SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur-603203.

Artificial Intelligence and Data Science

UG-Curricula and Syllabi

B.Tech – Artificial Intelligence and Data Science

Regulation 2023

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)
B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
REGULATIONS – 2023

VISION OF THE INSTITUTE

"Educate to excel in Social Transformation"

To accomplish and maintain international eminence and become a model institution for higher learning through dedicated development of minds, advancement of knowledge and professional application of skills to meet the global demands.

MISSION OF THE INSTITUTE

• To contribute to the development of human resources in the form of professional engineers and managers of international excellence and competence with high motivation and dynamism, who besides serving as ideal citizen of our country will contribute substantially to the economic development and advancement in their chosen areas of specialization.

• To build the institution with international repute in education in several areas at several levels with specific emphasis to promote higher education and research through strong institute-industry interaction and consultancy.

VISION OF THE DEPARTMENT

To become a model for Artificial Intelligence with innovation and analysis for higher learning through various analytical knowledge, creative competent and dynamic technocrats; while remaining responsive to ethical, societal and environmental issues.

MISSION OF THE DEPARTMENT

M1: To develop the students as an Artificial Intelligence designer and data analyst professionals in order to meet the global design challenges and entrepreneurs of International excellence as global leaders capable of contributing towards technological innovations, learning process, participation citizenship in their neighborhood and economic growth.

M2: To transform value-based data science education to the students and groom them as leaders in the field of Artificial Intelligence and Data Science for the empowerment of society.

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1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To afford the necessary background in the field of Artificial Intelligence and data Science to deal with engineering problems to excel as engineering professionals in industries.

2. To improve the qualities like creativity, leadership, teamwork and skill thus contributing towards the growth and development of society.

3. To develop ability among students towards innovation and entrepreneurship that caters to the needs of Industry and society.

4. To inculcate and attitude for life-long learning process through the use of Artificial Intelligence and Data Science sources.

5. To prepare then to be innovative and ethical leaders, both in their chosen profession and in other activities.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, Bachelor of Technology in Artificial Intelligence and Data Science Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcomes
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

After the completion of Bachelor of Technology in Artificial Intelligence and Data Science programme the student will have following Program specific outcomes

1. Design and develop secured database applications with data analytical approaches of data preprocessing, optimization, visualization techniques and maintenance using state of the art methodologies based on ethical values.

2. Design and develop intelligent systems using computational principles, methods and systems for extracting knowledge from data to solve real time problems using advanced technologies and tools.

3. Design, plan and setting up the network that is helpful for contemporary business environments using latest software and hardware.

4. Planning and defining test activities by preparing test cases that can predict and correct errors ensuring a socially transformed product catering all technological needs.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
I	3	3											3	3	3	
II			3		3	3	3		2					3		
III			3	3	3	3					1	2			3	3
IV												2	3			
V								3		3			3	3	3	3

Contribution: 1 - Reasonable   2 - Significant   3 – Strong

MAPPING – UG –ARTIFICIAL INTELLIGENCE AND DATA SCIENCE ENGINEERING

S. No	Semester	Course Code	Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
			I YEAR																
1	Sem I	EN3111	Professional English - I	2.2	2.6	2.0	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
2		MA3122	Matrices and Calculus	3.0	2.0	2.0	1.0	-	-	-	-	-	-	-	1.0	-	-	1.0	-
3		PH3123	Engineering Physics	2.8	1.4	1.4	1.0	1.3	1.0	1.0	-	-	-	-	1.0	-	-	-	-
4		CH3124	Engineering Chemistry	2.8	1.8	2.2	1.5	1.0	1.0	2.0	-	-	-	-	2.0	-	-	-	-
5		GE3131	Basic Electrical and Electronics Engineering	2.8	2.8	1.8	1.7	3.0	2.0	2.0	2.0	-	-	-	-	1.8	1.5	2.5	2.0
6		GE3111	தமிழர் மரபு / Heritage of Tamils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7		GE3121	Physics and Chemistry Laboratory	2.5	1.7	1.8	1.0	1.1	-	1.0	-	-	-	-	1.0	-	-	-	-
8		GE3134	Engineering Practices Laboratory	3.0	2.0	2.3	2.0	2.3	1.0	-	-	1.0	-	1.0	1.0	1.7	2.0	2.5	2.0
9		EN3119	English Language Learning Laboratory	1.7	1.3	1.0	1.3	2.0	-	2.0	-	-	2.8	-	1.0	-	-	-	-
10	Sem II	EN3211	Professional English – II	2.0	2.0	1.4	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
11		MA3222	Statistics and Numerical Methods	3.0	3.0	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-
12		PH3222	Physics for Information Science	3.0	1.0	1.8	1.0	2.0	1.0	1.3	-	-	-	-	1.0	-	-	-	-
13		CH3222	Chemistry for Information Science	1.6	1.0	1.0	2.0	2.3	-	1.0	-	-	-	1.0	1.0	2.0	-	1.0	-
14		GE3231	Problem solving and Python Programming	2.4	2.6	3.0	2.8	1.8	-	-	-	-	-	1.6	2.0	2.5	-	2.0	1.0

S. No	Semester	Course Code	Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
15		GE3211	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16		GE3233	Engineering Graphics and Design	2.0	-	3.0	-	1.0	-	-	-	1.0	3.0	-	2.0	2.0	1.0	1.0	1.0
17		GE3232	Problem solving and Python Programming Laboratory	2.6	2.6	3.0	2.8	2.2	-	-	-	-	-	2.0	2.0	1.0	3.0	1.7	2.0
18		GE3221	Engineering Sciences Laboratory	2.5	1.9	1.8	1.0	1.1	2.0	2.0	2.0	-	-	-	-	-	-	-	-
19		GE3251	NSS / YRC / NSO / Club Activities #	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
II YEAR																			
20		MA3322	Discrete Mathematics	3.0	3.0	2.4	-	-	-	-	-	1.0	-	-	1.0	-	-	1.0	-
21		AD3361	Data Exploration and Visualization	2.3	2.5	2.0	2.0	1.0	-	-	-	3.0	2.0	2.0	2.0	1.8	1.0	2.0	2.5
22		AD3362	Database Design and Management	2.3	2.5	2.3	2.0	1.0	-	-	-	1.0	1.5	1.0	2.0	1.2	1.5	2	1.0
23	Sem III	AD3363	Digital Principles and Computer Organization	2.7	2.5	2.5	2.5	2.0	2.0	1.0	1.0	1.0	1.0	-	2.5	1.5	-	2.0	-
24		IT3361	Programming and Data Structures	3.0	2.8	2.6	-	-	-	-	-	-	-	-	-	3.0	2.0	-	-
25		CS3363	Software Engineering	2.0	2.0	3.0	3.0	-	2.5	-	-	-	2.0	3.0	2.0	2.0	2.0	1.5	-
26		AD3364	Data Exploration and Visualization Laboratory	2.4	1.8	2.0	1.6	1.0	-	-	-	2.4	2.2	1.8	2.2	2.0	2.0	-	2.2
27		AD3365	Database Design and Management Laboratory	2.5	2.5	2.3	2.0	1.0	-	-	-	1.0	2.5	-	2.0	2.0	1.0	1.0	1.5

S. No	Semester	Course Code	Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
28	Sem III	IT3363	Programming and Data Structures Laboratory	2.6	2.3	3.0	-	2.0	-	-	-	-	-	-	-	3.0	2.3	-	-
29		MA3428	Applied Mathematics for Data Science	3.0	3.0	3.0	-	-	-	-	-	-	-	-	-	-	-	1.0	-
30		AD3461	Artificial Intelligence - I	2.3	2.0	2.3	2.0	1.0	-	-	-	2.0	1.0	2.0	1.5	2.0	2.0	-	1.4
31		AD3462	Data and Information Security	3.0	2.5	2.0	2.0	1.7	-	-	-	3.0	-	1.0	3.0	2.0	-	1.8	2.0
32		AD3463	Data Communication and Networks	3.0	2.5	2.0	2.3	1.5	-	-	-	3.0	-	1.0	2.0	2.0	-	2.0	-
33		AD3464	Fundamentals of Data Science and Analytics	1.3	3.0	2.3	1.7	1.5	-	-	-	1.5	2.0	3.0	2.5	2.6	1.5	-	1.3
34	Sem IV	IT3461	Operating Systems	2.0	2.0	2.4	1.8	1.0	-	-	-	-	-	-	-	-	2.0	-	-
35		GE3451	NCC Credit Course Level – I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36		AD3465	Artificial Intelligence - I Laboratory	2.7	2.0	3.0	2.3	1.0	-	-	-	1.5	2.0	2.0	2.0	2.0	2.2	-	2.0
37		AD3466	Data Communication and Networks	2.7	2.5	3.0	2.3	2.5	-	-	-	3.0	-	1.0	3.0	2.7	-	2.0	-
38		AD3467	Data Science and Analytics Laboratory	2.3	2.5	1.0	2.5	2.0	-	-	-	1.7	3.0	3.0	2.5	2.4	2.0	-	2.0
39		AD3561	Embedded Systems and IoT	2.6	2.5	2.5	2.0	-	-	-	-	-	-	-	-	2.0	-	2.0	2.0
40	Sem V	AD3562	Machine Learning	1.6	1.8	2.8	2.0	1.5	-	-	-	2.8	2.3	2.3	2.3	2.7	2.3	-	2.0
41		AD3563	Text and Speech Analysis	2.2	1.8	1.8	1.6	2.0	-	-	-	2.2	2	1.2	2.0	2.4	2	-	1

