

Course Educational Objectives:

1. The student will understand the use of measuring devices.
2. The student will be able to understand central forces.
3. Understand optical fiber principle.
4. Understand concepts of optics.
5. Understand the principles of laser.

UNIT 1	Measurements	8 hours
Physical quantities-standards and units-International systems of units-the standard of time-the standard length-the standard mass precession and significant figures. Dimensional Homogeneity and Consistency-Dimensional analysis-Dimensionless groups and their use in chemical engineering-National Standards of Weights-Measurements & their calibration.		
UNIT 2	**Mechanics**	**8 hours**
Forces and Resolution of Forces-Composition of Coplanar Forces-friction-Centre of Gravity-Simple Lifting Machine-Work and Kinetic Energy Theorem-Conservative and non-conservative forces- Potential Energy-Energy diagram Stable and unstable equilibrium-Work & Potential energy-Work done by non-conservative forces-Law of conservation of Energy.		
UNIT 3	**Wave nature of light and Optical fibers**	**8 hours**
Introduction-Nature of light-Reflection and refraction-Total internal reflection- Definition and properties of wave front and ray - Huygens principle- Mathematical representation of plane wave-General wave equation-Optical Fibers-Numerical aperture- Acceptance angle-Step and Graded Indices (Concept and definitions only). Single and Multiple mode fibers (Concept and definition Only)-Applications of optical fibers		

UNIT 4	**Waves-Interference and Diffraction**	**8 hours**
Division of amplitude and wave front-Young's double slit experiment-Phase change on reflection- Stokes' treatment-Interference in Thin films-parallel and wedge-shaped films-Fringes of equal inclination (Haidinger fringes). Newton's Rings: Measurement of wavelength and refractive index. Diffraction-types of diffraction-Diffraction grating and resolving power.		
UNIT 5	**LASER**	**8 hours**
Introduction-Absorption-Spontaneous and stimulated emissions-Meta stable state-population inversion-Lasing action-components of laser-Types of laser -Ruby laser -He-Ne laser - Semi conductor laser -Characteristics and applications of laser.		

Textbooks:

1. Physics-D.Resnick and R.Halliday, Wiley Publishers
2. Text book of Engineering Physics-Dr. M N Avadhanulu&Dr.P G Kshirsagar, S Chand & Co Pvt Ltd, New Delhi

References:

3. Optics-Brijlal Subrahmanyam, S Chand Co
4. Engineering Physics-R.K.Gaur and S.L.Gupta, Dhanpat Rai & Sons, Delhi

Course Outcomes:

On successful completion of this course, students will be able to:

1. Use measuring devices in determining the physical properties of objects.
2. Understand the features of non-inertial systems and fictitious forces.
3. Understand working of optical fiber and their applications in communication
4. Understand how several waves or parts of waves interact, and be able to calculate and analyze diffraction and interference phenomena,
5. This course the students would gain the knowledge basic principles, would study the various types of lasers.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1						1				
CO2	1						1				
CO3	1						1				
CO4	1						1				
CO5	1						1				

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

MATH1111	STATISTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Engineering and Science"						

Course Description:

This course is an introductory to statistics for undergraduate students in sciences. Statistical methods are important tools which provide the student with both descriptive and analytical methods for dealing with the variability in observed data. It introduces students to cognitive learning in statistics; and develops skills on analyzing the data by using different tests and designing the experiments with several factors.

Course Educational Objectives:

- To summarize the data and to obtain its salient features from the vast mass of original data.
- To describe the basic concepts in Different types of means in statistical analysis.
- To explain the concept of variability in data.
- To describe the basic measures of statistics including measures of location, dispersion, and linear regression.
- To understand the concepts of Large Samples and Small Samples.

UNIT 1 Statistical Methods 8 hours

Definition and scope of Statistics, concepts of statistical population and sample. **Data:** quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives.

UNIT 2 Measures of Central Tendency 8 hours

Arithmetic mean, Median, Mode, Geometric Mean, Harmonic mean.

UNIT 3 **Measures of Dispersion** **8 hours**

range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections

UNIT 4 **Bivariate Data Analysis** **8 hours**

Definition, scatter diagram, simple, correlation, rank correlation. Simple linear regression.

UNIT 5 **Testing of Hypothesis** **8 hours**

Formulation and procedure testing of hypothesis
Test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems. Student t-distribution (test for single mean, two means), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Textbooks:

1. Feller, W. (2014): An Introduction to Probability theory and application, Wiley.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edition. The World Press, Kolkata.
3. Gupta, S.C. and Kapoor, V.K. (2007): Fundamental of Mathematical Statistics, 11th Edition. (Reprint), Sultan Chand & Sons.

References:

1. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edition.), Pearson Education, Asia.
2. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edition., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New D.
4. S. Ross, A First Course in Probability, Pearson Education India, 2002.

Course Outcomes:

On successful completion of this course, students will be able to:

1. explain uses of control charts
2. interpret control charts and control limits
3. construct X-bar and R charts for variables
4. explain sampling plans
5. understand Chi square test for goodness of fit, Kolmogorov and Smirnov test and Kendall's and Spearman's test

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	3	1	1	1	1
CO2	3	2	1	2	3	2	3	1	1	1	1
CO3	3	2	1	2	2	1	3	1	2	1	1
CO4	3	2	1	2	2	2	3	1	2	1	1
CO5	3	2	1	2	3	2	3	1	1	2	2

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

APPROVED IN:

BOS : 30-09-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHYS1061	PHYSICS I LAB	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Able to determine and measure physical quantities with accuracy"						

Course Description: This lab focuses on experiments related to the measurements, oscillations, optics and laser phenomena.

Course Educational Objectives:

- To make the students understand the use of measuring devices, develop intuition about waves for various light phenomena and to know the lasing action.

List of experiments:

1. Determination of thickness of wire by using Screw guage
2. Determination of volume of the cylinder or sphere by using Vernier calipers
3. Radius of curvature of curved surface using Spherometer
4. Determination of time period of Simple pendulum
5. Determination of Numerical aperture/Loss of Optical fiber
6. Determination of wavelength of LASER using grating
7. Determination of wavelength of monochromatic light with Newton's rings
8. Diffraction due to single slit/circular aperture
9. Study of characteristics of LASER

Course Outcomes:

1. Enable to determine thickness of objects using screw gauge, Vernier calipers
2. Understand use of Pendulums
3. Compare the process in LASERS.
4. Able to understand the total internal reflection in optical fibers
5. In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1						1				
CO2	1						1				
CO3	1						1				
CO4	1						1				
CO5	1						1				

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

PHYS1071	PHYSICS II	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Understand and analyzing the various types of soilds its theories, types of radiation and theories"						

Course Description:

To Study the general properties of solids and nucleus

Course Educational Objectives:

Understanding and examine the solids with properties of crystals, electron theory and different magnetic materials. Interpret the general properties of nuclei and its radioactive properties.

UNIT 1 Crystal Structure 8 hours

Amorphous and Crystalline Materials, Unit Cell, Miller Indices, Reciprocal Lattice, Types of Lattices, Diffraction of X-rays by Crystals, Bragg's Law, Experimental techniques, Laue's method, and powder diffraction method.

UNIT 2 Introduction to Free electron and band theory 8 hours

Free electron theory and its demerits**,** Bloch theorem and Kronig Penny model, Energy Bands in solids, Energy gaps, Conductors, Semiconductors and insulators, P and N type Semiconductors, P-N Junction diode, Half wave and Full wave rectifiers (qualitative).

UNIT 3 Magnetic Materials& Superconductivity 8 hours

Dia, Para, Ferromagnetic Materials, Classical Langevin Theory of Paramagnetism, Curie-Weiss's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains- Basic concepts of superconductivity Experimental Results, Critical Temperature, Critical magnetic field-Meissner effect. Type I and type II Superconductors- applications of super conductors

UNIT 4 **General Properties of Nuclei** **8 hours**

Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments, semi-empirical mass formula. Liquid drop model-Shell model- Collective model (qualitative), Magic numbers.

UNIT 5 **Radioactivity decay** **8 hours**

Alpha decay: basics of α-decay processes, Gamow's theory of α-decay, Geiger Nuttal law, β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. Detectors of nuclear Radiation -Ionization chamber, Proportional counter, GM Counter, scintillation counter.

Textbooks:

1. Elements of Solid State Physics,J.P.Srivastava, Prentice Hall of India Pvt., Ltd.
2. Unified Physics, Vol.4.,S.L.Gupta & Sanjeev Gupta, Jai Prakash Nath & Co. Meerut.

References:

1. Concepts of Modern Physics, Arthur Beiser Tata McGraw Hill Edition.
2. Nuclear Physics, Irving kaplan, Narosa publishing House.
3. Introduction to Solid State Physics,C.Kittel, John Wiley& Sons.
4. Solid State Physics, A.J.Dekker, McMillan India.
5. Physics of Magnetism Sushin Chikazumi, Stanley H. Charap, Krieger Pub Co (June 1978)
6. Nuclear Physics, D.C. Tayal, Himalaya Publishing House.

Course Outcomes:

On successful completion of this course, students will be able to:

1. Understand the basic aspects of crystallography in solid state physics
2. Defines Energy bands, Bloch theory and Kronig-Penney model
3. Understand magnetization process and different kinds of magnetic materials
4. Understand the ideas of basics of nucleus and their energy
5. Understand the basic aspects of nuclear structure and fundamentals of radioactivity

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2						2				
CO2	2						2				
CO3	2						2				
CO4	2						2				
CO5	2						2				

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

CSCI1011	PROGRAMMING WITH C	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

C is a general-purpose programming language. It is basis for Java and C++. This course deals with the same objects that are manipulated by computers: single characters, numbers and memory addresses. Any other type of object is created, by the programmer, by combining those objects (e.g., character strings, arrays, records, fields, etc.).

Course Educational Objectives:

- To understand the difference between different data types
- To learn the basic concept, applications of control statements
- To identify and practice the functions and program structures
- Ability to process arrays, multi-dimensional arrays and character arrays.
- To understand the concept of pointers and functions.
- To understand the concept of structures and unions

UNIT 1 **8 hours**

Datatypes, operators and some statements, Identifiers and keywords, constants, Coperators, Type conversion. Writing a program in C: Variable declaration, statements, simple C programs, simple input statement, simple output statement, feature of study.
Control statements: conditional expressions, If statement, If–else statement, switch statement, Loop statements, for loop, while loop, do-while loop, Breaking, control statements, Break statement, continue statement, Goto statement.

UNIT 2 **8 hours**

Functions and Program structures: Introduction, Defining a function, Return statement, Types of functions, Actual and formal arguments, Local Global variables, Automatic variables, register variables, static variables, External variables, Recursive functions.

UNIT 3 **8 hours**

Arrays: Array Notation, Array declaration, Array initialization, Processing with arrays, Arrays and functions, Multidimensional array, Character array.

UNIT 4 **8 hours**

Pointers: Pointer declaration, Pointer operator, address operator, pointer expressions, pointer arithmetic, pointers and functions, call by value. Call by reference, pointers and arrays, pointer and one dimensional array, pointer and multidimensional array, pointer and strings, array of pointers, pointer stop inters.

UNIT 5 **8 hours**

Structures, Unions: Declaration of structure, Initializing a structure, Functions and structures, Arrays of structures, arrays with in a structure, structure with in a structure, Flow charts and structures, Unions.

Textbooks:

1. Programming in C by D. Ravi Chandran, New Age international Publishers, 2006.

References:

1. Let Us C byYashwant Kanetkar,13th Edition, Publications, 2012.
2. Programming in ANSIC by E. Balaguruswamy, 6thEdition, McGraw Hill Education, 2012.
3. Programming in C by Smarajit Ghosh, Prentice Hall India Pvt. Ltd (2004).

Course Outcomes:

On successful completion of this course, students will be able to:

- Describe the basic concepts of control statements in C
- Explain the concepts of Loop statements in C
- Explain difference between Local and Global variables
- Explain the concept of recursive functions
- Explain multidimensional arrays and character arrays
- Explain different types of pointers and functions
- Explain the concept of pointer and strings and also pointer stopointers
- Explain different types of functions and structures in C
- Explain the concept of arrays of structures, structures with in a structure and flow charts and structures in C

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	1	1	1	2	2	1	3	2
CO2	3	1	1	1	1	1	2	3	2	3	3
CO3	3	1	1	1	1	1	2	3	1	3	3
CO4	3	1	1	1	1	1	3	3	2	3	3
CO5	3	1	1	1	1	1	3	3	2	3	3

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

APPROVED IN:
BOS :13-09-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
Ensuing an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities

SDG Justification:
The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times

PHYS1081	PHYSICS II LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Determine properties of solids and radiation"						

Course Description:

To perform experimental studies related to solids state and radioactive sources

Course Educational Objectives:

To develop and explain properties related to solids state and radioactive sources.