S. No	Semester	Course Code	Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
42	Sem V	IT3761	Cloud Computing	2.4	2.5	2.5	-	-	-	-	-	-	-	-	-	2.0	-	2.0	2.0
43		CE3531	Environmental Studies	2.8	1.8	1.0	1.0	-	2.2	2.4	-	-	-	-	1.8	-	-	-	-
44		AD3564	Embedded Systems and IoT Laboratory	2.4	2.5	2.5	-	-	-	-	-	-	-	-	-	2.0	-	2.0	2.0
45		AD3565	Machine Learning Laboratory	2.0	1.8	2.0	1.4	2.0	-	-	-	3.0	2.0	3.0	2.5	2.5	2.3	-	2.3
46		AD3566	Text and Speech Analysis Laboratory	2.2	1.8	1.8	1.6	2.0	-	-	-	2.0	1.5	1.3	2.3	2.3	1.8	-	1.0
47	Sem VI	AD3661	Big Data Analytics	2.8	3.0	2.8	2.8	2.8	-	-	-	2.2	1.8	2.6	2.0	2.2	2.8	-	2.6
48		AD3662	Distributed Computing	1.8	2.4	1.8	2.4	2	-	-	-	2.6	2.2	2.2	1.6	2	-	1.8	1.6
49		IT3662	Mobile Computing	3.0	2.0	3.0	-	-	-	-	-	-	-	-	-	-	2.0	1.5	-
50		AD3663	Big Data Analytics Laboratory	3.0	2.5	3.0	2.6	2.0	-	-	-	2.0	2.0	2.0	2.0	2.2	2.8	-	2.3
51		EN3649	Professional Communication Laboratory	1	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-
52		AD3641	Mini Project	3.0	3.0	3.0	1.0	3.0	-	-	-	-	-	-	-	2.0	2.3	2.0	3.0
53	Sem VII	AD3761	Artificial Intelligence - II	2.8	3	2.6	-	-	-	-	-	-	-	-	-	-	2.6	-	-
54		AD3762	Deep Learning	2.8	2.4	2	2.4	2.2	-	-	-	1.6	2.4	1.4	2.4	2.0	1.0	2.0	1.3
55		BA3711	Human Values and Ethics	-	-	1.0	1.5	-	-	1.0	-	-	-	-	-	-	-	-	-

S. No	Semester	Course Code	Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
56	Sem VII	AD3763	Artificial Intelligence – II Laboratory	1.5	1.6	2.0	2.0	3.0	3.0	3.0	3.0	-	-	-	-	2.0	2.0	2.4	-
57		AD3764	Deep Learning Laboratory	3.0	2.4	1.5	2.3	2.0	-	-	-	2.5	2.0	1.5	-	-	1.8	2.4	2.3
58		AD3741	Internship	2.0	2.0	3.0	3.0	-	2.5	-	-	-	2.0	3.0	2.0	2.0	2.0	1.5	-
59	Sem VIII	AD3841	Project Work	2.8	2.7	2.5	2.7	2.0	2.0	2.0	1.0	2.7	2.7	3.0	2.0	2.5	3.0	2.5	3.0

SRM VALLIAMMAI ENGINEERING COLLEGE
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REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM
B. Tech. ARTIFICIAL INTELLIGENCE and DATA SCIENCE
CURRICULA AND SYLLABI
SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	EN3111	Professional English - I	HSMC	3	0	0	3	3
2.	MA3122	Matrices and Calculus	BSC	3	1	0	4	4
3.	PH3123	Engineering Physics	BSC	3	0	0	3	3
4.	CH3124	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE3131	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
6.	GE3111	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICAL								
7.	EN3119	English Language Learning Laboratory	HSMC	0	0	2	2	1
8.	GE3121	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9.	GE3134	Engineering Practices Laboratory	ESC	0	0	4	4	2
			TOTAL	**16**	**1**	**10**	**27**	**22**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	EN3211	Professional English – II	HSMC	3	0	0	3	3
2.	MA3222	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3222	Physics for Information Science	BSC	3	0	0	3	3
4.	CH3222	Chemistry for Information Science	BSC	3	0	0	3	3
5.	GE3231	Problem solving and Python Programming	ESC	3	0	0	3	3
6.	GE3211	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1	1
THEORY CUM PRACTICAL								
7.	GE3233	Engineering Graphics and Design	ESC	1	0	4	5	3
PRACTICAL								
8.	GE3221	Engineering Sciences Laboratory	BSC	0	0	4	4	2
9.	GE3232	Problem solving and Python Programming Laboratory	ESC	0	0	4	4	2
10.	GE3251	NSS / YRC / NSO / Club Activities #	PCD	0	0	0	0#	0#
# Conducted after college hours			**TOTAL**	**17**	**1**	**12**	**30**	**24**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	MA3322	Discrete Mathematics	BSC	3	0	0	3	3
2.	AD3361	Data Exploration and Visualization	PCC	3	0	0	3	3
3.	AD3362	Database Design and Management	PCC	3	0	0	3	3
4.	AD3363	Digital Principles and Computer Organization	PCC	3	0	0	3	3
5.	IT3361	Programming and Data Structures	PCC	3	0	0	3	3
6.	CS3363	Software Engineering	PCC	3	0	0	3	3
PRACTICAL								
7.	AD3364	Data Exploration and Visualization Laboratory	PCC	0	0	3	3	1.5
8.	AD3365	Database Design and Management Laboratory	PCC	0	0	3	3	1.5
9.	IT3363	Programming and Data Structures Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**18**	**0**	**9**	**27**	**22.5**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	MA3428	Applied Mathematics for Data Science	BSC	2	0	0	2	2
2.	AD3461	Artificial Intelligence - I	PCC	3	0	0	3	3
3.	AD3462	Data and Information Security	PCC	3	0	0	3	3
4.	AD3463	Data Communication and Networks	PCC	3	0	0	3	3
5.	AD3464	Fundamentals of Data Science and Analytics	PCC	3	0	0	3	3
6.	IT3461	Operating Systems	PCC	3	0	0	3	3
7.	GE3451	NCC Credit Course Level – I *	PCD	3*	0	0	3*	3*
PRACTICAL								
8.	AD3465	Artificial Intelligence - I Laboratory	PCC	0	0	3	3	1.5
9.	AD3466	Data Communication and Networks Laboratory	PCC	0	0	3	3	1.5
10.	AD3467	Data Science and Analytics Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**17**	**0**	**9**	**26**	**21.5**

*NCC Credit Course Level – I is offered for NCC Students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	AD3561	Embedded Systems and IoT	PCC	3	0	0	3	3
2.	AD3562	Machine Learning	PCC	3	0	0	3	3
3.	AD3563	Text and Speech Analysis	PCC	3	0	0	3	3
4.	IT3761	Cloud Computing	PCC	3	0	0	3	3
5.	PXXXXX	Professional Elective – I	PEC	3	0	0	3	3
6.	PXXXXX	Professional Elective – II	PEC	3	0	0	3	3
7.	CE3531	Environmental Studies	ESC	2	0	0	2	2
8.	GE3551	NCC Credit Course Level – II *	PCD	3*	0	0	3*	3*
PRACTICALS								
9.	AD3564	Embedded Systems and IoT Laboratory	PCC	0	0	3	3	1.5
10.	AD3565	Machine Learning Laboratory	PCC	0	0	3	3	1.5
11.	AD3566	Text and Speech Analysis Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**20**	**0**	**9**	**29**	**24.5**