List of Experiments:

Ultrasonic Interferometer
Rigidity modulus-Internal friction
B-H Curve- Determination of Curie temperature
Thermo EMF
Dielectric Constant
Plateau Characteristics
Intensity variation of radiation
Absorption Coefficient of material
Statistical Aspects of Radiation
Beta back scattering factor
Gamma ray Spectrometer Energy resolution characteristics

Course Outcomes:

1. Learn the ground state properties of a nucleus.
2. Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays.
3. Learn the basic aspects of measurements
4. Learn about the detectors of nuclear radiations.
5. Gain knowledge on the how to measure properties of radiation

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1						2	3			
CO2	1						3	2			
CO3	1						1	2			
CO4	1						2	1			
CO5	1						1	3			

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

PROGRAMME CORE

CHEM1061	INORGANIC CHEMISTRY I	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	This course is not offering as open elective						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to gain knowledge in chemistry, starts with dealing of the nucleus (proton, electron, etc.), theories, and wave functions, in further it gives the information regarding the periodic classification, bonding nature, bond types (sigma and pi), bond order, and different types of the interactions. The knowledge gained in this course will be helpful in different chemical reactions (bond cleavage and bond breaking).

Course Educational Objectives:

- To study the atom, proton, electron, and element properties
- To know the importance of wave functions
- To impart knowledge of the bonding nature in molecules
- To emphasize the importance of the electron filling and bond order
- To study the different types of chemical bonding

UNIT 1 Atomic structure 8 hours

Bohr's theory, its limitations, and the atomic spectrum of the hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, the significance of ψ and ψ2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for the hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d, and f orbitals. Contour boundary and probability diagrams.

UNIT 2 Periodicity of s, p, d, f - block elements 8 hours

s, p, d, and f-block elements, the long form of the periodic table. A detailed discussion of the following properties of the elements, with reference to s, p, d, and f-block.
(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in the periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies, and factors affecting ionization energy. Applications of ionization enthalpy. Electro negativity, Pauling's/Mulliken's/ electro negativity scales.

UNIT 3 **Chemical bonding 1** **8 hours**

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule, and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Born-Haber cycle and its application, Salvation energy. Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetic of hybridization, equivalent and non-equivalent hybrid orbital's. Bent's rule.

UNIT 4 **Chemical bonding 2** **8 hours**

Molecular Orbital Theory (MOT), molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B, F_2, CO, NO, and their ions; HCl, BeF_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability.Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electro negativity difference.

UNIT 5 **Chemical bonding 3** **8 hours**

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment).

Textbooks:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.

References:

1. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Course Outcomes:

On successful completion of this course, students will be able to:

1. understand about the particles which are in the nucleus of atom/element
2. comprehend the idea of the periodic table classification and its order
3. differentiate between crystal and powder and its arrangement in crystal,
4. Product formation through many steps (sublimation, ionization enthalpy, etc.)
5. explain the chemical bonding and bond order in homo and hetero molecules
6. describe the conductors, insulators, and different types of interactions

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	2	1	3	3	2	3
CO2	3	3	2	3	3	3	1	3	2	3	2
CO3	3	2	3	2	3	2	1	3	2	3	3
CO4	3	2	2	3	3	3	1	3	2	3	2
CO5	3	2	3	1	3	3	1	3	3	2	2

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

CHEM1071	INORGANIC CHEMISTRY I LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

In this course, we projected to teach and demonstrate the usage of the apparatus, and preparation of the different concentrated solutions. It continues, there are two different types of the experiments with acid-base titrations and oxidation-reduction titrimetric.

Course Educational Objectives:

- Demonstration about the usage of the chemical apparatus which are in laboratory experiments
- Gives idea about the acid-base terms, its reactions and indicators
- Oxidation and reduction terms (oxidizing agent, reducing agent) and indicators.

1. **Titrimetric Analysis**
   - Calibration and use of apparatus
   - Preparation of solutions of different Molarity/Normality of titrants
2. **Acid-Base Titrations**
   - Estimation of carbonate and hydroxide present together in mixture.
   - Estimation of carbonate and bicarbonate present together in a mixture.
3. **Oxidation-Reduction Titrimetry**
   - Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.
   - Estimation of oxalic acid and sodium oxalate in a given mixture.
   - Estimation of Fe(II) with $K_2Cr_2O_7$ using internal **external** (diphenylamine, anthranilic acid) and external indicator.

Course outcomes

1. understand the basics of laboratory practices
2. understand about the usage of the chemical apparatus
3. know about the acid-base reactions and usage of specific indicator in particular pH range
4. get the idea about the terms of oxidation and reduction reactions.
5. master the pertaining laboratory skills in inorganic chemistry

Text Books

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6thEd., Pearson, 2009

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	3	1	3	2	3	1
CO2	3	2	3	3	2	3	1	3	3	2	1
CO3	3	3	2	2	2	2	1	3	2	3	1
CO4											
CO5											

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement: SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM1081	PHYSICAL CHEMISTRY I	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The difference in the physical and chemical properties of the three states of matter: solid, liquid and gas, can be understood in terms of atomic hypothesis as rightly pointed out by Richard Feynman: "I believe it is the atomic hypothesis that all things are made of atoms — little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another." This hypothesis forms the preamble of this beginners course in Physical Chemistry.

Course Educational Objectives:

- To introduce different states of matter as a mere interplay of inter atomic interactions.
- To illustrate different theories to model the behaviour of gas particles
- To rationalize the properties of liquids like vapour pressure, surface tension and viscosity in terms of associated inter atomic interactions
- To provide insights into properties of amorphous and crystalline solids and theories behind crystal X-ray diffraction.
- To demonstrate how different types of acids, bases and salts interact in solutions in terms of equilibrium between the substance and its constituent ions and consequences of these interactions

UNIT 1 **Gaseous state** **9 hours**

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, relation between mean free path and coefficient of viscosity, Variation of viscosity with temperature and pressure, Molecular velocities (average, root mean square and most probable) and average kinetic energy.
Behavior of real gases: Deviations from ideal gas behavior, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behavior. Vander Waals equation of state

UNIT 2 **Liquid state** **8 hours**

Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Temperature variation of viscosity of liquids. Qualitative discussion of structure of water (in the ice form).

UNIT 3 **Solid state** **9 hours**

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Braggs's equation.

UNIT 4 **Ionic equilibria-1** **9 hours**

Strong, moderate, and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions- derivation of Henderson equation and its applications; and applications of buffers in analytical chemistry.

UNIT 5 **Ionic equilibria-2** **8 hours**

Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid–base titration curves (calculation of pH at various stages). Theory of acid-base indicators; selection of indicators and their limitations.

Textbooks:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).

References:

1. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
2. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

Course Outcomes:

On successful completion of this course, students will be able to:

1. understand differences in properties of the three states of matter in terms of atomic hypothesis
2. gain knowledge of kinetic theory of gases and differences between the behavior of ideal and real gases
3. gain insights into different physical properties of liquids
4. appreciate the symmetry in crystalline solids and understand the usefulness of crystal X- ray diffraction
5. gain insights into ionic interactions in solutions and their role in solubility and conductance

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	3	1	3	2	3	1
CO2	3	2	3	3	2	3	1	3	3	2	1
CO3	3	3	2	2	2	2	1	3	2	3	1
CO4	3	3	2	2	3	3	1	3	3	2	1
CO5	2	3	3	2	2	3	1	3	2	3	1

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM1091	PHYSICAL CHEMISTRY I LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This lab course complements the theory course in States of Matter and Ionic equilibrium. It is concerned with the measurement of physical properties of liquids such as surface tension and viscosity, and the instrumental technique of pH metry.

Course Educational Objectives:

- To illustrate the concepts of surface tension and viscosity
- To provide hands-on experience in determining surface tension and viscosity of a given liquid using simple techniques
- To provide hands-on experience in performing pH metry involving strong and weak acids and bases

1. **Surface tension measurements.**
   - Determination of the surface tension by drop number method.
2. **Viscosity measurement using Ostwald's viscometer**.
   - Determination of viscosity of aqueous solutions of (i) ethanol and (ii) sugar at room temperature.
3. **pH metry**
   - Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium Acetate, and their mixtures.
   - Preparation of buffer solutions of different pH
     - Sodium acetate-acetic acid
     - Ammonium chloride-ammonium hydroxide
   - pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

Course outcomes:

By the end of this lab course, the student will be able to

1. understand physical properties of liquids(L2)
2. understand the applications of pH metric titrations(L2)
   obtain hands-on experience in measuring surface tension and viscosity, and I
3. performing pH metry.(L3)

Text Books:

1. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry, R. Chand& Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8thEd.; McGraw-Hill: New York (2003).
3. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rdEd.; W.H. Freeman & Co.: New York (2003).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	3	2	2	1	2	2	3
CO2	3	3	2	2	3	3	1	2	2	2	3
CO3	3	3	2	3	3	3	2	2	2	3	1
CO4											
CO5											

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2001	ORGANIC CHEMISTRY I	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Organic chemistry is the chemistry of the compounds of carbon and these compounds constitute a major role in the survival of mankind. The importance and existence of millions of carbon compounds has necessitated the emergence of this branch of chemistry. It includes the study of the structure, composition, nomenclature, properties (physical, chemical, etc..), reactions, and synthesis of the library of organic compounds. This course was intended to create knowledge in basics of organic chemistry and their applications in the study of simple hydrocarbons.

Course Educational Objectives:

- To explain the importance of organic chemistry, how it is different from other branches of chemistry
- To make the students understand the structural features of the organic compounds and their classification
- To discuss the nomenclature rules laid by IUPAC
- To introduce the basic concepts encountered in organic chemistry – bond breaking, reagents, electronic effects, reaction intermediates, and types of organic reactions
- To create a 3-dimensional visualization of organic molecules and talk about their structural and stereoisomerism. Biological importance of stereoisomers
- Application of the knowledge to synthesize basic organic molecules and to study their properties
- To introduce the chemistry of aromatic compounds and their reactivity

UNIT 1 Basics of organic chemistry 9 hours

Organic compounds: Classification, nomenclature and hybridization.
Electronic displacements: Inductive, electrometric, resonance, mesomeric, hyper conjugation effect and their applications; dipole moment, bond fission (homolytic and heterolytic) with suitable examples; curly arrow rules; reactive intermediates–carbonation, carbanion, Free radical and carbene; organic reagents – electrophile and nucleophile; nucleophilicity and basicity.

Introduction to types of organic reactions and their mechanism – Addition, elimination and Substitution reactions (only basics)

UNIT 2 Stereochemistry 9 hours

Classification: Configurational and conformational isomers; representation of three dimensional molecules – Wedge, Fischer, Newmann and Sawhorse Projection formulae and their interconversions; **Optical isomerism:** Optical isomers, optical activity, specific Rotation, chirality – Conditions for optical activity, molecules with one or two chiral centers– enantiomers, diastereoisomers and meso compounds, racemization and resolution (Basic only); relative and absolute configuration – D/L and R/S designations; geometrical isomerism – Cis & Trans and E/Z notations.

UNIT 3 Chemistry of aliphatic hydrocarbons-1 8 hours

Carbon-Carbon sigma bonds:
Chemistry of alkanes: Formation of alkanes – Wurtz Reaction, Corey-House synthesis, Kolbe's electrolysis, Hydrogenation of alkenes & alkynes Properties of alkanes: Physical, chemical – Free radical halogenation, oxidation, isomerization and aromatization.
Conformational analysis of alkanes: Factors affecting stability of conformational isomers, Conformation analysis of ethane, propane & n-butane – Eclipsed, Staggered, Gauche and Anti conformations.
Conformational analysis of cycloalkanes: Baeyer strain theory, energy diagrams of cyclohexane: chair, boat and twist boat conformations and their relative stabilities.

UNIT 4 Chemistry of aliphatic hydrocarbons-2,Carbon-Carbon pi bonds 8 hours

Formation of alkenes – By elimination reactions (From alcohols, alkyl halide), Mechanism of E1, E2, E1cb reactions, Saytzeff and Hofmann eliminations, hydrogenation of alkyne and Kolbe's electrolysis.
Properties of alkenes: Physical, chemical properties - Electrophilic additions following Markownikoff/Anti-Markovnikoff rules & mechanisms, oxymercuration-demercuration, hydroboration, ozonolysis, reduction, oxidation - syn and anti-hydroxylation.
Conjugated dienes – 1,2-and 1,4-addition reactions and Diels-Alder reaction; allylic and benzylic bromination mechanism with NBS.
Formation of alkynes: From Vicinal dihalide, CaC_2, Kolbe's Electrolysis
Properties of alkynes: Physical, Chemical properties - Acidity, Electrophilic (X_2, HX and HOX) and Nucleophilic (H_2O) additions, Hydroboration, oxidation, ozonolysis, polymerization, Alkylation of terminal alkynes.

UNIT 5 Aromatic hydrocarbons 8 hours

Aromaticity: Hückel's rule, aromatic character of arenes, benzenoid and non-benzenoid compounds. Electrophilic aromatic substitution – halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanisms. Directing effects of the groups– Ortho-para directing and meta directing groups.