*NCC Credit Course Level – II is offered for NCC Students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	AD3661	Big Data Analytics	PCC	3	0	0	3	3
2.	AD3662	Distributed Computing	PCC	3	0	0	3	3
3.	IT3662	Mobile Computing	PCC	3	0	0	3	3
4.	PXXXXX	Professional Elective – III	PEC	3	0	0	3	3
5.	PXXXXX	Professional Elective – IV	PEC	3	0	0	3	3
6.	MAN10X	Management Elective #	HSMC	2	0	0	2	2
7.	MXX10X	Mandatory Course – I &	MC	3	0	0	3	0
PRACTICALS								
8.	AD3663	Big Data Analytics Laboratory	PCC	0	0	3	3	1.5
9.	EN3649	Professional Communication Laboratory	EEC	0	0	2	2	1
10.	AD3641	Mini Project	EEC	0	0	4	4	2
			TOTAL	**20**	**0**	**9**	**29**	**21.5**

& Mandatory Course- I is a Non-credit Course (Student shall select one course from the list given under Mandatory Course- I)
# Management Elective shall be chosen from the Management Elective Courses

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	AD3761	Artificial Intelligence - II	PCC	3	0	0	3	3
2.	AD3762	Deep Learning	PCC	3	0	0	3	3
3.	PXXXXX	Professional Elective – V	PEC	3	0	0	3	3
4.	PXXXXX	Professional Elective – VI	PEC	3	0	0	3	3
5.	BA3711	Human Values and Ethics	HSMC	2	0	0	2	2
6.	OXXXXX	Open Elective – I **	OEC	3	0	0	3	3
7.	MXX20X	Mandatory Courses – II &	MC	3	0	0	3	0
PRACTICALS								
8.	AD3763	Artificial Intelligence – II Laboratory	PCC	0	0	3	3	1.5
9.	AD3764	Deep Learning Laboratory	PCC	0	0	3	3	1.5
10.	AD3741	Internship *	EEC	0	0	0	0	1
			TOTAL	**20**	**0**	**6**	**26**	**21**

& Mandatory Course- II is a Non-credit Course (Student shall select one course from the list given under Mandatory Course- II)

** Open Elective shall be chosen from the emerging technologies.

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
PRACTICALS								
1.	AD3841	Project Work	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

MANAGEMENT – ELECTIVE

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	MAN101	Principles of Management	HSMC	2	2	0	0	2
2.	MAN102	Total Quality Management	HSMC	2	2	0	0	2
3.	MAN103	Human Resources Management	HSMC	2	2	0	0	2
4.	MAN104	Entrepreneurship Development	HSMC	2	2	0	0	2

MANDATORY COURSES I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	MBA101	Introduction to Gender Studies	MC	3	3	0	0	0
2.	MEN101	Elements of Literature	MC	3	3	0	0	0
3.	MBA102	Patents Drafting for Beginners	MC	3	3	0	0	0
4.	MBA103	Industrial Psychology	MC	3	3	0	0	0
5.	MBA104	Indian Constitution	MC	3	3	0	0	0

MANDATORY COURSES II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	MGE201	Well Being with traditional practices – Yoga, Ayurveda and Siddha	MC	3	3	0	0	0
2.	MGE202	History of Science and Technology in India	MC	3	3	0	0	0
3.	MCY201	Awareness of Cyber Security and Cyber law	MC	3	3	0	0	0
4.	MME201	Industrial Safety	MC	3	3	0	0	0

PROFESSIONAL ELECTIVE COURSES: VERTICALS

PE	VERTICAL I INFORMATION ANALYTICS	VERTICAL II CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES	VERTICAL III CYBER SECURITY AND DATA PRIVACY	VERTICAL IV CREATIVE MEDIA	VERTICAL V COMPUTATIONAL INTELLIGENCE	VERTICAL VI INDUSTRY 4.0
BOARD	AI&DS	IT	CYS	IT	CSE	CSE
1	Bio-Inspired Optimization Techniques	Data Warehousing	Modern Cryptography	Multimedia Data Compression and Storage	Knowledge Engineering	Introduction to Industry 4.0
2	Image and Video Analytics	Storage Technologies	Cryptocurrency and Blockchain Technologies	Video Creation and Editing	Soft Computing	3D Printing and Design
3	Health Care Analytics	Virtualization	Ethical Hacking	Multimedia and Animation	Cognitive Science	Internet of Everything
4	Business Analytics	Cloud Services and Management	Social Engineering	Augmented Reality and Virtual Reality	Optimization Techniques	Neural Networks
5	Game Theory	Security and Privacy in Cloud	Big Data Security	Game Development	Computer Vision	Extended Reality Technologies
6	Ethics And AI	Software Defined Networking	Data Privacy	Digital Marketing	Computational Linguistics	Robotic Process Automation

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2023, Clause 19.

Total number of courses per vertical may change in the each programme of study as 6 or 7 or 8. If there is shortage of courses in a vertical the same may be chosen from another vertical of the same programme.

PROFESSIONAL ELECTIVES (PE)
VERTICAL I: INFORMATION ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	PAD101	Bio-Inspired Optimization Techniques	PEC	3	0	0	3	3
2.	PAD103	Image and Video Analytics	PEC	3	0	0	3	3
3.	PAD104	Health Care Analytics	PEC	3	0	0	3	3
4.	PAD106	Business Analytics	PEC	3	0	0	3	3
5.	PAD108	Game Theory	PEC	3	0	0	3	3
6.	PAD109	Ethics And AI	PEC	3	0	0	3	3

VERTICAL II: CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	PIT201	Data Warehousing	PEC	3	0	0	3	3
2.	PIT202	Storage Technologies	PEC	3	0	0	3	3
3.	PIT203	Virtualization	PEC	3	0	0	3	3
4.	PIT204	Cloud Services and Management	PEC	3	0	0	3	3
5.	PIT205	Security and Privacy in Cloud	PEC	3	0	0	3	3
6.	PIT206	Software Defined Networking	PEC	3	0	0	3	3

VERTICAL III: CYBER SECURITY AND DATA PRIVACY

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	PCY301	Modern Cryptography	PEC	3	0	0	3	3
2.	PCY302	Cryptocurrency and Blockchain Technologies	PEC	3	0	0	3	3
3.	PCY303	Ethical Hacking	PEC	3	0	0	3	3
4.	PCY304	Social Engineering	PEC	3	0	0	3	3
5.	PCY305	Big Data Security	PEC	3	0	0	3	3
6.	PCY306	Data Privacy	PEC	3	0	0	3	3

<h2>VERTICAL IV: CREATIVE MEDIA</h2>

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	PIT401	Multimedia Data Compression and Storage	PEC	3	0	0	3	3
2.	PIT402	Video Creation and Editing	PEC	3	0	0	3	3
3.	PIT403	Multimedia and Animation	PEC	3	0	0	3	3
4.	PIT404	Augmented Reality and Virtual Reality	PEC	3	0	0	3	3
5.	PIT405	Game Development	PEC	3	0	0	3	3
6.	PIT406	Digital Marketing	PEC	3	0	0	3	3

<h2>VERTICAL V: COMPUTATIONAL INTELLIGENCE</h2>

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	PCS501	Knowledge Engineering	PEC	3	0	0	3	3
2.	PCS502	Soft Computing	PEC	3	0	0	3	3
3.	PCS503	Cognitive Science	PEC	3	0	0	3	3
4.	PCS504	Optimization Techniques	PEC	3	0	0	3	3
5.	PCS505	Computer Vision	PEC	3	0	0	3	3
6.	PCS506	Computational Linguistics	PEC	3	0	0	3	3

<h2>VERTICAL VI: INDUSTRY 4.0</h2>

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
THEORY								
1.	PCS601	Introduction to Industry 4.0	PEC	3	0	0	3	3
2.	PCS602	3D Printing and Design	PEC	3	0	0	3	3
3.	PCS603	Internet of Everything	PEC	3	0	0	3	3
4.	PCS604	Neural Networks	PEC	3	0	0	3	3
5.	PCS605	Extended Reality Technnologies	PEC	3	0	0	3	3
6.	PCS606	Robotic Process Automation	PEC	3	0	0	3	3

OPEN ELECTIVES (OE)

SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	COURSE OFFERING DEPARTMENT	CONTACT PERIODS				C
				L	T	P	Total	
1.	OCE101	Air and Noise Pollution Control Engineering	CIVIL	3	0	0	3	3
2.	OCE102	Environmental Impact Assessment	CIVIL	3	0	0	3	3
3.	OCE103	Green Building Design	CIVIL	3	0	0	3	3
4.	OAG101	Environment and Agricultural Engineering	AGRI	3	0	0	3	3
5.	OAG102	Organic Farming for Sustainable Agricultural Production	AGRI	3	0	0	3	3
6.	OAG103	Sustainable Development through Indian Knowledge System	AGRI	3	0	0	3	3
7.	OCY101	Cyber Forensic and Investigation	CYS	3	0	0	3	3
8.	OCY102	Social Media Security	CYS	3	0	0	3	3
9.	OEE101	Renewable Energy Sources	EEE	3	0	0	3	3
10.	OEE102	Energy Conservation and Management	EEE	3	0	0	3	3
11.	OEE103	Electric and Hybrid Vehicles	EEE	3	0	0	3	3
12.	OEI101	Fundamentals of Robotics	EIE	3	0	0	3	3
13.	OEI102	Sensors for Engineering Applications	EIE	3	0	0	3	3
14.	OEC101	Introduction to 5G Communication Networks.	ECE	3	0	0	3	3
15.	OEC102	Introduction to Industrial IoT	ECE	3	0	0	3	3
16.	OEC103	Arduino Programming and its Applications	ECE	3	0	0	3	3
17.	OMD101	Introduction to Food Processing	MDE	3	0	0	3	3
18.	OMD102	Introduction to Biomedical Instrumentation.	MDE	3	0	0	3	3
19.	OME101	Refrigeration and Air Conditioning	MECH	3	0	0	3	3
20.	OME102	Advanced Manufacturing Processes	MECH	3	0	0	3	3

21.	OME103	Material Testing and Characterization	MECH	3	0	0	3	3
22.	OME104	Hazardous Waste Management	MECH	3	0	0	3	3
23.	OME105	Automotive Engineering	MECH	3	0	0	3	3
24.	OCH131	Nanomaterials and Applications	CHEMISTRY	3	0	0	3	3
25.	OPH131	Advanced Functional materials	PHYSICS	3	0	0	3	3

SUMMARY

S.NO.	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	5	4				2	2		**13**
2.	BSC	12	10	3	2					**27**
3.	ESC	5	10			2				**17**
4.	PCC			19.5	19.5	16.5	10.5	9		**75**
5.	PEC					6	6	6		**18**
6.	OEC							3		**3**
7.	EEC						3	1	10	**14**
8.	PCD		1#							**0**
9.	Mandatory						0	0		**0**
	Total	**22**	**24**	**22.5**	**21.5**	**24.5**	**21.5**	**21**	**10**	**167**

COURSES IN MINOR DEGREE
OFFERED BY DEPARTMENT OF MANAGEMENT STUDIES
DEPARTMENT OF AGRICULTURAL ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FOR B.E / B.TECH (HONOURS) / OPTIONAL COURSES (R2023)

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

Enrolment for B.E. / B. Tech. (Honours) / Minor degree (Optional) A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also. Complete details are available in clause 19 of Regulations 2023.

<u>VERTICALS FOR MINOR DEGREE: (In addition to all the verticals of other Programmes)</u>

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable Infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Block chain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis

VERTICAL I: FINTECH AND BLOCKCHAIN

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
1.	BAM101	Financial Management	PEC	3	0	0	3	3
2.	BAM102	Fundamentals of Investment	PEC	3	0	0	3	3
3.	BAM103	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CSM101	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	BAM104	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	BAM105	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
1.	BAM201	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2.	BAM202	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	BAM203	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	BAM204	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5.	BAM205	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	BAM206	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL III: PUBLIC ADMINISTRATION

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
1.	BAM301	Principles of Public Administration	PEC	3	0	0	3	3
2.	BAM302	Constitution of India	PEC	3	0	0	3	3
3.	BAM303	Public Personnel Administration	PEC	3	0	0	3	3
4.	BAM304	Administrative Theories	PEC	3	0	0	3	3
5.	BAM305	Indian Administrative System	PEC	3	0	0	3	3
6.	BAM306	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL IV: BUSINESS DATA ANALYTICS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
1.	BAM401	Statistics For Management	PEC	3	0	0	3	3
2.	BAM402	Data Mining For Business Intelligence	PEC	3	0	0	3	3
3.	BAM403	Human Resource Analytics	PEC	3	0	0	3	3
4.	BAM404	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5.	BAM405	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6.	BAM406	Financial Analytics	PEC	3	0	0	3	3

VERTICAL V: ENVIRONMENT AND SUSTAINABILITY

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS				C
				L	T	P	Total	
1.	AGM501	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	AGM502	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	AGM503	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	AGM504	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	AGM505	Green Technology	PEC	3	0	0	3	3
6.	AGM506	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3

SEMESTER I

EN3111   **PROFESSIONAL ENGLISH – I**   **LT P C**

                                                                                3 0 0 3

OBJECTIVES:

- To upgrade the English language skills of students by introducing communication techniques, speaking and grammar learning activities which are relevant to authentic contexts.
- To improve the basic reading and writing skills of the learners.
- To enhance the communicative competence of the first-year engineering students.
- To enable learners to use language effectively in academic/work contexts.
- To help learners understand content- context in relevant situations.

UNIT–I: INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION   9

Listening: Podcast watching – Listening for new words and pronunciation.

Speaking: Note of appreciation for classmates / family member – formal appreciation of someone, expression of feelings.

Reading: Books, shorts stories to be read. Filling forms (i.e.) post office or bank.

Writing: Film and series Review / Book Review, Email and Informal letters.

Language and Vocabulary development: WH questions, Yes/No questions, Single Word Substitutes, Pronouns, Parts of Speech, Question tags, Prefixes and Suffixes.

UNIT–II: NARRATION AND SUMMATION   9

Listening: Books – Short Stories to be read aloud in class for listening purpose.

Speaking: Short stories to be read and narrated in the class.

Reading: Reading favorite blogs on Travel, Sports and Food and expressing opinions regarding the same.

Writing: Paragraph writing, Report – field trip / I.V., Autobiography and Comprehension.

Language and Vocabulary development: Tenses – Past, Antonyms, Synonyms, Subject Verb agreement and Prepositions.

UNIT–III: DESCRIPTION OF A PROCESS/PRODUCT   9

Listening: Listening to snippets from celebrities/ National leaders' lives.

Speaking: Narrating personal experiences/ events – Expression of emotions and feelings.

Reading: Reading short biographies – famous people and description of the same.

Writing: Instruction, Product / Process description and Advertisements (classified advertisement and display advertisement)

Language and Vocabulary development: Adjectives- Degrees of Comparison, Tenses – Present, Compound Nouns, Homonyms, Homophones and Discourse markers – connective and sequence words

UNIT–IV: CLASSIFICATION AND INTERPRETATION   9

Listening: Listening to Ted Talks.

Speaking: Recreating a Ted talk session in the class.

Reading: Newspaper Reading (Editorial) and understanding.

Writing: Note making, Blogging, Interpretation of charts and graphs.

Language and Vocabulary development: Articles, Collocations and Phrasal Verbs.

UNIT–V: EXPRESSION OF THOUGHTS AND IDEAS   9

Listening: Listening to audio books and answering questions.

Speaking: Presentation on a non-technical topic.

Reading: Editorials from newspaper.

Writing: Essay writing – Descriptive and Narrative essays.

Language and Vocabulary development: Tenses – future, Negative statements and questions, Punctuations, Cause and Effect, Content and Function words.

                                                                    TOTAL: 45 PERIODS

COURSE OUTCOMES:

   At the end of the course, learners will be able

- To strengthen the basics of grammar.
- To narrate informal and informal situations.
- To describe a process/product and express opinion.
- To interpret and analyze the content/information given.
- To write short essays, personal letters and emails in English.

TEXT BOOKS:

1. English for Science and Technology Cambridge University Press,2021. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deep Mary Francis, Dr.K.N.Shoba and Dr.Lourdes Joevani, Department of English, Anna University.
2. Technical Communication – Principles and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.

REFERENCE BOOKS:

1. Effective Communication Skill, Kulbhusan Kumar, R.S.Salaria, Khanna Publishing House.

2. Wings of Fire - An Autobiography by A.P.J Abdul Kalam with Arun Tiwari, Sangam Books Ltd, Edition: 50, 1999

3. World's Most Popular Short Stories Saki Maupassant, Anton Chekhov, O Henry Paperback

4. Professional Speaking skills, Aruna Koneru, Oxford University Press.

5. English For Engineers and Technologists, Orient Blackswan Private Ltd. Department of English,Anna University,2020.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	2	-	-	-	-	3	-	-	-	-	-	-
2	2	2	-	-	-	-	-	-	-	3	1	1	-	-	-	-
3	2	-	2	2	-	-	-	-	-	3	-	1	-	-	-	-
4	3	3	-	2	-	-	2	-	-	3	-	-	-	-	-	-
5	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	2.2	2.6	2.0	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-

MA3122   **MATRICES AND CALCULUS**   **L T P C**
                                                                                       3 1 0 4

OBJECTIVES:

* To understand and apply matrix techniques for engineering applications.
* To familiarize the student with basic calculus and traditions of traditional calculus.
* To solve the problems in single and multivariable calculus and plays an important role in science, economics, engineering.
* Vector calculus can be widely used for modeling the various laws of physics.
* To familiarize the student with multiple integrals and their usage in find the area and volume of two and three dimensional objects.