Textbooks:

1. A Textbook of Organic Chemistry: Book by R.K. Bansal, SBN: 9788122420258 Publisher: New Age International Year of publishing: 2007.
2. Agarwal, O.P. Unified Chemistry, Vol I, II, & III, Jai Prakashnath Publications, Fiftieth Edition, 2016.
3. Bahl. A &Bahl, B.S. A textbook of Organic Chemistry, S. Chand & Company Pvt.Ltd. 2014.
4. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

References:

1. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Course Outcomes:

On successful completion of this course, students will be able to:

1. find out the differences in structural aspects among various hydrocarbons and name the organic compounds
2. point out and recognize the various reagents, attacking species, intermediates encountered in organic reactions and predict the basic mechanism of an organic reaction
3. write the 3-D projection of organic molecules and differentiate between configuration and conformation
4. talk about the optical activity of compounds and the criteria conditions and give E/Z; D/L and R/S designation configuration to chiral molecules
5. explain the different conformations observed for alkanes and cycloalkanes and their stabilities. Explain the Hückel rule of aromaticity and Write the mechanism of electrophilic aromatic substitution

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	2	2	3	2	2	2	1	3
CO2	2	3	3	2	1	2	2	2	2	3	2
CO3	1	2	2	2	1	3	2	2	3	2	1
CO4	3	2	1	2	2	3	2	3	2	1	2
CO5	3	1	1	3	2	2	1	2	2	2	3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2011	ORGANIC CHEMISTRY I LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The courses in the theoretical sessions should be well supported by practical classes. The laboratory practices give us the knowledge of how to deal with the chemicals and the realistic way of performing a reaction or operating an analytical instrument. Practicality has always been a driving force for innovation. In this course, we intended to teach and demonstrate a few practicals related to determination of physical characteristics of chemicals and also, make the students self-capable of carrying out the experiments.

Course Educational Objectives:

- To explain about the solubility of the compounds and how the information can be used to purify solid compounds by the process of recrystallization
- To illustrate the method to determine melting point of organic compounds and explaining its importance
- Training the students how to determine boiling point of organic compounds
- To address the concept of chromatography and train the students in performing TLC

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
    a. Water
    b. Alcohol
    c. Alcohol-Water
3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus).
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)

6. Chromatography

a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
b. Separation of a mixture of two sugars by ascending paper chromatography
c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Text Books:

1. Vogel's textbook of Organic Analysis, Longmann Publishers
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

Course outcomes

By the end of this course, the student will be able to

1. get the essence of an organic chemistry lab
2. learn the DO's and DONT's in laboratory
3. make proper handling of the lab chemicals
4. crystallize a solid compound from a solution
5. find out the melting point and boiling point of solid and liquids respectively
6. make TLC plates using Silica gel and use them in TLC technique

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	3	3	3	2	1	3	1
CO2	3	2	1	3	2	1	2	3	2	2	1
CO3	3	1	2	1	2	2	3	3	2	2	2
CO4	2	3	3	1	2	3	2	2	1	3	2
CO5											

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2021	INORGANIC CHEMISTRY II	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to gain knowledge in periodic table classification with more focus on s-block, p-block elements and its relevant compounds followed by the discussion of the acid-bases, noble gases and inorganic polymers. The knowledge gained in this course will be helpful to know the difference between strong and weak acidic, basic nature and bonding nature in s-and p-block elements of different compounds

Course Educational Objectives:

- To study the theories which describe about the acid and bases and strength of ions
- Periodic table classification with s-and p-block elements comparison and relative study among s-and p-block elements
- To impart knowledge of the p-block elements and its compounds and structures
- To study the inert gases and its compounds with preparation and bonding features and geometry
- To study the different types of the inorganic polymers

UNIT 1 Acids and Bases 9 hours

Bronsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle,

UNIT 2 Chemistry of s and p Block Elements: 8 hours

Inert pair effect, relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

UNIT 3 **Chemistry of p-block compounds** **8 hours**

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine.Peroxo acids of sulphur, interhalogen compounds.

UNIT 4 **Noble Gases** **8 hours**

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2).

UNIT 5 **Inorganic Polymers** **9 hours**

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates, and phosphagens, and polysulfides.

Textbooks:

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.

References:

1. Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.

Course Outcomes:

On successful completion of this course, students will be able to:

1. understand about the theories which are describes about acid & bases
2. get the idea of the periodic table classification of s & p-block elements
3. bonding nature in p-block elements its reactivity and synthesis
4. know the information about the noble gases and its hybridization
5. different types of inorganic polymers and its applications

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	2	3	1	1	3	3	1
CO2	2	1	3	2	3	3	2	1	3	3	2
CO3	3	2	1	3	3	2	2	3	3	2	1
CO4	2	1	1	2	1	3	2	2	2	3	1
CO5	2	1	3	2	2	3	2	2	3	3	2

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2031	INORGANIC CHEMISTRY II LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

In this course, there are two category experiments which describe the iodo and iodimetric titrations, followed by the different types of inorganic complex preparations. We were projected to teach and demonstrate the structural aspects and hybridization and chemical reactions involved in each experiment

Course Educational Objectives:

- The differences between iodo and iodimetric titrations
- Different types of inorganic complexes preparations
- Color aspect of copper and differences between mono and double salt
- Structures and geometries of the inorganic complexes

(A) Iodo/Iodimetric Titration

1. Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).
2. Estimation of available chlorine in bleaching powder iodometrically.

(B) Inorganic preparations

1. Cuprous Chloride, Cu_2Cl_2
2. Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$
3. Preparation of Aluminum potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

Course outcomes

1. understand the differences between iodo and iodimetric titrations
2. know about the preparation methods of inorganic complexes preparation
3. get the idea about the electronic configuration and color exhibition of copper and differences between mono and double salt

Textbooks:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3	1	3	1	1	3	3	2
CO2	1	1	2	2	3	2	1	2	3	2	1
CO3	2	2	1	1	3	2	2	1	3	1	1
CO4	2	3	2	3	2	1	2	2	2	3	1
CO5											

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

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CHEM2041	PHYSICAL CHEMISTRY II	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Thermodynamics describes macroscopic behaviour of a system in a time-invariant state in terms of bulk properties such as pressure, volume, temperature and chemical potential. It is also concerned with the potential functions obtained by combining these properties and their relation to spontaneity of physical and chemical processes.

Course Educational Objectives:

- To demonstrate the laws of thermodynamics through real-life examples and applications
- To generate an intuitive understanding among the students for the concept of entropy and its relevance in design of a heat engine
- To demonstrate how thermodynamics dictates the feasibility of physical transformations and chemical reactions
- To provide insights into the concept of chemical equilibrium and factors influencing equilibrium
- To introduce the idea that solute particles in dilute solutions behave essentially like gas particles and discuss properties associated with such solutions

UNIT 1 Chemical thermodynamics -1 9 hours

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities(ideal) under isothermal and adiabatic conditions.

UNIT 2 **Chemical Thermodynamics -2** **8 hours**

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions, calculation of bond energy, bond dissociation energy, and resonance energy from thermochemical data.

Second Law: Concept of entropy; Carnot cycle, statement of the second law of thermodynamics; Calculation of entropy change for reversible and irreversible processes.

UNIT 3 **Chemical Thermodynamics -3** **8 hours**

Third Law: Statement of the third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs free energy and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Gibbs-Helmholtz equation; Maxwell relations;

UNIT 4 **Chemical Equilibrium** **9 hours**

Criteria of thermodynamic equilibrium,
chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Thermodynamic derivation of relations between the various equilibrium constants Kp, Kc and Kx. Le Chatelier principle and application to the synthesis of NH3 (Haber's process) and SO3(Contact process).

UNIT 5 **Solutions and Colligative Properties** **8 hours**

Dilute solutions; lowering of vapor pressure, Raoult's and Henry's Laws and their applications. Derive relations between the four colligative properties [(i) relative lowering of vapor pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure and amount of solute.

Textbooks:

1. Peter, A. & Paula, J. de. Physical Chemistry 10th Ed., Oxford University Press (2014).
2. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).

References:

1. Levine, I .N. Physical Chemistry 6th Ed., Tata McGraw Hill (2010).
2. Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006).

Course Outcomes:

On successful completion of this course, students will be able to:

1. understand the analogy between solute particles in dilute solutions and gas particles
2. explain the concepts of vapor pressure and its relation to boiling point
3. describe different colligative properties and their applications

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	2	2	3	1	1	3	2
CO2	3	1	1	1	2	2	3	1	1	3	2
CO3	3	1	1	1	2	2	3	1	1	3	2
CO4	3	1	1	1	2	2	3	1	1	3	2
CO5	3	1	1	1	2	2	3	1	1	3	2

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2051	PHYSICAL CHEMISTRY II LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This lab course in thermochemistry complements the SCY-104 theory course in chemical thermodynamics and its applications. It is concerned with an industrially important technique known as calorimetry that involves measuring heat changes in physical processes and chemical reactions

Course Educational Objectives:

- To encourage students to make a home-made coffee cup calorimeter using thermal insulators such as thermocoal
- To illustrate the concepts of enthalpy of neutralization, enthalpy of ionization, enthalpy of solution, enthalpy of hydration and basicity of an acid
- To provide hands-on experience in measuring heat changes of physical transformations and chemical reactions by means of calorimetry

1. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2. Calculation of the enthalpy of ionization of ethanoic acid.
3. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
4. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
5. Determination of enthalpy of hydration of copper sulphate.

Course outcomes

1. understand the terminology of thermochemistry
2. understand the principles of calorimetry
3. obtain hands-on experience in making a coffee cup calorimeter and performing calorimetry

Textbooks

1. Khosla, B. D.; Garg, V. C. &Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	1	3	1	1	3	2
CO2	3	1	2	1	1	1	2	1	1	3	2
CO3	3	1	1	1	1	1	3	1	1	3	2
CO4											
CO5											

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM3001	ORGANIC CHEMISTRY II	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Knowing the basic definition of organic chemistry and the mechanisms involved, it is quite important to know about the different organic compounds encountered in biological systems. This course was aimed at teaching the students more compounds with versatile functional groups. More importantly hydroxy compounds, carbonyl compounds and carboxylic acids. These compounds have diverse applications in the manufacturing of a plethora of organic compounds.

Course Educational Objectives:

- To discuss the preparation methods, physical and chemical properties of aliphatic and aromatic halogen compounds
- To explain the preparation methods, physical and chemical properties of aliphatic and aromatic alcohols and introduce the compounds having ether functional group
- Illustrate the preparation methods and properties of carbonyl compounds. Nucleophilic additions, oxidation, reductions, and addition reactions
- Outline the acidity of carboxylic acids, preparation methods and properties and extend it to carboxylic acid derivatives and introduce the chemistry of sulphur compounds, their importance, preparation, and properties
- Emphasize more on clear mechanistic explanation of all the reactions and developing application skills pertaining to prediction of the reaction outcome, introducing, and interconverting functional groups

UNIT 1 Chemistry of Halogenated Hydrocarbons 9 hours

Alkyl halides: Methods of preparation–Preparation of CH_3Cl/ $CHCl_3$/ C_2H_5Cl/ $ClCH_2CH_2Cl$ from alkanes & alkenes, alcohols and Hundsdiecker reaction; Chemical Properties – SN1, SN2 and SNi mechanisms with stereo-chemical aspects; Nucleophilic substitution vs elimination; Preparation of Grignard reagent.

Aryl halides: Preparation – From benzene, Sandmeyer reaction, Gattermann reaction; Chemical properties: Electrophilic aromatic substitutions – nitration, sulphonation, and

Friedel-Crafts alkylation; Nucleophilic substitution reaction with an example, Coupling reactions – Ullamann reaction, Wurtz- fitting; Benzyne mechanism.
Relative reactivity of alkyl, vinyl, allyl, aryl and benzyl halides towards nucleophilic substitution reactions.

UNIT 2 Alcohols, Phenols, Ethers and Epoxides 8 hours

Alcohols: Preparation from – Alkyl halide hydrolysis, Hydration of alkenes, Hydroboration-oxidation of alkenes, RMgX to carbonyls; Properties and relative reactivity of 1°, 2° and 3° alcohols – Dehydration, Dehydrogenation, Grignard reagents, Oxidation; Distinguish test between 1°, 2° and 3° alcohols; Hydrogen bonding.
Preparation of Glycol: From 1,2-dichloroethane, alkene; Physical and chemical properties – Reaction with Na, PCl_5, PI_3, oxidation with HIO_4, dehydration and Pinacol-Pinacolone rearrangement.
Phenols: Preparation – Dow method, Cumene, Benzenediazonium salt; Properties – Acidity, Reimer- Tiemann reaction, Kolbe's-Schmidt reaction, Phthalic anhydride, Zn dust, oxidation; Effect of substituents on acidity.
Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$.

UNIT 3 Carbonyl Compounds 8 hours

Aldehydes and ketones:
Preparation – Oxidation of alcohols and alkenes, dehydrogenation of alcohols, hydration of alkynes.
Properties – Nucleophilic additions: HCN, $NaHSO_3$, RMgX; Nucleophilic addition-elimination reactions with ammonia derivatives: NH_2OH, Hydrazine, 2,4- dinitrophenylhydrazine and semicarbazide; reduction with $LiAlH_4$, $NaBH_4$, Clemensen& Wolf- Kishner; Oxidation with PCC, PDC; Mechanisms of Aldol, Perkin, Benzoin condensation, Cannizzaro, Wittig reaction, Beckmann rearrangements, haloform reaction and Baeyer-Villiger oxidation.
Addition reactions of unsaturated carbonyl compounds: Michael addition.
Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate

UNIT 4 Carboxylic Acids 8 hours

Methods of Preparation – From 1° alcohols /aldehydes, Hydrolysis of nitriles, RMgX with CO_2; Properties – Reaction with NH_3, $SOCl_2$, dehydration, HVZ reaction; Acidity, Effects of substituent on Acidity; Typical reactions of dicarboxylic acids, hydroxy acids, and unsaturated acids: succinic/phthalic, lactic, tartaric, maleic and fumaric acid.

UNIT 5 **Carboxylic Acids Derivatives** **8 hours**

Typical Preparation methods and reactions: For acid chlorides, anhydrides, esters, amides; Comparative study of nucleophilic substitution at acyl group; Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation, and Curtius rearrangement.
Sulphur containing compounds: Preparation and reactions of thiols, thioethers and sulphonic acids.