UNIT-I: **MATRICES**   **9L+3T**

Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Reduction of a quadratic form into canonical form by orthogonal transformation.

UNIT-II: **DIFFERENTIAL CALCULUS OF ONE VARIABLE**   **9L+3T**

Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Rolle's Theorem and Mean Value theorem -Taylor's series- Maxima and Minima of functions of one variable.

UNIT-III: **DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES**   **9L+3T**

Partial derivatives - Total derivatives - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT-IV: **MULTIPLE INTEGRALS**   **9L+3T**

Double integrals in Cartesian and polar coordinates - Change of order of integration - Area enclosed by plane curves - Change of variables in Polar coordinates - Triple integrals - Volume of solids.

UNIT-V: **VECTOR CALCULUS**   **9L+3T**

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields – Vector Integration Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

                                                 TOTAL: 45L +15T PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To apply the idea of reducing complex problems into simple form using matrix technique.

- Basic application of calculus in engineering problems and to tackle for different geometries.

- This course equips the students to have basic knowledge and understanding the Partial derivatives and maxima and minima by Lagrange's method.

- Basic application of Double and Triple integrals used in Engineering real life problems

- To study the vector differentiation and vector integration by using standard theorems.

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

2. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd.,11th Edition, 2005.

3. Veerarajan.T, "Engineering Mathematics", McGrawHill Education(India) Private Ltd 2019.

REFERENCE BOOKS:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt. Ltd., 2011.

2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.

3. Sivarama Krishna Das P. and Rukmangadachari E, "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2017.

4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	1	-
2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	1	-
3	3	2	2	1	-	-	-	-	-	-	-	1	-	-	1	-
4	3	2	2	1	-	-	-	-	-	-	-	1	-	-	1	-
5	3	2	2	1	-	-	-	-	-	-	-	1	-	-	1	-
Average	3.0	2.0	2.0	1.0	-	-	-	-	-	-	-	1.0	-	-	1.0	-

PH3123   **ENGINEERING PHYSICS**   **L T P C**

(Common to all Branches of B.E./B.Tech. Programmes)   **3 0 0 3**

OBJECTIVES:

- To enhance the fundamental knowledge in crystalline materials and its applications.
- To explore the knowledge in the production of ultrasonic waves and application in the engineering field.
- To familiarize the basics of laser and their technical advances in scientific, industrial and health care areas.
- To understand the principle of fibre optical fibre and its applications.
- To explore basic concept of quantum and dual nature of particle.

UNIT-I   PROPERTIES OF MATERIALS   9

Elasticity - Hooke's law - Stress-strain and its uses - Poisson ratio - factors affecting elastic modulus and tensile strength.

Single crystalline, polycrystalline and amorphous materials - unit cell - space lattice - crystal systems - Bravais lattice - Miller indices - d-spacing - characteristics of unit cell - SC, BCC, FCC and HCP structure - - thermal and mechanical properties of materials - crystal growth techniques - Czochralski and Bridgmann.

UNIT-II: ULTRASONICS   9

Introduction - Properties - Production: **Magnetostriction method** and **Piezoelectric method -** Acoustical grating - **determination of ultrasonic velocity in liquid - Application:** Detection of flaw in materials (Non Destructive Testing) - ultrasonic soldering, welding - SONAR - diagnostic sonography - cars' air bag sensor-dispersion of fog - Probe sonication for 2D material formation.

UNIT-III: LASERS AND ITS APPLICATIONS   9

Basic concepts and characteristics - Einstein's A and B coefficients (derivation) - population inversion - Pumping methods - Nd-YAG laser - CO_2 laser - Semiconductor lasers: homo junction and heterojunction - applications: laser welding, laser cutting, laser cooling, pattern formation by laser etching, laser bar code scanner - LIDAR - Laser tissue interaction, laser surgery - Holography - NLO - electro-optic effect.

UNIT-IV: FIBRE OPTICS 9

Structure and principle - Propagation of light through optical fibre - acceptance angle, numerical aperture - fractional index change - Types of optical fibres (material, mode and refractive index) - Attenuation: absorption, scattering and bending - Dispersion - Fibre optic communication system (Block diagram) and advantages over conventional methods - fibre optic sensors: pressure and displacement- Endoscope.

UNIT-V: QUANTUM PHYSICS 9

Black body radiation and energy distribution spectrum - Planck's theory of radiation - matter waves - de-Broglie wavelength in terms of energy, voltage and temperature - Electron diffraction - G.P.Thomson experiment - wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - Particle in a one-dimensional box- Normalization of wave function - Quantum Tunnelling - Scanning Tunnelling Microscope.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students should be able

- To understand the properties of materials, crystalline material and growth techniques.
- To understand the basics, generation and application of ultrasonics.
- To acquire knowledge on the concepts of lasers and their applications in industry and medical field.
- To conversant on principle behind the fibres and their applications in communication and devices made out of optical fibre.
- To get knowledge on advanced physics concepts of quantum theory and its applications.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
4. Brijlal and Subramanyam, "Properties of Matter", S .Chand publishing, 2002.

5. M.N.Avadhanulu & P.G.Kshirasagar, "A Text Book of Engineering Physics" – IX Edition, S.Chand Publications, 2014.

6. V.Rajendiran, Engineering Physics, Tata McGraw-Hill, New Delhi. 2011.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.

2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.

3. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics". Pearson, 2018.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	-	-	1	1	-	-	-	-	1	-	-	-	-
2	3	1	1	1	2	1	1	-	-	-		1	-	-	-	-
3	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
5	2	1	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Average	2.8	1.4	1.4	1.0	1.3	1.0	1.0	-	-	-	-	1.0	-	-	-	-

CH3124   **ENGINEERING CHEMISTRY**   **L T P C**

(First Semester-Common to all branches)   **3 0 0 3**

OBJECTIVES

- To make the students familiar with boiler feed water requirements, related problems and domestic water treatment techniques.
- To introduce the basic concepts and applications of chemical thermodynamics.
- To acquaint the student with the principles of chemical kinetics and its applications towards engineering.
- To make the student conversant with the basics of surface chemistry and catalysis.
- To inculcate the students with the basics principles and preparatory methods of nanomaterials.

UNIT-I: WATER TECHNOLOGY   9

Introduction-sources of water-impurities present in water-hard water and hardness - types, Municipal water treatment: primary treatment and disinfection - Desalination of brackish water: Reverse Osmosis, Boiler troubles: scale and sludge, caustic embrittlement, boiler corrosion priming and foaming, Treatment of boiler feed water - Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning). External treatment: Ion exchange process, cooling waters (Langelier index).

UNIT-II: CHEMICAL THERMODYNAMICS   9

Introduction-terminology of thermodynamics, the first law of thermodynamics: enthalpy, second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions: Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions, Criteria of spontaneity; Gibbs-Helmholtz equation, Clausius-Clapeyron equation, Maxwell relations, Van't Hoff isotherm and isochore.

UNIT-III: CHEMICAL KINETICS   9

Introduction-factors influencing the rate of reaction, order and molecularity of a reaction, kinetic equations of different orders (first, second and third order) - determination of the order of a reaction, the temperature dependence of reaction rates, unimolecular reactions, photochemical reactions and chain reactions, Theories of reaction rates, lasers in chemistry, fast reactions.

UNIT-IV: SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: classification - adsorption of gases on solids - adsorption from solutions - adsorption isotherms - applications of adsorption - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm, B.E.T isotherm. Catalysis: introduction - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid -base catalysis - enzyme catalysis - Michaelis - Menten equation.

UNIT-V: NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties; Types of nanomaterials: Definition, properties and uses of - nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electrospinning. Applications of nanomaterials in medicine, agriculture, food science and energy resources.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student should be able:

- To infer the quality of water from quality parameter data and propose suitable treatment.
- To apply the knowledge of chemical thermodynamics for material design and aspects
- To recommend the proper chemical kinetics for engineering processes and applications.
- To recognize the surface morphology and its engineering applications.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

TEXTBOOKS:

1. Payal B. Joshi and Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
2. Shikha Agarwal, "Engineering Chemistry"-Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.
3. P. C. Jain and Monica Jain, "Engineering Chemistry", 18th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2021.