Textbooks:

1. Agarwal, O.P. Unified Chemistry, Vol I, II, & III, Jai Prakashnath Publications, Fiftieth Edition, 2016.
2. Bahl. A &Bahl, B.S. A textbook of Organic Chemistry, S. Chand & Company Pvt.Ltd. 2014.
3. Agarwal, O.P. Unified Chemistry, Vol I, II, & III, Jai Prakashnath Publications, Fiftieth Edition, 2016.

References:

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

Course Outcomes:

On successful completion of this course, students will be able to:

1. write the preparations and reactions of substituted halogen compounds, alcohols, carbonyl compounds, Sulphur compounds, carboxylic acids and their derivatives
2. find out the difference between substitution vs elimination of halogen compounds
3. explain about relative reactivity of alkyl, vinyl, allyl, aryl and benzyl halides towards nucleophilic substitution reactions.
4. distinguish between 1°, 2° and 3° alcohols and depict the 1,4 addition reactions of unsaturated carbonyl compounds
5. explain the keto-enol tautomerism and their role in the reactivity of active methylene compounds and comment on physical properties and compare the acidities of alcohols and carboxylic acids
6. predict the difference in properties (physical and chemical) between carboxylic acids and their derivatives and outline the mechanism of acidic and alkaline hydrolysis of esters

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	2	3	2	3	3			
CO2	3	2	1	2	3	2	3	3			
CO3	3	2	1	2	3	2	3	3			
CO4	3	2	1	2	3	2	3	3			
CO5	3	2	1	2	3	2	3	3			

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM3011	ORGANIC CHEMISTRY II LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The laboratory real time experience showcases the theoretical explanations given for various organic compounds. This course was intended to explain the typical reactions shown by a few classes of compounds and to demonstrate them. Also, make the students understand the safer ways to perform a reaction by illustrating the preparations of a few organic compounds.

Course Educational Objectives:

- To explain the qualitative analysis of few organic compounds
- To demonstrate the standard protocols for the preparation of organic compounds
- To make the students be able to practice the protocols in a safer manner

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:
   I. Acetylation of one of the following compounds: amines (aniline) and phenols (salicylic acid) by any one method:
      (a). Using conventional methods. (b). Using green approach
   II. Benzolyation of amines (aniline) and phenols (β-naphthol) by Schotten-Baumann reaction.
   III. Oxidation of ethanol/ isopropanol (Iodoform reaction).
   IV. Bromination of any one of the following:
      (a). Acetanilide by conventional methods
      (b) Acetanilide using green approach (Bromate-bromide method)

V. Nitration of any one of the following:

(a). Acetanilide/nitrobenzene by conventional method

(b). Salicylic acid by green approach (using ceric ammonium nitrate).

VI. Selective reduction of meta dinitrobenzene to m-nitroaniline.

VII. Reduction of p-nitrobenzaldehyde by sodium borohydride.

VIII. Hydrolysis of amides and esters.

IX. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.

X. S-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).

I. Aldol condensation using either conventional or green method.
II. Benzil-Benzilic acid rearrangement

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.
At least 6-8 experiments to be performed under S. No 2.

Textbooks:

1. Vogel's textbook of Organic Analysis, Longmann Publishers
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: QualitativeAnalysis, University Press (2000).

Course outcomes

By the end of this Course, the student will be able to

1. know about the changes happen while doing a reaction
2. safe handle the reagents and chemicals
3. carry out a reaction following the standard protocols and achieving the desired product

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	3	3	3	2	2
CO2	3	2	2	2	3	2	3	3	3	2	2
CO3	3	2	2	2	3	2	3	3	3	2	2
CO4											
CO5											

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities. & SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times. & The experimets included in this course enable the students to detect different types of compounds. Provides knowledge on safe practices to be employed while making new organic compounds. This helps in sustainable growth and good employment.

CHEM3021	ANALYTICAL CHEMISTRY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to apply the various statistical tools in the analysis and acquire the basic principles of atomic, molecular techniques, Electro-analytical methods and separation methods and their applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

1. To familiarize the students with various types of basic statistical tools.
2. To study about the basic principles of atomic, molecular techniques and separation methods.
3. To emphasize the importance of UV Vis spectroscopy and atomic spectroscopy in quantitative determination of Metal ions.
4. To impart knowledge on the basic concepts of pH metry and conductometry.
5. To compare the different separation methods like chromatography and solvent extraction.

UNIT 1 Evaluation of analytical data 8 hours

errors, accuracy and precision. Types of errors and Methods for minimization of errors. Significant figures
Statistical test of data: F, Q and t test, rejection of data, and confidence intervals.

UNIT 2 UV-Visible spectrophotometry: 8 hours

Interaction of radiation with matter. fundamental laws of spectroscopy: Beer-Lambert's law and its validity.: source of radiation, wavelength dispersion: monochromator: gratings, prisms, interference filters. Detection of signal: photocells, photomultipliers, diode arrays. Schematic diagrams of Single and Double Beam instruments. applications in the quantitative determination of cations (Fe2+, Ni2+, Cr6+) and anions (PO43-, NO3- and NO2-).

UNIT 3 Flame Emission and Flame Absorption Spectrometry 8 hours

Basic principle and instrumentation: source of excitation, atomization, nebulizer, types of burner, monochromator and detector. Interferences: Physical, Chemical and spectral. Quantitative estimation of metal ions in water samples by Flame emission and Flame absorption spectroscopy.

UNIT 4 Electroanalytical methods 8 hours

Basic principle, Instrumentation and applications of pH metric, potentiometric and conductometric titrations.

UNIT 5 Separation techniques 8 hours

Solvent extraction: Principle of solvent extraction and efficiency of the technique. Technique of extraction: batch, continuous and counter current extractions. Solvent extraction systems: Metal chelates and ion association systems.
Chromatography: Principle and classification of the technique. Mechanism of separation: adsorption and partition. Development of chromatograms: frontal, elution and displacement methods.

Textbooks:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
3. Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.

References:

1. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

Course Outcomes:

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

- list various types of statistical tools and the instruments for chemical analysis.
- explain the role of various parts of instrumentation of atomic and molecular techniques
- identify suitable analytical technique for chemical analysis.
- distinguish atomic and molecular techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3				2		1				3
CO2	3				3		1			1	3
CO3	3				2		1			1	3
CO4	3				3		1			2	3
CO5	3				2		1				3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM3031	ANALYTICAL CHEMISTRY LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This lab course is platform for the application of knowledge acquired in Analytical methods in Chemistry theory course by providing a hands-on experience in performing the experiments of chromatography, solvent extraction and spectrophotometry

Course Educational Objectives:

- To demonstrate the separation of metal ions, pigments and other active ingredients of plant extract through chromatographic techniques.
- To demonstrate the basic difference in performing the paper and TLC chromatographic techniques.
- To demonstrate the calibration and use of pH meter and flame photometry in analysis of soil, cool drinks and shampoos.
- To explain the characterization of different compounds through UV-Vis and IR spectroscopies and use of Spectrophotometry in quantitative analysis.
- To demonstrate the quality of water by doing DO, BOD and COD experiments.

I. Separation Techniques

Chromatography:

1. Separation of mixtures
   i. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.
   ii. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.
   iii. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.
   iv. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions

2. To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.

3. Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

4. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

5. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

6. Analysis of soil:

Determination of pH of soil.

Total soluble salt

Estimation of calcium, magnesium, phosphate, nitrate

7. Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

III. Spectrophotometry

1. Determination of pKa values of indicator using spectrophotometry.
2. Structural characterization of compounds by infrared spectroscopy.
3. Determination of dissolved oxygen in water.
4. Determination of chemical oxygen demand (COD).
5. Determination of Biological oxygen demand (BOD).
6. Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Course outcomes

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

1. apply the correct chromatographic method for the analysis of metal ions, pigments and other plant extracts.
2. use of UV Vis spectrophotometry in quantification of different analytical species and are able to identify carbonyl groups through IR.
3. use of pH meter and flame photometry in finding the quality of soil as well as cool drinks, shampoo and soaps.
4. find the quality of water by application of DO, BOD and COD experiments.

Text Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Khopkar, S.M.Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
5. Skoog, D.A.HollerF.J.and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Edition.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2			3		3	3				3
CO2	2			3		3	3				3
CO3	2			3		3	3				3
CO4	2			3		2	3			2	3
CO5	2			2	3	2	2				3

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM3041	GREEN CHEMISTRY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to gain knowledge on various green synthetic process towards sustainable development. These methods include Ionic liquids, Phase transfer catalyst, Supercritical CO2, Use of Microwave and Ultrasonic irradiation in synthesis along with Green analytical techniques. The knowledge gained in this course can be applied to the latest developments in the scale up process.

Course Educational Objectives:

- To familiarize the students with Green Chemistry and its twelve principles
- To design the green synthetic method by choosing appropriate starting materials etc. To emphasize the importance of Ionic liquids and its applications in organic reactions.
- To impart knowledge of PTC in organic synthesis.
- To explain the importance of Supercritical CO2 in extraction and various process
- To expose the student's about the microwave activation and ultrasound-assisted reactions.
- To enable them with Green Analytical Techniques

UNIT 1 Introduction to green chemistry 8 hours

Green chemistry - Introduction - need for green chemistry - goals of green chemistry - Anastas' twelve principles of green chemistry - Designing a green synthesis (tools) - choice of starting materials, solvents, catalysts, reagents, processes with suitable examples.

UNIT 2 **Ionic liquids and Phase Transfer Catalyst (PTC)** **8 hours**

Ionic liquids - synthesis, physical properties of ionic liquids - applications in alkylation, epoxidation, Friedel-Crafts reaction - Diels-Alder reactions – Knoevenagel condensations and Wittig reactions.

Phase Transfer Catalyst (PTC) - Definition - advantages, types of PTC reactions - synthesis of PTC, applications of PTC in organic synthesis - Michael reaction - alkylation of aldehydes and ketones. Wittig, generation of dihalocarbene, elimination reaction

UNIT 3 **Supercritical CO_2** **8 hours**

phase diagram - uses in extracting natural products, dry cleaning, bromination, Kolbe-Schmidt synthesis - Friedel-crafts reaction. Dimethyl carbonate as a methylating agent in green synthesis

UNIT 4 **Microwave and ultrasound assisted reactions and Sonochemistry** **8 hours**

Microwave and ultrasound assisted reactions

Microwave activation - advantages of microwave exposure - Microwave assisted reactions, condensation reactions - oxidation, reduction reactions, multicomponent reactions.

Sonochemistry - use of ultrasound in organic synthesis (alternate source of energy) - saponification - substitution, addition, oxidation reactions, reductions.

UNIT 5 **Green Analytical Techniques** **8 hours**

Micelle mediated extraction- Cloud point extraction and adsorptive miceller flocculation methods. Solid Phase Microextraction (SPME)

Textbooks:

1. Paul T. Anastas and John C. Warner, “Green Chemistry”, Oxford University Press, Indian Edition, 2008.
2. V. K. Ahluwalia and M. Kidwai, “New Trends in Chemistry”, Anamaya Publishers, 2nd Edition, 2007.
3. V. Kumar, “An Introduction to Green Chemistry”, Vishal Publishers, 1st Edition, 2007.

References:

1. V. K. Ahluwalia and R. S. Varma, “Green Solvents”, Narosa Publishing, 1st Edition, 2009.
2. V.K.Ahluwalia and Renu Aggarwal, “Organic Synthetic Special Techniques”, Narosa, 2nd Edition, 2009.
3. V. K. Ahluwalia, “Green Chemistry - Environmentally Benign Reactions”, Ane books, India, 2006.
4. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).

Course Outcomes:

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

1. list various types of Green synthetic and analytical methods.
2. understand the importance of Ionic liquids and PTC along with their applications in organic Synthesis.
3. explain Supercritical CO2 and its applications in various process.
4. compare the Microwave assisted synthesis and Ultrasonic synthesis.
5. distinguish between various Green analytical techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1						1					3
CO2						3		2			3
CO3						2		1	1		3
CO4						3		2			3
CO5					1	3	1				3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

GOAL 3: Good Health and Well-being

SDG Justification:

Ensure healthy lives and promote well-being for all at all ages.

CHEM3051	GREEN CHEMISTRY LAB	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 enables the students to apply the knowledge on various green synthetic process towards sustainable development. The students would perform experiments which follow some of the green chemistry principles and make use of environmentally benign reagents, catalysts, starting materials and solvents like Ionic liquids, Phase transfer catalyst, Supercritical CO2 or green techniques like Microwave and Ultrasonic irradiation in organic synthesis. The knowledge and skills gained in this course can be applied to the latest developments in the scale up process.

Course Educational Objectives:

- To apply Green Chemistry and its twelve principles for different reactions.
- To design the green synthetic method by choosing appropriate starting materials, green solvents etc.
- To use Supercritical CO_2 in extraction.
- To enable the student to use the microwave for activation of organic reactions.
- To equip them with the use of Green Techniques like photochemical, mechanochemical for different organic conversions.

1. **Safer starting materials**
   Preparation and characterization of nanoparticles of gold using tea leaves.
2. **Using renewable resources**
   Preparation of biodiesel from vegetable waste cooking oil.
3. **Avoiding waste**
   Principle of atom economy.
   Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
   Preparation of propene by two methods can be studied

I. Triethylamine ion + OH^- → propene + trimethylpropene + water H_2SO_4/□

II.1-propanol propene + water

Other types of reactions, like addition, elimination, substitution, and rearrangement should also be studied for the calculation of atom economy.