REFERENCE BOOKS:

1. R. V. Gadag and A. Nithyananda Shetty, "Engineering Chemistry", 3rd Edition, Wiley & I.K. International (P), LTD, New Delhi, 2019.
2. S.S. Dara and S.S. Umare, "A Text Book of Engineering Chemistry", 12th Edition, S. Chand & Company LTD, New Delhi, 2018.
3. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Publishing Company LTD, 2023.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	2	-	1	3	-	-	-	-	2	-	-	-	-
2	3	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	3	2	1	-	1	-	-	-	-	2	-	-	-	-
Average	2.8	1.8	2.2	1.5	1.0	1.0	2.0	-	-	-	-	2.0	-	-	-	-

GE3131   BASIC ELECTRICAL AND ELECTRONICS ENGINEERING   L T P C

3 0 0 3

OBJECTIVES:

- To introduce the basics of electric circuits and analysis.
- To impart knowledge in the basics of working principles and application of electrical machines.
- To introduce analog devices and their characteristics.
- To educate on the fundamental concepts of digital electronics.
- To introduce the functional elements and working of measuring instruments.

UNIT-I: ELECTRICAL CIRCUITS   9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only).

UNIT-II: ELECTRICAL MACHINES   9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, working principle and Applications of Transformer, three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT-III: ANALOG ELECTRONICS   9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters.

UNIT-IV: DIGITAL ELECTRONICS   9

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations – minimization using K maps (Simple Problems only).

UNIT-V: MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument, Standards and calibration, Operating Principle, types Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- compute the electric circuit parameters for simple problems.
- explain the working principle and applications of electrical machines.
- analyze the characteristics of analog electronic devices.
- explain the basic concepts of digital electronics.
- explain the operating principles of measuring instruments.

TEXTBOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020.
2. S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A. Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015

REFERENCE BOOKS:

1. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
3. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	-	-	3	-	-	-	-	-	2	-	2	-
2	3	2	-	-	-	2	-	2	-	-	-	-	1	2	-	2
3	2	3	2	2	-	-	-	-	-	-	-	-	3	-	-	-
4	3	3	1	-	3	-	2	-	-	-	-	-	1	-	3	-
5	3	3	2	1	-	-	1	-	-	-	-	-	2	1	-	2
Average	2.8	2.8	1.8	1.7	3.0	2.0	2.0	2.0	-	-	-	-	1.8	1.5	2.5	2.0

GE3111　　　　　　தமிழர்மரபு　　　　　　L T P C
　　　　　　　　　　　　　　　　　　　　　　　　1 0 0 1

அலகு-I:　　மொழி மற்றும் இலக்கியம்　　　　　　　　　3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள்- தமிழ் ஒரு செம்மொழி- தமிழ் செவ்விலக்கியங்கள்- சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் மேலாண்மைக் கருத்துகள்- தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்- சிற்றிலக்கியங்கள்- தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

அலகு-II:　　மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் –
　　　　　　　சிற்பக் கலை　　　　　　　　　　　　　　　　3

நடுகல் முதல் நவீன சிற்பங்கள் வரை –ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் , பொம்மைகள்- தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள்

அலகு-III:　　நாட்டுபுறக் கலைகள் மற்றும் வீர விளையாட்டுகள்　3

நாட்டுப்புற கதைகள், பாடல்கள்-தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து- ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம்- வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்

அலகு-IV:　　தமிழர்களின் திணைக் கோட்பாடுகள்　　　　　3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள்- தமிழர்கள் போற்றிய அறக்கோட்பாடு –தமிழ் சங்கம்-சங்கம் வளர்த்த தமிழ்- சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்- சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

அலகு-V:　　இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத்
　　　　　　　தமிழர்களின் பங்களிப்பு　　　　　　　　　　3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு இந்தியா மற்றும் வெளிநாட்டின் பிற பகுதிகளின் தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு- கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு

TOTAL: 15 PERIODS

TEXT CUM REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3111   **HERITAGE OF TAMILS**   **L T P C**
                                                                    1 0 0 1

UNIT-I: LANGUAGE AND LITERATURE   3

Language Families in India - Dravidian Languages – Tamil as a Classical Language-Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT-II: HERITAGE - ROCK ART PAINTINGS TO MODERN ART –
                SCULPTURE   3

Hero stone to modernsculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making -Massive Terracotta sculptures, Village deities.

UNIT-III: FOLK AND MARTIAL ARTS   3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT-IV: THINAI CONCEPT OF TAMILS   3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils –Tamil Sangam- Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Exportand Import during Sangam Age - Overseas Conquest of Cholas.

UNIT-V: CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT
                AND INDIAN CULTURE   3

Contributionof Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of TamilBooks.

                                                        TOTAL: 15 PERIODS

TEXT CUM REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

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7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

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9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

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11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3121　　　　　　**PHYSICS AND CHEMISTRY LABORATORY**　　　**L T P C**

0 0 4 2

(Common to all branches of B.E. / B.Tech Programmes)

OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Calculation of lattice cell parameter – X-ray diffraction method.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
3. (a). Compact disc- Determination of width of the groove using Laser.

    (b). Determination of particle size using Laser
4. (a). Determination of wavelength using Laser

    (b). Determination of acceptance angle and numerical aperture in an optical fiber.
5. Determination of Planck's constant using LED.
6. Determination of thickness of a thin wire – Air wedge method
7. Determination of wavelength of mercury spectrum – spectrometer grating
8. Determination of rigidity modulus – Torsion pendulum
9. Determination of Young's modulus by non-uniform bending method.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the students should be able

- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.

- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.

REFERENCES:

1. Wilson J.D. and Hernaandez Hall C.A, "Physics Laboratory Experiments", Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, A Text Book of Practical Physics, S. Sultan Chand publications. 2005
3. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

OBJECTIVES

- To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity, hardness, DO, TDS, chloride, and chlorine.
- To familiarise the students with electroanalytical techniques like conductometry and flame photometry to determine the impurities in aqueous solution.
- To find the various characteristics of domestic water.
- To understand the Pseudo first-order kinetics reaction.
- To make the students know the synthesis of nanoparticles.

LIST OF EXPERIMENTS:

1. Determination of chloride content of water sample by Argentometric method.
2. Determination of total, temporary & permanent hardness of water by EDTA method.

3. Determination of DO content of water sample by Winkler's method.

4. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.

5. Determination of types and amount of alkalinity in water samples.

6. Estimation of available chlorine in bleaching powder solution.

7. Conductometric titration of barium chloride against sodium sulfate (Precipitation titration).

8. Estimation of sodium /potassium present in water using a flame photometer.

9. Estimation of TDS of a water sample by gravimetry.

10. Preparation of nanoparticles ($Ag/Au/TiO_2/ZnO/CuO$).

11. Pseudo first-order kinetics- ester hydrolysis.

TOTAL: 30 PERIODS

OUTCOMES

At the end of the course, the student should be able:

- To infer the quality of water samples for alkalinity, hardness, DO, TDS, chloride, and chlorine.

- To apply the knowledge on the estimation of metal ions, acidity and its precipitation nature towards their process.

- To recognize the threshold limit for various characteristics of domestic water.

- To identify the simple method of synthesis of nanoparticles.

- To understand the pseudo first-order kinetics reaction from ester hydrolysis.

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).

2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).

3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	1	1	-	1	-	-	-	-	-	-	-	-	-
2	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
3	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
4	2	1	1	1	2	-	-	-	-	-	-	1	-	-	-	-
5	2	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	2.0	1.0	1.0	1.0	1.2	-	1.0	-	-	-	-	1.0	-	-	-	-

GE3134   **ENGINEERING PRACTICES LABORATORY**   **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes)   **0 0 4 2**

COURSE OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools
- To gain the skills for making fitting joints and assembling air conditioner
- To develop the skills for making simple electrical wiring connections using suitable tools
- To provide hands on experience for soldering and gain knowledge about the behavior of electronics components

<u>GROUP A (CIVIL & MECHANICAL)</u>

I   CIVIL ENGINEERING PRACTICE   15

Buildings:

a)   Study of plumbing and carpentry components of residential and industrial buildings safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise:

   Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry works:

a)   Study of the joints in roofs, doors, windows and furniture.
b)   Hands-on-exercise:

   Wood work, joints by sawing, planning and cutting.

II   MECHANICAL ENGINEERING PRACTICE   15

Welding:

   a)   Preparation of butt joints, lap joints and T- joints by Shielded metal
arc welding.

   b)   Gas welding practice - Study

Basic Machining:

   a)   Facing

   b)   Simple Turning

   c)   Step Turning

Sheet Metal Work:

   a)   Forming & Bending

   b)   Model making – Trays

Demonstration on:

   a) Smithy operations, upsetting, swaging, setting down and bending.

   b) Foundry operations like mould preparation for gear and step cone pulley.

   c) Assembly of centrifugal pump

   d) Assembly of air conditioner

<u>GROUP B (ELECTRICAL & ELECTRONICS)</u>

III   ELECTRICAL ENGINEERING PRACTICE   15

1. Residential house wiring using Switches, Fuse, Indicator, Lamp and Energy meter.
2. Fluorescent Lamp Wiring.
3. Staircase Wiring.
4. Measurement of Voltage, Current, Power and Power factor in electrical circuit.
5. Measurement of Energy using Analog & Digital Energy meter.
6. Measurement of Earth Resistance.
7. Study of Industrial house wiring.
8. Identification & Study of protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage.