1. Use of enzymes as catalysts

Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

2. Alternative Green solvents

Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice.

Mechanochemical solvent free synthesis of azomethines

3. Alternative sources of energy

Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).

Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Textbooks:

1. Anastas, P.T& Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press (1998).
2. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi. Bangalore CISBN 978-93-81141-55-7 (2013).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2					3					3
CO2	2					3					3
CO3	2					3					3
CO4	2					3					3
CO5	2					3					3

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

GOAL 3: Good Health and Well-being

SDG Justification:

Ensure healthy lives and promote well-being for all at all ages.

CHEM2061	CONCEPTS OF MEDICINAL CHEMISTRY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to gain knowledge on various chemical processes and its calculations includes Material balances with and without Chemical reactions and energy balances and also on various aspects related to Fuels and its combustion processes. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

- To familiarize the students with various types of chemical calculations.
- To study about the material balances without chemical reactions.
- To emphasize the importance of material balances with chemical reactions.
- To impart knowledge on the various concepts of energy balanced techniques.
- To compare different types of fuels.
- To expose the students to the latest combustion techniques of fuel.

UNIT 1 Drug structure and biological activity 8 hours

Pharmaceutically important functional groups-alcohols, carboxylic acid, amines, sulfonamides and carbonyl compounds. Basic reactions for drug molecule synthesis: Aldol, Diels-Alder, Claisen, Grignard, Michael, and Mannich reactions

UNIT 2 Chemistry of drug metabolism 8 hours

absorption distribution, drug metabolism and excretion site specificity, stability, prolong release, minimum toxicity, patient acceptance.

UNIT 3 Vitamins 8 hours

Structure, physiological role and uses of Vitamins A , Vitamin D Thiamine (B1) and Pyridoxine (B6).

UNIT 4 **8 hours**

Chemistry of selected drugs- Synthesis and basic concept of action for the following drugs

(i) Anticancer: 5-Fluorouracil
(ii) Antimalarials :Chloroguanide
(iii) Anti-inflammatory: Diclofenac Sodium
(iv) Sedatives: Phenobarbital

UNIT 5 **8 hours**

Chemistry of selected drugs- Synthesis and basic concept of action for the following drugs

(i) Antiulcers and antacids: Omeprazolee
(ii) Antiviral: Acyclovir
(iii) Antihistaminic: Cinnarizine
(iv) Antiasthmatic agents: Salbutamol

Textbooks:

1. Medicinal Chemistry, A. Burger, Vol. I-III, Wiley Interscience Publications, New York, 1995.
2. Medicinal Chemistry, A. Kar, Wiley Eastern Ltd., New Delhi, 1993.

References:

1. The Organic Chemistry of Drug design and Drug action, Richard B. Silverman; II Ed.; Elsevier Acadmic Press, 2004
2. Medicinal Chemistry; Rama Rao Nadendla; PharmaMed Press, 2013

Course Outcomes:

On successful completion of this course, students will be able to:

1) After the completion of the course, the student will be able to
2) describe the lead Drug discovery and Design
3) explain the Drug structure and biological activity
4) understand the structure, physiological role and uses of Vitamins
5) mention some Anticancer, Anti-malarials, Anti-inflammatory, Sedatives agents
6) give some Anti-ulcers and antacids, Antiviral, Antihistaminic,

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	1	2	3	3	3	3
CO2	3	1	1	1	1	2	2	3	3	3	3
CO3	3	1	1	1	1	2	2	3	3	3	3
CO4	3	1	1	1	1	2	2	3	3	3	3
CO5	3	1	1	1	1	3	3	3	3	3	3
CO6	3	1	1	1	1	2	2	3	3	3	3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

GOAL 3: Good Health and Well-being

SDG Justification:

Ensure healthy lives and promote well-being for all at all ages.

CHEM2071	CONCEPTS OF MEDICINAL CHEMISTRY LAB	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 enables the students to gain knowledge on various chemical processes, drug synthesis and its calculations includes Drug assays, Material balances with and without Chemical reactions. The aim of this subject is to offer advanced knowledge in modern synthetic chemistry in some related areas like designing of drugs, discovery, and the development process. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

- To familiarize the students with various types of chemical calculations.
- To study about the material balances without chemical reactions.
- To emphasize the importance of material balances with chemical reactions.
- To impart knowledge on analysis of various medicines.
- To gain the knowledge of medicine synthesis

(1) Assay of Ibuprofen by alkalimetry.

(2) Assay of Diclofenac by alkalimetry.

(3) Assay of Analgin by iodimetry

(4) Assay of Lidocaine HCl by nonaqueous titrimetry

(5) Assay of Metronidazole by nonaqueous titrimetry

(6) Preparation of Benzimidazole from O-phenyline diamine

(7) Preparation of Benzotriazole from O-phenyline diamine

(8) Preparation of Para amino salicylic acid from p-nitro salicylic acid

(9) Preparation of Chlorbutol

(10) Preparation of Benzil from benzoin

(11) Preparation of Phenytoin from benzyl

(12) Preparation of Benzocaine from p-amino benzoic acid

(13) Preparation of 7-hydroxy, 4-methyl coumarin

(14) Preparation of paracetamol

(15) Preparation of Aspirin

At least 8-10 of the above (Assay:3-4 and Preparations:5-6)

Textbooks:

1. Medicinal Chemistry, A. Burger, Vol. I-III, Wiley Interscience Publications, New York, 1995.
2. Medicinal Chemistry, A. Kar, Wiley Eastern Ltd., New Delhi, 1993.
3. The Organic Chemistry of Drug design and Drug action, Richard B. Silverman; II Ed.; Elsevier Acadmic Press, 2004
4. Medicinal Chemistry; Rama Rao Nadendla; PharmaMed Press, 2013

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	2	2	3	2	3	3
CO2	3	1	1	1	1	2	2	3	2	3	3
CO3	3	1	1	1	1	2	2	3	2	3	3
CO4	3	1	1	1	1	2	2	3	2	3	3
CO5	3	1	1	1	1	3	3	3	2	3	3

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

GOAL 3: Good Health and Well-being

SDG Justification:

Ensure healthy lives and promote well-being for all at all ages.

CHEM2081	FUNDAMENTALS OF INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Studied Chemistry at 12th Std"						

Course Description:

This course enables the students to choose correct analytical tools for the characterization as well as quantification of different analytical species and acquire the basic principles of atomic, molecular techniques, Radio-analytical methods and advanced separation methods and their applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

1) To familiarize the students with various types of basic and advanced analytical techniques.
2) To study about the basic principles of atomic, molecular techniques and advanced separation methods.
3) To emphasize the importance of IR spectroscopy, Fluorimetry, thermal methods of analysis and advanced atomic spectroscopy in both qualitative and quantitative analysis of compounds.
4) To impart knowledge on the basic concepts of advanced characterization techniques like HPLC, GC and ICPOES.

UNIT 1 Spectro fluorimetry 8 hours

Theory of fluorescence,phosphorescence, instrumentation, application with reference to thiamine (B1) and riboflavin (B2) Infrared spectroscopy - Interactions with molecules, source of excitation, separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection). Qualitative interpretation of spectrum.

UNIT 2 Mass spectroscopy and NMR spectroscopy 8 hours

Mass spectroscopy: Principle and Instrumentation: Ionization methods: Electron impact ionization, chemical ionization, electrical discharge, laser desorption, fast atom

bombardment. Separation of ions on basis of mass to charge ratio: Magnetic sector analyzer, Time of flight and quadrupole analyzer, Detector.
NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, spin- spin coupling, Applications.

UNIT 3 High performance liquid chromatography and Gas liquid chromatography: 8 hours

High performance liquid chromatography: Theory and instrumentation: pumps, column, detectors-UV detector, refractive index detector, Fluorescence detector, photodiode array detector, applications.
Gas liquid chromatography: Theory and instrumentation: columns (packed and capillary columns), detector: thermal conductivity detector, flame ionization detector, electron capture detector, nitrogen-phosphorus detector, photo ionization detector and applications.

UNIT 4 Induced Couple Plasma Optical Emission Spectroscopy and Thermal methods of analysis 8 hours

Induced Couple Plasma Optical Emission Spectroscopy: source of Excitation: plasma. Nebulizer, Wavelength separation and resolution, Detection of radiation. matrix effects, chemical & spectral interferences.
Thermal methods of analysis: Thermogravimetry (TG): Basic principle and Instrumentation. Thermogram of CuSO4.5H2O and CaC2O4. 2H2O

UNIT 5 Radiochemical Methods and X-ray Fluorescence spectroscopy (surface analysis) 8 hours

Radiochemical Methods: Detection and measurement of radioactivity. Applications of tracer technique: Isotope dilution analysis and applications. Neutron activation analysis and applications. Radio Carbon dating technique
X-ray Fluorescence spectroscopy (surface analysis): Theory, instrumentation: x-ray tube, Energy dispersive and wavelength dispersive spectrometers, matrix effect and general applications.

TextBooks:

1) D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
2) Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, 7th ed, IBH Book House, New Delhi.
3) Atkins, P.W & Paula, J.D. Physical Chemistry, 10th Ed., Oxford University Press (2014).

References:

1. Kakkar, R. Atomic and Molecular Spectroscopy: Concepts and Applications. Cambridge University Press, 2015.
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
3. Banwell, C. N. &McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
4. Smith, B.C. Infrared Spectral Interpretations: A Systematic Approach. CRC Press, 1998.
5. Moore, W.J., Physical Chemistry Orient Blackswan, 1999.

Course Outcomes:

On successful completion of this course, students will be able to:

- list various types of analytical techniques for chemical analysis.
- explain the role of various parts of instruments used in IR spectroscopy, Fluorimetry, thermal methods of analysis and advanced atomic spectroscopy.
- identify suitable analytical technique for chemical analysis.
- distinguish atomic and molecular techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	2	2	3	2	3	3
CO2	3	1	1	1	1	2	2	3	2	3	3
CO3	3	1	1	1	1	2	2	3	2	3	3
CO4	3	1	1	1	1	2	2	3	2	3	3
CO5	3	1	1	1	1	3	3	3	2	3	3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2091	FUNDAMENTALS OF INSTRUMENTAL METHODS OF ANALYSIS LAB	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This lab course is platform for the application of knowledge acquired Instrumental Methods of Analysis (SCY 244) theory course by providing a hands-on experience in performing the experiments of chromatography, solvent extraction and spectrophotometry

Course Educational Objectives:

- To demonstrate the titration curve of amino acids and compare the amino acids and to characterize carbonyl compounds through IR spectroscopy.
- To demonstrate the detection of pollutants through different analytical methods
- To demonstrate the basic difference in performing the HPLC and GC chromatographic techniques.
- To demonstrate the separation and quantification of metal ions through solvent extraction and their quantification.
- To demonstrate the calibration and use of potentiometer for quantification of mixture of analytes.

List of Experiments

1. Safety Practices in the Chemistry Laboratory.
2. Titration curve of an amino acid.
3. Determination of Nickel by spectrophotometry.
4. IR Absorption Spectra – Interpretation of IR spectra (amines, carboxylic acids, alcohols, aldehydes and Ketones).
5. Quantification of the Concentration of sodium and potassium present in different fruit juices by flame absorption and emission spectroscopy.
6. Quantitative Analysis of Mixtures of various Volatile Solvents by Gas Chromatography: Interpretation of the chromatogram.
7. Separation of Mixture of different drug substances by HPLC: Interpretation of the chromatogram.
8. Determination of Ferrous Iron (II) with potassium permanganate by Potentiometric Titration.
9. Thermogravimetric analysis of polymers: Interpretation of thermogram.

10. Thermogravimetric Analysis of the mixture of Calcium, Strontium and Barium oxalate through– Interpretation of thermogram and calculation of the amount of calcium, strontium and barium as oxides.
11. Determination of Chromium by Spectrophotometry.
12. Determination of Nitrite by Spectrophotometry.
13. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption Spectroscopy (Demonstration).

At least 8-10 experiments to be performed.

Reference Books:

1. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

Course Outcomes:

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

1. Apply the correct chromatographic method for the analysis of solvents and carbohydrates
2. Use of UV Vis spectrophotometry in quantification of different analytical species and are able to identification of carbonyl groups through IR.
3. Use of AAS in quantification of metal ions in different samples.
4. Quantify the different pollutants using suitable analytical techniques

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3				3		2			1	3
CO2	3				3		2				3
CO3	3				3		2				3
CO4	3				3		3			2	3
CO5	3				3		2			2	3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong

SDG Justification:

Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2101	PHARMACEUTICS I	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Studied Chemistry at 12th Std"						

Course Description:

This course is to impart fundamental knowledge on industrial pharmacy. Different Dosage forms design, development, and evaluation studies and the manufacturing process problems and scale-up process.

Course Educational Objectives:

Upon completion of this course, the student should be able to:

- Know the various dosage forms and their drug delivery system
- Formulation design and development of dosage forms
- Understand the manufacturing process by using machinery
- Quality control testing of dosage forms and their importance
- Problems in manufacturing process and their scale-up

UNIT 1 **8 hours**

Study the following dosage forms, including the definition, types, formulation design, development, scale-up, and testing of Monophasic liquid dosage forms: Mouth Washes, Ear Drops, Nasal Drops, Lotions. Only Definition of Gargles, Throat Paints, Liniments, Enemas and Colloids Biphasic Liquid dosage forms - Suspensions and Emulsions.

UNIT 2 **Tablets** **8 hours**

definition, types, formulation design and development with details functions excipients, manufacturing process and scale-up of unit operations, problems in manufacturing, quality control testing and machinery involved in Preparation of tablets

Tablet coating: introduction, reasons for coating tablets, types of tablet coating, sugar, film ideal characteristics, formulation design and development with detailed functions of coating component, process details & equipment used in film coating and scale-up of unit operations, defects in the coating.

UNIT 3 Capsules 8 hours

Introduction, sizes of capsules, raw materials required for empty capsules shell manufacturing, properties of Gelatin, the process of Preparation, equipment.

Hard Gelatin Capsule: Formulation design and development with detailed functions of excipients used in capsule preparation, Capsule filling & Machines used in the filling, filling of Powder, Pellet, semi-solid & Liquid into the empty shell.

Soft Gelatin Capsules: Introduction to soft gelatin capsule dosage form, Rationale for the selection of soft gels as a dosage form, Manufacture of soft gels.

UNIT 4 Semi-solid preparations 8 hours

Classification - topical formulations and their application, ointment bases, and their application. Unit operations involved in the manufacturing of ointment, cream, paste, lotion, and gel formulations, CQA for ointment, cream, paste, and gel formulations, CPP, and CMA for ointment, cream, paste, and gel manufacturing process.

UNIT 5 Sustained and Controlled Release Dosage Forms 8 hours

Definition, Types, formulation design of matrix dosage form and pellets and evaluation.

Introduction to labeling & packaging, types of packaging materials, factors that affect the selection of containers, materials used for containers & closures, drug-container considerations, quality control tests for packaging materials.

Textbooks:

1) Leon Lachman, H. A. Lieberman & J. L. Kanig: The Theory and Practice of Industrial Pharmacy, 3rd edition, Varghese Publishing House, Bombay, 1991.
2) M. E. Aulton: ―Pharmaceutics – The Science of Dosage Form Design‖, 2nd edition, Churchill Livingstone, 2002.
3) L. V. Allen, N. G. & Popovich H. C. Ansel: ―Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems‖, 8th edition, Lippincott William & Wilkins, USA, 2005.

References:

1. Rawlins, Ed.: ―Remington's The Science and Practice of Pharmacy, 20th edition, Lippincott William& Wilkins, USA, 2000.
2. Indian Pharmacopoeia‖ Government of India, Ministry of Health & Family Welfare, the Indian Pharmacopeia Commission, Ghaziabad, 2007
3. British Pharmacopoeia, Vol. III, 2009.
4. United States Pharmacopoeia‖, USP 32 – NF 27, Vol1 & 2, Asian Edition, 2008.Rawlins, Ed.: ―Remington‘s The Science and Practice of Pharmacy, 20th edition, Lippincott William & Wilkins, USA, 2000.

Course Outcomes:

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

1. define dosage forms and their applications
2. distinguish between mono-phasic and biphasic liquid dosage forms with examples
3. plan formulation design of tablets and their manufacturing process
4. Define capsules and explain the difference between the Hard gelatine capsules & Soft gelatin capsules.
5. explain about CQA, CPP, and CMA for semi-solid dosage forms and define Sustained and controlled release dosage forms and their advantages

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		1	3					1
CO2	3	2	1		1	3					1
CO3	3	2	1		1	3					1
CO4	3	2	1		1	3					1
CO5	3	2	1		1	3					1

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

APPROVED IN:
BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:
SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:
Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2111	PHARMACEUTICS I LAB	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 know the Preparation of dosage forms. Different conventional dosage forms formulation and their evaluation studies.

Course Educational Objectives:

- Know the basics of different dosage forms and their formulation design
- Understand the manufacturing process by using machinery
- Preparation of various conventional dosage forms and their quality control testing

1. Preparation & evaluation of granules loaded with Active Pharmaceutical Ingredients.
2. Preparation & Evaluation of Tablets
3. Preparation & Evaluation of Film-Coated Tablets
4. Preparation & Evaluation of Capsules
5. Preparation and evaluation of semi-solid dosage forms.

References

1. R.S.Gaud and G.D.Gupta Practical Pharmaceutics
2. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
3. Carter S.JCooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
4. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh.
5. Indian pharmacopoeia.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	1	1		1	2		1			1
CO2	2	1	1		1	2		1			1
CO3	2	1	1		1	2		1			1
CO4	2	1	1		1	2		1			1
CO5	2	1	1		1	2		1			1

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

APPROVED IN:
BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:
SDG 3- Good Health and Well being: Ensure healthy lives and promote well-being for all at all ages. **SDG 4:** Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:
Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2121	UNIT OPERATIONS IN CHEMICAL 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 course enables the students to gain knowledge on various unit operations in chemical engineering which includes filtration, extraction, leaching, distillation, crystallization, Drying, size separation, blending and reactor studies. The knowledge gained in this course can be applied to the latest operations in chemical industries.

Course Educational Objectives:

- To familiarize the students with various types of unit operations.
- To study about the filtration, extraction and leaching techniques.
- To impart knowledge on the various concepts of distillation and crystallization.
- To study about the reactor equipment's.
- To compare different types of methods and select a suitable method for purification of components.
- To expose the students to common industrial techniques.

UNIT 1 Filtration 8 hours

Types of filters batch, continuous filtration, Centrifugation-batch, continuous and basket, inverting bag, bottom discharge, micron, and cartridge filters, Factors affecting filtration and selection of filtration equipment. Microfiltration

Extraction and Leaching: Introduction-extract, raffinate, choice of solvent for extraction, single-stage, multistage extraction, Equipment for extraction operation: lipid liquid extractor, factors affecting extraction and leaching, leaching and its applications.

UNIT 2 Distillation and Crystallization 8 hours

Distillation: Binary systems relative volatility, Ideal solutions, Steam distillation, continuous distillation, azeotropic distillation, extractive distillation, batch distillation, flash distillation, distillation under reduced pressure – FEE, ATFE t.

Crystallization: principles, super saturation cooling crystallization, reactive crystallization, seeding, formation of polymorph, type of agitators, factors affecting crystallization classification of crystallizers, equipment – crystallization in batch reactors.

UNIT 3 Drying 8 hours

Drying: Definition, Applications, the purpose of drying, classification of dryers, drying equipment-Tray dryer, rotary dryers, pneumatic dryer, spray dryer, drum dryer, VTD, FBD, RCVD, RCVD, ATFD, ANFD, Spherical dryer. (Basic theoretical concepts with more practical applications)

UNIT 4 8 hours

Size separation/reduction: Grinders –types-circuit, screening-industrial screens, gyratory and vibratory screens-air jet mail, multi mail, Co mail, bantam mill, hammer mill, sifter Mixing-Homogenous, Heterogeneous.
Blending – types of blender octagonal, hexagonal, double cone type.

UNIT 5 Reactor studies and Unit processes and operations 8 hours

Reactor studies: Basic functions of a reactor, autoclave types –batch, CSTR, semi-batch, body construction, types of agitators- Spargers, gas induction turbine, anchor, PBT, propeller
Unit processes and operations: Oxidation, reduction, dehydration, condensation, Hydrolysis hydrogenation, neutralization, Friedel – craft reaction, the basis of pH, evaporation, column chromatography, membrane separation, bromination, chlorination humidification, basics of organic chemistry, absorption, adsorption.

Textbooks:

1) Julian C. Smith, Warren L.McCabe, Peter Harriott Unit Operations of Chemical Engineering (English), 7th Edition, Mcgraw Hill Education.

References:

2) Shyamal K Sanyal, Salil K Ghosal, Siddhartha, Introduction to Chemical Engineering (English), 1st Edition, Mcgraw Hill Education

Course Outcomes:

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

- list various types of unit processes and operations.
- compare the different processes and select appropriate method for separation.
- explain the methods of filtration, extraction, leaching, distillation, crystallization, Drying, size separation, blending.
- identify common techniques of in chemical units/plants.
- distinguish between different unit operations.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	1	2	1	3	1	1	3
CO2	3	3	3	1	2	1	1	3	1	1	3
CO3	3	3	3	1	2	2	1	3	1	1	3
CO4	3	3	3	1	2	1	1	3	1	1	3
CO5	3	3	3	1	2	2	1	3	1	1	3

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

APPROVED IN:
BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:
SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:
Statement: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEM2131	INDUSTRIAL CHEMICALS AND THE ENVIRONMENT	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 student to the basics of chemistry in production of industrial gases, Inorganic chemicals, Environment and composition, ecosystems, Environmental pollution, Environmental problems, wastewater treatment techniques, waste management, sources of energy.

Course Educational Objectives:

- Introduce the production of Industrial gases, Manufacture of Inorganic chemicals.
- Provide the Knowledge of Environment and its segments.
- Describe the various types of environmental pollution.
- Introduce the techniques used for wastewater treatment, waste management.
- Describe the applications of energy resources.

UNIT 1 Industrial Gases and Inorganic Chemicals 8 hours

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

UNIT 2 Environment and its segments 8 hours

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulfur.

Air Pollution: Major regions of the atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size, and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO2, CO2, CO, NOx, H2S. Methods of estimation of CO, NOx, Sox, and control procedures.

UNIT 3 **8 hours**

Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulfur from coal. Control of particulates. Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

UNIT 4 **8 hours**

Water purification methods. Effluent treatment plants (primary, secondary, and tertiary treatment). Industrial effluents from the following industries and their treatment: textile, tannery, dairy, petroleum, and petrochemicals.

Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electrodialysis, ion exchange). Water quality parameters for wastewater, industrial water, and domestic water.

UNIT 5 **Energy & Environment** **8 hours**

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Textbooks:

1) J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

References:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers,New Delhi
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.
7. S.E. Manahan, Environmental Chemistry, CRC Press (2005).
8. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
9. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

Course Outcomes:

After studying the course, the student will be able to:

1. Explain the production process of industrial gases.
2. Summarize application, analysis and hazards in handling the Inorganic chemicals.
3. identify different major sources of pollution and Techniques for measuring pollution
4. apply the knowledge and principles of chemistry to understand environmental adverse effects
5. analyze Industrial effluents from the industries and their treatment:
6. Appreciate the potential of renewable energy resources and nuclear energy.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1				1	2	3					1
CO2				2	1	3					1
CO3						3					1
CO4						3					1
CO5						1					2

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

APPROVED IN:
BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:
SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.
SDG Justification:
The modules and topics mentioned in this course are designed to provide complete and thorough education with equity for all individuals and encourage education options at all periods.

CHEM2141	INDUSTRIAL SAFETY, CHEMICAL TECHNOLOGY & SOCIETY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to gain knowledge on various aspects of Industrial safety which pertains to transport, handling and storing of flammable liquids and toxic materials, various separation and purification processes which include distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. It aims in enabling students to explore societal and technological issues from a chemical perspective. The knowledge gained in this course can be useful for the application in clean technology and the latest developments in industrial safety and hygiene.

Course Educational Objectives:

- To familiarize the students with various terminology and professionals associated with industrial hygiene.
- To study the classification of toxic agents and to emphasize the importance of industrial safety concerning transport, handling and storing of flammable liquids and toxic materials.
- To familiarize the students with basic purification techniques.
- To impart knowledge on the various scale up operations in chemical industry.
- To emphasize the importance of scientific literacy for better environment and to introduce clean technology.

UNIT 1 **8 hours**

Introduction to Industrial Hygiene & Historical views, Definitions and professionals involved in industrial Hygiene work. Safety and Hygiene aspects related to

I. Transport, handling & storage of inflammable liquids & gases & toxic materials

UNIT 2 **8 hours**

Safety and Hygiene aspects related to Process equipment including piping (fire, static electricity, pressure, temperature etc.) safety aspects at process development & design stage. Threshold Limit Value (TLV) and Permissible Exposure Limits (PEL) for chemicals, Industrial toxicology and the basics, Classification of toxic agents.

UNIT 3 **Chemical Technology – I** **8 hours**

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption.

UNIT 4 **Chemical Technology – II** **8 hours**

An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry.

UNIT 5 **Society** **8 hours**

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water, energy from natural sources (i.e., solar and renewable forms), fossil fuels and nuclear fission, materials like plastics and polymers and their natural analogues, proteins and nucleic acids.

Textbooks:

1. A Textbook of Chemical Technology - S. D. Shukla, G. N. Pandey · 1977
2. Industrial Safety and Environment by Prashar, Anupama, New Delhi SK. Kataria& Sons 2009.
3. Industrial Safety and Environment by A K Gupta, New Delhi University Science Press 2012.
4. John W. Hill, Terry W. McCreary & Doris K. Kolb, Chemistry for changing times 13th Ed, Prentice-Hall (2012).

References:

1) John W. Hill, Terry W. McCreary & Doris K. Kolb, Chemistry for changing times 13th Ed, Prentice-Hall (2012).
2) Industrial Safety, Health Environment and Security by Basudev Panda, Bangalore University Science Press 2013.