IV   ELECTRONICS ENGINEERING PRACTICE   15

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.

3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- Carry out various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering
- Fabricate carpentry components and pipe connections including plumbing works and use welding equipment's to join the structures.
- Carry out the basic machining operations, make the models using sheet metal works. Illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and measure the electrical quantities
- Elaborate on the electronics components, gates and soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.   15 Sets
2. Carpentry vice (fitted to work bench)   15 Nos.
3. Standard woodworking tools   15 Sets
4. Models of industrial trusses, door joints, furniture joints   5 each

MECHANICAL

1. Arc welding transformer with cables and holders   5 Nos.
2. Welding booth with exhaust facility   5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.   5 Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.   2 Nos.
5. Centre lathe   2 Nos.
6. Hearth furnace, anvil and smithy tools   2 Sets
7. Moulding table, foundry tools   2 Sets
8. Power Tool: Angle Grinder   2 Nos.
9. Study-purpose items: centrifugal pump, air-conditioner   One each

10. Fitting tools, Hack saw frame, 12' file, hack saw blade Nos.   15

ELECTRICAL

1. Assorted electrical components for house wiring   15 Sets
2. Fluorescent Lamp   15 Sets
3. Electrical measuring instruments   10 Sets
4. Analog & Digital energy meter   5 Sets
5. Megger   2

ELECTRONICS

1. Soldering guns   10 Nos.
2. Assorted electronic components for making circuits   50 Nos.
3. Small PCBs   10 Nos.
4. Multimeters   10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	-	-	1	-	-	-	-	-	1	2	-	3	-
2	-	1	2	-	3	-	-	-	-	-	1	-	-	-	2	-
3	-	-	-	3	2	-	-	-	-	-	-	1	1	-	-	2
4	-	2	3	1	2	-	-	-	-	-	-	-	-	2	-	-
5	-	3	2	2	-	-	-	-	1	-	-	-	2	-	-	-
Average	3.0	2.0	2.3	2.0	2.3	1.0	-	-	1.0	-	1.0	1.0	1.7	2.0	2.5	2.0

EN3119   ENGLISH LANGUAGE LEARNING LABORATORY   L T P C
                                                                0 0 2 1

COURSE OBJECTIVE:

The course aims to

- Enhance the employability and career skills of students.
- Orient the students towards grooming as a professional.
- Make them industry ready.
- Develop their confidence and help them attend interviews successfully.
- Help students to interact confidently in a professional scenario.

UNIT-I: PRONUNCIATION   6

Tone- Pronunciation – Intonation- Reading Aloud and Addressing- Syllable- Rhythm- Accent- Wrongly Pronounced words -Poetry Reading

UNIT-II: NON VERBAL COMMUNICATION   6

Non Verbal Communication - Facial expressions- Eye contact - Subtle (and not so subtle) gestures -Tone of voice – Touch- Posture -Personal space.

UNIT-III: SELF INTRODUCTION AND PRESENTATION   6

Self-Introduction - Introducing oneself to the audience- Introducing the Topic – answering   questions – Individual Presentation Practice – Presenting Visuals effectively -5 Minute Presentations.

UNIT-IV: BASICS OF SOFT SKILLS   6

Recognizing differences between groups and teams – managing time – networking professionally – Respecting social protocols- understanding career management – Developing a long - term career plan- making career changes.

UNIT-V: GROUP DISCUSSION   6

Introduction to Group Discussion – Participating in Group discussions – Understanding group dynamics – Brainstorming the Topic – Questioning and Clarifying – GD Strategies – activities to improve GD Skills.

TOTAL: 30 PERIODS

COURSE OUTCOME:

At the end of the course, the learners will be able to:

- Pronounce the words correctly.
- Understand the nonverbal clues.
- Make an effective presentation.

- Adequate soft skills required for the workplace.
- Participate confidently in Group Discussions.

REFERENCES:

1. Professional Communication by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2014.
2. Soft Skills by S. Hariharan, N. Soundarajaran and S.P. Shanmugapriya MJP Publishers, Edition: 2013
3. Soft Skills for Everyone by Butterfield, Jeff, Cengage Learning India Pvt. Ltd.,2015. New Delhi.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	1	-	-	-	-	-	3	-	1	-	-	-	-
2	1	1	-	-	-	-	1	-	-	2	-	1	-	-	-	-
3	2	2	1	2	2	-	-	-	-	3	-	1	-	-	-	-
4	2	1	1	-	-	-	3	-	-	3	-	1	-	-	-	-
5	-	1	-	1	-	-	-	-	-	3	-	1	-	-	-	-
Average	1.7	1.3	1.0	1.3	2.0	-	2.0	-	-	2.8	-	1.0	-	-	-	-

EN3211   **PROFESSIONAL ENGLISH – II**   **L T P C**

3 0 0 3

OBJECTIVES:

- The course prepares the second semester Engineering students
- To develop strategies and techniques to enhance their reading skills.
- To engage them in meaningful activities in order to improve their listening, speaking, reading and writing skills.
- To improve their ability to write effective job application, resumes and draft impressive reports.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To participate in group discussions.

UNIT–I: MAKING COMPARISON   9

Listening: Clippings of Ted talk, cartoon and interviews of sports personalities for listening and discussion.

Speaking: Descriptions and discussions based on newspaper.

Reading: Learning shades of meaning (using Thesaurus) and inferring the context from general passages.

Writing: Compare & Contrast essays and Jumbled Sentences.

Language and Vocabulary development: Prepositional phrases, contextual meaning of words. Verbal Analogy, Same word used as Noun and Verb.

UNIT–II: EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING   9

Listening: Anecdotes to be read from books like Chicken Soup books. Evaluative listening – Advertisement and Product description.

Speaking: Marketing a product, persuasive speech

Reading: Description of any product / jewellery, Brochures and Manual.

Writing: Formal letters- letters of complaint, appreciation, and suggestion, Comprehension and E-mail (formal)

Language and Vocabulary development: Active & Passive, Infinitive, Gerund, Purpose Statements, Adverbs and Word formation

UNIT–III: ABILITY TO PUT IDEAS OR INFORMATION COGENTLY   9

Listening: Listen to English songs and find the lyrics/new words

Speaking: Role play and Interviews

Reading: Reading magazine articles, Excerpts from literary texts

Writing: Job Application, Resume, Cover letter, SWOC Analysis and Recommendations.

Language and Vocabulary development: Correction of errors, If conditional, Sentence completion and Connotations.

UNIT–IV: ANALYZING PROBLEMS AND EXPRESSING SOLUTIONS   9

Listening: Watching Stand-up comedies and comprehending ideas expressed there.

Speaking: Speak about the Stand-up comedies viewed and express personal views about the same

Reading: Reading different types of books (novels, short stories, biographies, magazines etc. and speaking about the same.

Writing: Dialogue Writing, Checklist and Problem Solving essays.

Language and Vocabulary development: Reported Speech, Modals, Slogan writing and Conjunctions.

UNIT–V: REPORTING EVENTS   9

Listening: Listening to spot errors, listening to varied dialects and accents of English.

Speaking: Group discussion- Expression of opinions, assertion, coercion etc.

Reading: Reading life experiences of common man from magazines.

Writing: Accident Report / Survey Report and Letters to the Editor.

Language and Vocabulary development: Numerical Adjective, Idioms, Vocabulary – Shades of Meaning.

TOTAL: 45 PERIODS

OUTCOMES:

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

- To compare and contrast ideas and information from technical texts.
- To incorporate basic grammar structures to express appreciation, suggestion and complaint in writing**.**
- To draft effective resumes using appropriate vocabulary and to avoid common errors.
- To analyse problems so as to arrive at appropriate solutions and to communicate relevantly.
- To draft technical reports, letters and to express ideas creatively.

TEXT BOOKS:

1. English for Science and Technology Cambridge University Press,2021. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deep Mary Francis, Dr.K.N.Shoba and Dr.Lourdes Joevani, Department of English, Anna University.

2. Technical Communication – Principles and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.

3. Technical English for Professional – Advanced by C. Gangalakshmi, B. Rathika and L. Saranraj, Cengage Learning India Pvt. Ltd.,2022.