Course Outcomes:

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

1. classify different toxic materials.
2. list professionals involved in industrial Hygiene work.
3. identify the measures towards transport, handling & storage of inflammable liquids & gases & toxic materials and apply the knowledge in transporting, handling, and storage of different materials.
4. explain Scaling up operations in chemical industry.
5. compare the different purification techniques like distillation, solvent extraction leaching, adsorption etc.
6. explain different types of natural resources and societal or technological impact on it in a chemical perspective.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1				1		2					1
CO2						2					1
CO3						3					1
CO4											1
CO5						3					2

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

APPROVED IN:
BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:
SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.
SDG Justification:
The modules and topics mentioned in this course are designed to provide complete and thorough education with equity for all individuals and encourage education options at all periods.

CHEM2151	CONCEPTS OF ORGANIC METALLIC CHEMISTRY & CATALYSIS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Studied Chemistry at 12th Std"						

Course Description:

The course would cover various application aspects of organometallic compounds in industrial processes. The course would also highlight the concepts behind these blockbuster industrial processes that have directly impacted our society at large over the last century. Not to mention the fact that nine Nobel prizes have been attributed to the field for original discoveries over the last century, and which too, along with their far-reaching implications, would be covered in this course.

Course Educational Objectives:

- To understand the synthesis, structure, bonding and properties
- To learn about the reactivity of organometallic compounds such as: metal carbonyls, hydrocarbon, and carbocyclic based molecules.
- To know the 18-electron rule (Saturation and Unsaturation), Organometallic reaction (substitution, oxidative-addition, reductive elimination, insertion and de-insertion, and isomerization).
- To study the main concepts and applications of organometallic compounds.
- To recall the role of organometallic and metallic complexes in catalysis.

UNIT 1 **Introduction** **8 hours**

Definition and scope of organometallic, homogeneous vs. heterogeneous catalysis; importance of homogeneous catalysis in the synthesis of high value chemicals and Valence electron count 18 and 16 electron complexes.

UNIT 2 **d-block carbonyls:** **8 hours**

Coordination modes characterization synthesis reactions carbonyl metallates ligands related to CO.

UNIT 3 **Metal carbonyls** **8 hours**

Synthesis, bonding, Properties and applications of Alkyls, aryls, alkenyls, acyl, alkynyls.

UNIT 4 **Metal-Carbon multiple bonded compounds** **8 hours**

Synthesis, bonding, Properties and applications of Carbenes, carbines and Metal-complexes: Alkenes, d—and polyenes.

UNIT 5 **Hydroformylation** **8 hours**

Cobalt and Rhodium complexes, the role of phosphine ligands in regio selective formation of linear aldehydes. Markovnikov and anti-Markovnikov addition and mechanisms.

Textbooks:

1. Inorganic Chemistry; Ajay kumar
2. Inorganic Chemistry By Madan Malik Tuli
3. Principal of inoganic chemistry by puri sharma kalia
4. Lee, J.D. Concise Inorganic Chemistry 9th Ed., John Wiley and sons 2020.

References:

1. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
2. Applied Homogeneous Catalysis with Organometallic Compounds, Vols. 1 & 2, edited by B. Cornils and W.A. Herrmann, VCH, Weinheim, New York, 1996.
3. Organometallics: A concise Introduction, Ch. Elshebroicn and A Salzer, VCH, Chapters 12 to 16.

Course Outcomes:

On successful completion of this course, students will be able to:

1. By the completion of the course, students will get a good overview of the fundamental principles of organ transition-metal chemistry.
2. Have insight into the use of modern methods to characterize organometallic compounds.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	3	3	2	2	3	1	1
CO2	3	2	1	2	3	3	2	3	3	2	2
CO3	3	1	2	1	3	2	3	3	3	3	3
CO4	2	1	2	2	2	3	3	2	3	1	2
CO5	3	2	2	1	2	2	3	3	3	1	3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 9:Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG Justification:

Statement: The modules in this course to impart basic quality education for fostering of industrialization and innovation in health sector

CHEM2161	ELECTROCHEMISTRY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Electrochemistry deals with conversion of electrical energy to chemical energy and how free energy change of a spontaneous chemical reaction can be converted into EMF. It is concerned with how EMF measurements enable determination of free energy and equilibrium constants of a chemical reaction.

Course Educational Objectives:

- introduce Arrhenius theory of strong and weak electrolytes.
- introduce the concepts of ionic mobility, transference number and methods for their determination.
- demonstrate the applications of conductometric and potentiometric titrations
- discuss concept of electrode potential, liquid junction potential and usefulness of electrochemical series
- discuss Faraday's laws, Nernst equation and their applications
- provides insights into electrical and magnetic properties of molecules

UNIT 1 **8 hours**

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions.

UNIT 2 **8 hours**

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) conductometric titrations, and (iii) hydrolysis constants of salts.

UNIT 3 **8 hours**

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells.

UNIT 4 **8 hours**

Determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

UNIT 5 **8 hours**

Basic ideas of electrostatics, Electrostatics of dielectric media, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, Para magnetism.

Textbooks:

1. Atkins, P.W & Paula, J.D. Physical Chemistry, 10thEd., Oxford University Press(2014).

References:

1. Rogers, D. W. Concise Physical Chemistry Wiley (2010)

Course Outcomes:

1. acquaintance with terminology and concepts of electrochemistry
2. insights into applications of conductometric and potentiometric titrations
3. appreciate the usefulness of electrochemical series and ability to apply it for determining the direction in which a given reaction proceeds spontaneously
4. insights into electrical and magnetic properties of molecules

On successful completion of this course, students will be able to:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	1	3	1	3	-	-	3	2
CO2	2	3	2	1	3	1	3	-	-	3	2
CO3	3	3	2	1	2	2	3	-	1	3	2
CO4	3	3	2	2	3	3	3	-	1	3	2
CO5	3	3	2	2	3	3	3	2	2	3	2

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

APPROVED IN:
BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to provide complete and thorough education with equity for all individuals and encourage education options at all periods.

CHEM2171	REGULATORY AFFAIRS AND QUALITY ASSURANCE	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 is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Course Educational Objectives:

Upon completion of the subject student shall be able to

- Know about the manufacturing process and facilities
- Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
- Know different Laws and Acts that regulate pharmaceutical industry
- Understand the approval process and regulatory requirements for drug products

1. Guidelines for Drug Master File: Types
2. Introduction to ICH
3. Abbreviated New Drug Application (ANDA): Hatch – Waxman amendment, patent term restoration, types of ANDA
4. Manufacturing premises
5. Equipment and Raw Materials
6. Manufacture and QC of Dosage Forms
7. Quality audit of Manufacturing process and facilities
8. Quality Control in Laboratory
9. Validation of Analytical Methods
10. Regulatory considerations in Validation
11. Validation
12. Process Validation
13. Globalization & Intellectual Property Rights
14. Drug Approval

UNIT- I

Quality assurance in pharamaceutical industry- Introduction ,Elements of quality, Quality control, quality assurance, Customer requirement of quality, quality policy. Quality assurance in design, development, Statistical process control, statistical quality control.

UNIT-II

Quality system and quality management system-general requirements, management Responsibility, documentation requirements, quality objectives ISO standards concept: ISO9000, ISO14000 and its requirements. Basic concept of ICH guidelines for impurity profiling.

UNIT-III

Good laboratory practice (GLP) – Introduction, history of GLP, Principles of good manufacturing practice, basic issues of GLP, GLP status in India

UNIT-IV

Validation of analytical method- methodology, -limit of detection, limit of Quantification, range, sensitivity, Selectivity and specificity, quality control-principles of Ruggedness/Robustness, Outlines of analytical method development, validation - HPLC for pharmaceutical dosage forms and bulk drugs and GC-MS for residual solvents.

UNIT-V

General idea regarding pharmaceutical industry.- Introduction, Definition and classification of drugs, Quality of drugs, Sources of impurities in pharmaceutical chemicals and raw materials. Impurity profiling, classification of impurities, dissolution techniques of drugs, Significance of stability studies.

Textbooks:

1. Quality Assurance and Quality Management in Pharmaceutical Industry, by Prof. Y. Anjaneyulu, R.Marayya ,Pharma Book syndicate,2002.
2. Analytical Chemistry Gary D Christian, John Wiley and Sons inc, 2003.

Reference Books:

1. D.A. Skoog, D.M. West F.J. Holler and S R. Crouch, Fundamentals of Analytical Chemistry, An Introduction, Sanders College Publishing, New York, 2004
2. K.V.S.G. Murali Krishna, An introduction ISO 9000, ISO 1400 Series, Environmental Management
3. Analytical Method Development and Validation, Michael Swartz, CRC press.1997

Course Outcomes:

On successful completion of this course, students will be able to:

- explain the different manufacturing processes and facilities
- distinguish quality assurance and quality management
- explain different Laws and Acts that regulate pharmaceutical industry
- understand the approval process and regulatory requirements for drug products

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	3	3	2	1	2	3	2
CO2	1	2	3	3	1	1	3	2	1	2	2
CO3	2	1	3	1	2	2	1	1	3	2	3
CO4	1	3	3	2	1	1	2	1	2	1	2

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

APPROVED IN:
BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:
GOAL 12: Responsible Consumption and Production
SDG Justification:
Ensure sustainable consumption and production patterns.

CHEM2181	CHEMICAL PROCESS CALCULATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Chemical Process calculations meets the requirements of B.Sc. Chemistry students. It covers basic concepts of Chemical processes and calculations suitable for academic and industrial applications.

Course Educational Objectives:

- To provide basic knowledge of Chemical processes
- To introduce the concepts of Basic chemical calculations
- To impart knowledge on material balances and energy balances
- To familiarize the concepts involved in the use of fuels and combustion

UNIT 1 **8 hours**

Basic chemical calculations: Gram mole, normality, molarity, weight percent, mole percent, volume percent, gases, ideal gas law, gaseous mixtures, Dalton's law, Amagat's law, relationship between partial pressure and mole fraction, average molecular weight of gas mixture, density of gas mixture, Raoult's law, Henry's law, problems.

UNIT 2 **8 hours**

Material balances without Chemical reactions: Law of conservation of mass, classification of material balance, Material balance without chemical reactions, outline of a procedure for material balance calculations, various operations carried out in industry, bypass operations, material balances of unsteady-state operations, basic problems.

UNIT 3 **8 hours**

Material balance with chemical reactions: Stoichiometric equation, Stoichiometric coefficient, Stoichiometric ratio, Stoichiometric proportion, limiting reactant, excess reactant, percent excess, conversion, yield and selectivity, basic problems.

UNIT 4 **8 hours**

Energy balances: Forms of energy, general energy balance procedure, sensible heat and heat capacities, relationship between Cp and Cv, enthalpy changes accompanying chemical reactions, heat of reaction, heat of formation, heat of combustion, Hess' law of constant heat summation, enthalpy changes in reaction with different temperatures, adiabatic process, adiabatic reaction, adiabatic reaction temperature, adiabatic flame temperature, phase change operation, latent heat of vaporization, latent heat of condensation, latent heat of fusion, latent heat of sublimation, Heat of solution and mixing, basic problems.

UNIT 5 **8 hours**

Fuels and combustion: Solid fuels, liquid fuels, gaseous fuels, calorific values of fuels, Analysis of fuel, theoretical calorific value, combustion of fuel, basic problems.

Textbooks:

1) Olaf A Hougen, KwennethM.Watson and Roland A.Ragatz, Chemical Process Principles Part-I, Material and Energy balances, 2/e, CBS Publishers and Distributors, 2010.
2) K.A. Gavhane, Chemical Process Principles (Stoichiometry), 25/e, NiraliPrakashan, 2009.

References:

1) K.V. Narayanan and B. Lakshmikutty, Stoichiometry and Process calculations, 2/e, PHI Learning Pvt Ltd. 2017.

Course Outcomes:

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

1. understand the concept of molarity, normality, etc.,
2. explainRaolt's law, Henry's law
3. understand the concept of Material balances, explain yield and selectivity
4. apply the concepts involved in fuels and combustion

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	2	2	3	2	2	3	1
CO2	3	1	1	2	3	2	2	2	2	3	2
CO3	3	1	2	2	2	3	3	2	2	3	1
CO4	3	1	2	2	2	3	3	2	2	3	1

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to provide complete and thorough education with equity for all individuals and encourage education options at all periods.

CHEM3061	NANO CHEMISTRY	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 is introduced to learn fundamental concepts of nano materials and their chemistry and characterization for B.Sc. Chemistry students. Also it emphasis on synthesis, their size dependent properties and applications.

Course Educational Objectives:

At the end of the course students should be able to answer the following

- To describe and explain Nano chemistry.
- To know Nanomaterials based on their dimensionality.
- To classify nanomaterials based on dimensionality
- To understand the characterization techniques
- To learn the synthesis methods of nanomaterials

UNIT 1 **8 hours**

Introduction to nanoscience, nanostructure and nanotechnology (basic idea), Overview of nanostructures and nanomaterials, classification, (cluster, colloid, nanoparticles, and nanostructures -Spheroid, Wire, Rod, Tube, and Quantum Dot); Calculation of percentage of surface atom and surface to volume ratio of spherical, wire, rod, and disc shapes nanoparticles.

UNIT 2 **8 hours**

Size dependent properties of nanomaterials (basic idea with few examples only): Quantum confinement, Electrical, Optical (Surface Plasmon resonance), variation in colors (Blue shift & Red shift), Magnetic, thermal and catalytic properties.

UNIT 3 **Synthesis of Nanomaterials** **8 hours**

Brief introduction about Top-down and Bottom-up approaches & self-assembly techniques of nanoparticles synthesis, Solvothermal process, Examples of preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires.

UNIT 4 **8 hours**

Material characterization techniques (basic idea of use of following instruments in nanomaterial characterization need to be emphasized): Electron microscopic technique, diffraction technique, photoelectron spectroscopy, zeta-potential measurement; Examples of use of nanomaterials in environmental remediation and biology (few practical examples of use of materials can be discussed).

UNIT 5 **8 hours**

Examples of use of nanomaterials in environmental remediation and biology (few practical examples of use of materials can be discussed).

Textbooks:

1) C. N. R. Rao, A. Muller, A. K. Cheetam, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Willey-VCH Verlag, Germany, 2005.
2) G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Appications, Imperial College Press, London, 2004

References:

1) R. W. Kelsall, I. W. Hameley, M. Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, England, 2005, 113
2) Charles P. Poole and Frank J Owens, Introduction to nano technology, Wiley Interscience,2003.

Course Outcomes:

On successful completion of this course, students will be able to:

1. Explain the importance of reduction in materials dimensionality, and its relationship with materials properties.
2. Give examples on size-dependant phenomena.
3. Explain top-down and bottom-up approaches for Nanomaterial fabrication, and give some examples.
4. Diffraction data analysis (especially X-ray diffraction) for identification of crystal structure of nanomaterials and thin-films
5. Understanding working principles and analysis of size, topography and morphology analysis of nanomaterials based on SEM/TEM.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1	2	3	3	3	2	2	2
CO2	3	1	1	2	2	3	3	3	2	3	1
CO3	3	3	2	1	2	3	3	3	2	1	3
CO4	3	2	2	1	3	2	3	3	2	1	3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to provide complete and thorough education with equity for all individuals and encourage education options at all periods.

CHEM3071	CHEMISTRY OF MATERIALS	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 is introduced to learn fundamental topics in material chemistry for undergraduate level such as nanomaterials, Porous materials, polymer and energy storage materials.

Course Educational Objectives:

- To understand the materials and their uses in real life problems
- To learn the basic concept and applications of materials
- To explain various synthesis and characterization and application of materials Ability to implement materials for in day today applications
- To study the different types of Materials

UNIT 1 Chemistry of Nanomaterials: 8 hours

Introduction to nanomaterials, nanoparticles, nano cluster, carbon nanotube (CNT) Nano sheets and nanowires. Chemical synthesis of nanomaterials: Sol-Gel method, reverse micellar method, electrolytic methods. Characterizations: Principle and applications of X-ray diffraction (XRD), scanning electron microscope (SEEM) and transmission microscopy (TEM).

UNIT 2 Microporous and Mesoporous Materials: 8 hours

Zeolites, metallosilicates, silicalites and related microporous materials: synthesis and characterizations. Mesoporous silica, metal oxides and related functionalized mesoporous materials: synthesis, and characterizations. Covalent organic frameworks, porous organic **polymers** and related organic porous materials: sensing, adsorption and gas storage applications. Organic-Inorganic hybrid materials, periodic mesoporous metal organic frameworks: H2 /CO2 gas storage and catalytic applications.

UNIT 3 Energy Storage Systems 8 hours

Batteries: Primary, Secondary batteries; difference between primary and secondary batteries, chemistries of primary batteries such as Zinc-Carbon, Alkaline and secondary batteries such as Lead acid, Nickel Cadmium, Metal hydrides, lithium ion, lithium phosphate and high temperature batteries-sodium-sulphur. Advantages, disadvantages, limitations and application each above mentioned batteries. Hydrogen for energy storage. Solar Ponds for energy storage

UNIT 4 Electrical & Electronic Materials, Magnetic Materials and Organic Solar Materials 8 hours

Electrical & Electronic Materials: Intrinsic and Extrinsic Semi conductivity, Dielectric material, Piezo-electric materials.
Magnetic Materials: Introduction, classification of magnetic materials, soft & hard magnetic materials.
Organic Solar Materials: Syntheses of indigo, cyanines, tetrathiafulvalenes dyes, organic sensitizers for DSSC, electron donors and acceptors for organic solar cells.

UNIT 5 Polymeric Materials 8 hours

Polymerization, factors influencing the properties of polymers, differences between thermoplastic and thermos setting polymers. Preparation and properties of polyethylene, polyvinylchloride and Bakelite. Polymer matrix composite materials: Classification and applications. Polymers as biomaterials and biodegradable polymers. Membranes for plasma separation and Blood oxygenation.

Textbooks:

1. B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday, Textbook of Nanoscience and Nanotechnology, University Press, 2013.
2. Pascal Van Der Voort, Karen Leus, Els De Canck, Introduction to Porous Materials, Wiley 2019.
3. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,Woodhead Medical Textiles and Biomaterials for Healthcare, Publishing Limited 2006.

References:

1. Raghavan V (2007), Materials Science and Engineering - A First Course, Prentice Hall, India
2. James F. Shackelford (1996), Introduction to Materials Science for Engineers, Prentice Hall, India
3. Askeland D.R.,& P. P. Fullay (2007), The Science and Engineering of Materials –4th Cengage Learning Publishers

Course Outcomes:

On successful completion of this course, students will be able to:

1. Acquire knowledge about the various materials used.
2. Understand about Nano materials and porous materials
3. gain knowledge on energy storage devices, electronic, magnetic materials and polymers.
4. gain insights into different synthesis physical & chemical properties of materials

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	2				3	1					
CO2	2				3	1					
CO3	1				3	2					
CO4	2				3	2					
CO5											

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

GOAL 3: Good Health and Well-being, GOAL 4: Quality Education,

SDG Justification:

Ensure healthy lives and promote well-being for all at all ages.& Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

CHEM3081	BIOORGANIC AND BIOINORGANIC CHEMISTRY	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 is designed to introduce the prime concepts in Bioorganic chemistry and Bio-inorganic chemistry. It emphasis on chemistry and biochemical aspects of molecule of life like carbohydrates, lipids, proteins, metals ions and Enzymes

Course Educational Objectives:

1. To understand the chemistry of carbohydrates
2. To know about the lipids and fats
3. To explain about the chemistry of amino acids, proteins, peptides and enzymes
4. To learn about the role of metals in biological reactions
5. To discuss the concepts of metalloenzymes

Unit-1 **Carbohydrates**

structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non- reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). (Definition, structure, functions, examples only) Carbohydrates as informational molecules, working with carbohydrates (applications of carbohydrate)

Unit-II

Lipids: Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils. General properties and structures of phospholipids, sphingolipids and cholesterol. Biomembranes - Behavior of amphipathic lipids in water. Formation of micelles, bilayers, vesicles, liposomes; Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Lipids as signals, cofactors and pigments (preliminary ideas only)

Unit-III **Amino acids**

Definition, classification & structures. Physico-chemical properties of amino acids(amphoteric molecules, ionisation, zwitterions, pk values, isoelectric point, Lambert-Beer's law, optical density, absorption spectra), titration of amino acids (glycine, glutamic acid, lysine, histidine), Formol titration of glycine (only reaction and principle), reaction of amino acids: reaction due to amino groups(reaction with mineral acids,alkyl halides, acetyl chloride, acetic anhydride in presence of base, nitrous acid, ninhydrin and fluorescamine), reaction due to carboxylic acid group (reaction with base, alcohol, LiAlH4, metal oxide), separation and analysis of amino acids by paper & thin layer chromatography and HPLC.

Unit -IV

Elements of life: essential and beneficial elements, major, trace and ultratrace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na+, K+, Mg2+, Ca2+, Fe3+/2+, Cu2+/+, and Zn2+). Metal ion transport across biological membrane Na+/ K+-ion pump. Dioxygen molecule in life. Dioxygen management proteins: Haemoglobin, Myoglobin, Hemocyanine and Hemerythrin. Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases (examples only)

Unit-V

Metalloenzymes -Structure and function –Carbonic anhydrase – Carboxy peptidase -Alkaline phosphatase -Alcohol dehydrogenase. Oxygenases, peroxidases and catalases. Interchangeability of zinc and cobalt in enzymes, Reasons for interchangeability –uniqueness of zinc as a biochemical element.

Textbooks:

1) Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C.Penny, Springer-Verlag., 2010
2) Bioorganic Chemistry; Harish K. Chopra, Anupama Parmar, Parmjit S. Panesar:Narosa Publishing House, 2013
3) Bioorganic, Bioinorganic and Supramolecular Chemistry by J.P.Kalsi, P.S.Kalasi, ew Age India Ltd, 2012

References:

1) Enzyme chemistry: Impact and Applications, Ed.Collin J Suckling, Chapman and Hall., 1990
2) Enzyme Structure and Mechanism, A Fershyt, W.H.Freeman.,1977
3) Biochemistry: The Chemical Reactions of Living Cells, D.E.Metzler, Academic Press, 2012
4) 4Bioinorganic Chemistry by L. Bertini, H.B. Gray, J.S. Valentine, Uni. Science Books, 1994.
5) Bioinorganic Chemistry: A short course by Rosette M. Roat-Malone, John-Wiley Sons. Inc., 2002.

Course Outcomes:

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

1. Explain the chemistry of carbohydrates
2. Classify the lipids and explain the importance
3. Explain about the chemistry of amino acids, proteins, peptides and enzymes
4. Discuss the role of metals in biological reactions
5. Discuss the concepts of metalloenzymes and their imporance

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	2	3	2	3	3	3	1	2
CO2	3	2	1	1	2	3	3	3	3	1	2
CO3	3	1	1	2	3	3	3	3	2	2	2
CO4	2	1	1	2	3	2	3	2	3	1	3
CO5	3	2	1	2	3	2	3	2	3	2	3

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG 4: Ensuring an inclusive and equitable quality education for all persons and promoting lifelong learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to provide complete and thorough education with equity for all individuals and encourage education options at all periods.

CHEM3091	PHARMACEUTICS 2	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	"Studied Chemistry at 12th Std"						

Course Description:

The course deals with the importance and implementation of the sterilization process in parenteral—dosage form design and development and scale-up of small volume and large volume parenteral. The knowledge gained in this course can be applied to the pharmaceutical industry.

Course Educational Objectives:

- To familiarize the students with various types of parenteral dosage forms.
- To study the formulation design, development, and evaluation tests for parenteral.
- To emphasize the importance of sterilization methods and their applications.
- To impart knowledge on the aseptic processes and sources for contamination.
- To expose the students to the latest techniques.

UNIT 1 **Parenterals**: **8 hours**

Definition, Types, vehicles, used and quality control tests for parenteral. Formulation design, development, and scale-up of parenterals.

UNIT 2 **Sterilization and Depyrogenation:** **8 hours**

Unit operations in Aseptic manufacturing, Moist heat sterilization and autoclaving cycle, Importance of F and Z value, Sterility Assurance Level (Overkill approach) and D value, Loading pattern and biological indicators, mechanism of sterilization using Dry Heat and FH Value, bacterial endotoxin, De pyrogenation, sterile filtration and filter media, filter integrity testing, and bubble point.

UNIT 3 **Aseptic Processing & Interventions:** **8 hours**

compounding for sterile filtration, aseptic processing, and aseptic interventions, aseptic process simulation and regulatory expectation, lyophilization and freeze-drying, explain the impact of extraneous matter in the final product.

UNIT 4 **Cleaning and Sanitization:** **8 hours**

Define and classify microorganisms, the impact of microbial contamination on the sterile product, various sources of microbial contamination, cleanroom behavior and aseptic gowning, cleaning in the aseptic area, decontamination of isolators using VHP, Physical and Chemical means of Disinfection.

UNIT 5 **Visual Inspection** **8 hours**

Personal Qualification as per SOP OPR 012
Environment Monitoring: Personal Qualification as per SOP FT7QC084

Textbooks:

1) Leon Lachman, H. A. Lieberman & J. L. Kanig: —The Theory and Practice of Industrial Pharmacy‖, 3rd edition, Varghese Publishing House, Bombay, 1991.
2) M. E. Aulton: —Pharmaceutics – The Science of Dosage Form Design‖, 2nd edition, hurchill Livingstone, 2002.
3) Rawlins, Ed.: —Remington's The Science and Practice of Pharmacy‖, 20th edition, Lippincott William & Wilkins, USA, 2000.

References:

1. Indian Pharmacopoeia‖ Government of India, Ministry of Health & Family Welfare, the
2. Indian Pharmacopeia Commission, Ghaziabad, 2007
3. British Pharmacopoeia, Vol. III, 2009.
4. United States Pharmacopoeia‖, USP 32 – NF 27, Vol1 & 2, Asian Edition, 2008.
5. Carter, Ed.: —Cooper & Gunn's Tutorial Pharmacy,‖ 6th edition., CBS Publishers, 1972.
6. S.J. Carter Ed.: —Cooper & Gunn's Dispensing for Pharmaceutical Students‖, 12th edition, CBS Publisher, New Delhi, 1987.

Course Outcomes:

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

1. explain about parenteral dosage form design and their classification
2. design the layout of the parenteral unit
3. describe sterilization methods and biological indicators
4. explain sources and impact of microbial contamination on sterile products
5. distinguish between viable and non-viable particulates & their detection techniques
6. define visual inspection and identification of defects on sterile products and their limitations

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		1	3					2
CO2	3	2	1		1	3					2
CO3	3	2	1		1	3					2
CO4	3	2	1		1	3					2
CO5	3	2	1		1	3					2

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

APPROVED IN:

BOS : 30-03-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-3 - Good Health and Well-being

SDG Justification:

Ensure healthy lives and promote well-being for all at all ages.