REFERENCES:

1. Learning to communicate – Dr. V. Chellammal, Oxford Univ.Press,2001 New Delhi.

2. Business Correspondence and Report Writing by Prof. R. C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.

3. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

4. Improve Your Writing ed. V.N Arora Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.

5. English For Engineers and Technologists, Orient Blackswan Private Ltd. Department of English, Anna University,2020.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	1	2	1	-	-	-	-	-	3	-	1	-	-	-	-
2	2	2	1	2	2	-	-	-	-	3	1	1	-	-	-	-
3	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-
4	2	3	2	3	-	-	2	-	-	3	-	-	-	-	-	-
5	2	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	2.0	2.0	1.4	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-

MA3222   **STATISTICS AND NUMERICAL METHODS**   **L T P C**
                                                                 3 1 0 4

OBJECTIVES:

- This course aims at providing the necessary basic concepts of statistical and Numerical Methods for solving numerically different problems of engineering and Technology.

- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.

- To introduce the basic concepts of solving algebraic and transcendental equations.

- To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology disciplines.

- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT-I: STATISTICAL HYPOTHESIS TESTS   9L+3T

Sampling distributions - Tests for single mean and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT-II: EXPERIMENTAL DESIGN FOR ANOVA   9L+3T

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design

UNIT-III: SOLUTION OF EQUATIONS AND EIGEN VALUE
**   PROBLEMS   9L+3T**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton - Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative method of Gauss Seidel –Dominant Eigenvalue of a matrix by Power method.

UNIT-IV: INTERPOLATION, NUMERICAL DIFFERENTIATION AND
**   NUMERICAL INTEGRATION   9L+3T**

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical integrations using Trapezoidal, Simpson's rules.

UNIT-V: **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS** **9L+3T**

Single step methods: Taylor's series method - Euler's method - Modified Euler's method Fourth order Runge-Kutta method for solving first order equations - Multi step methods: Milne's and Adams -Bash forth predictor corrector methods for solving first order equations.

TOTAL: 45L+15T PERIOD

OUTCOMES:

At the end of the course, the student should be able to:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.

- Apply the basic concepts of classifications design of experiments in the field of agriculture.

- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

- Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering application.

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi,2015.

2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition,2015.

REFERENCE BOOKS:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning,2016.

2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.

3. Gerald.C. F., Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, NewDelhi,2006.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
2	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Average	3.0	3.0	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-

PH3222   **PHYSICS FOR INFORMATION SCIENCE**   **LT P C**

For Second Semester-B.E. / B.Tech.   **3 0 0 3**

(CSE, IT, AI&DS and Cyber Security)

OBJECTIVES:

- To provide information on the free electron theories and to understand the electrical properties of conducting material.
- To teach the basic knowledge of semiconductors and their applications.
- To enhance the idea of magnetic materials in storage devices and also to enrich the basic knowledge of superconductors and their applications.
- To gain knowledge about the interaction of photons with materials and optoelectronic devices.
- To understand the fundamental concepts of nanomaterials and quantum computing.

UNIT–I: CONDUCTING MATERIALS   9

Classical free electron theory - postulates - Expression for electrical conductivity and thermal conductivity - Wiedemann-Franz law - Success and failures - Quantum free electron theory (qualitative) - Fermi distribution function - Density of energy states - Electron in periodic potential - Energy bands in solids - Low and high resistivity alloys.

UNIT–II: SEMICONDUCTOR PHYSICS   9

Properties - Intrinsic semiconductors - Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors - Variation of Fermi level with temperature and impurity concentration - Variation of carrier concentration with temperature for extrinsic semiconductors - Hall effect - Theory and experiment and applications.

UNIT–III: MAGNETIC MATERIALS AND SUPERCONDUCTOR   9

Basic definitions of magnetism - Classification (based on spin): Diamagnetism, Paramagnetism, Ferromagnetism, anti-Ferromagnetism and ferrimagnetism - Ferromagnetic domain theory - Energy involved in domains - Hysteresis curve - Temporary and permanent magnetic materials, examples and uses - Magnetic principles in computer data storage - Magnetic hard disc (GMR sensor).

Superconductors - properties - Applications (Magnetic levitation, Cryotron and SQUID).

UNIT–IV: OPTOELECTRONIC DEVICES 9

Classification of optical materials - Optical processes in semiconductors: optical absorption and emission - carrier injection and recombination - Photodiode - Solar cell - Light Emitting Diode - Organic Light Emitting Diode - Quantum dot laser - Optical data storage devices-plasmonics.

UNIT–V: NANODEVICES AND QUANTUM COMPUTING 9

Introduction - Quantum confinement - Quantum structures (qualitative) - Band gap of nanomaterial - Single Electron Transistor (SET): Tunnelling - Coulomb-blockade effect - Carbon nanotubes: Properties and applications.

Quantum cellular automata (QCA) - Quantum system for information processing - Characteristics and working of quantum computers - Advantages and disadvantages of quantum computing over classical computing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students should be able:

- To understand the classical and quantum-free electron theories, and energy bands in solids.
- To apply the concepts of semiconductor Physics and its applications in various devices.
- To apply the properties of magnetic materials and superconductors in various fields.
- To understand the basics of optical materials and apply knowledge to develop materials for optoelectronic devices.
- To know the concepts and applications of quantum structures and the basics of quantum computing.

TEXTBOOKS:

1. Kasap, S.O., "Principles of Electronic Materials and Devices", McGraw Hill Education, 2007.
2. M. Arumugam, "Semiconductor Physics and optoelectronics", Anuradha agencies,2003.
3. Kittel, C., "Introduction to Solid State Physics", Wiley, 2005.
4. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials".Narosa Publishing House, 2009.

5. B. K. Pandey., S. Chaturvedi., "Engineering Physics", Cengage Learning, 2012.

6. V.Rajendiran, Engineering Physics, Tata McGraw-Hill, New Delhi. 2011.

REFERENCE BOOKS:

1. B. N. Sankar., S. O. Pillai., "Engineering Physics" New age international publishers, 2007.

2. Donald .A.Neamen., "Semiconductor Physics and devices" Tata Mc Graw-Hill, New Delhi. 2007

3. Rogers, B., Adams, J. & Pennathur, S. "Nanotechnology: Understanding small systems", CRC Press, 2014.

ONLINE RESOURCES:

1. "Optoelectronics - An introduction" -Jhon Wilson and Jhon Hawkes- Prentice Hall Europe- ISBN 0-13-1039M-X

2. "Quantum Computing -A Gentle Introduction"- Eleanor Rieffel and Wolfgang Polak -ISBN 978-0-262-01506-6

3. "An introduction to Quantum Computing", NPTEL - https://nptel.ac.in/courses/106106232

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
2	3	1	2	-	1	-	-	-	-	-	-	1	-	-	-	-
3	3	-	1	-	2	1	1	-	-	-	-	1	-	-	-	-
4	3	-	2	1	3	-	1	-	-	-	-	1	-	-	-	-
5	3	1	2	1	2	1	2	-	-	-	-	1	-	-	-	-
Average	3.0	1.0	1.8	1.0	2.0	1.0	1.3	-	-	-	-	1.0	-	-	-	-

CH3222   **CHEMISTRY FOR INFORMATION SCIENCE**   **L T P C**

Second Semester-B.E./B.Tech.   **3 0 0 3**

(Common to AI & DS, CSE, CYS and IT)

OBJECTIVES:

- To make the students acquainted with various energy sources, storage devices, and battery technology.

- To acquaint the student with the principles of photochemistry, application of spectroscopy, and sample analyzing techniques.

- To understand the preparation, properties, and engineering applications of functional materials, nano reactors, nano electronics, and sensors.

- To make the student conversant with the basics of composites, their properties, and applications in memory devices.

- To acquaint the students with the basics of biomolecule networks, metabolic pathways, drug design applications, drawing tools, and structure visualizations.

UNIT-I: ENERGY SOURCES AND STORAGE DEVICES   9

Introduction - nuclear energy - light water nuclear power plant - breeder reactor, solar energy conversion - solar cells: principle, working and applications. Types of batteries - primary battery (alkaline battery), secondary battery (lead acid battery, NICAD battery, lithium-ion battery), fuel cells (H_2-O_2 fuel cell). Supercapacitors: storage principle, applications. Electric vehicles-working principles.

UNIT-II: PHOTOCHEMISTRY AND SPECTROSCOPY   9

Photochemistry: laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law, and Lambert-Beer Law, quantum efficiency - determination - Jablonski diagram: internal conversion, intersystem crossing, fluorescence, phosphorescence, chemiluminescence, and photo-sensitization - applications. Spectroscopy: electromagnetic spectrum - absorption of radiation - electronic, vibrational, and rotational transitions, UV-visible and IR spectroscopy: principles, instrumentation (block diagram) - applications.

UNIT-III: SMART MATERIALS   9

Introduction - organic functional materials: preparation, properties, and engineering applications of graphite, fullerenes, carbon nanotubes, smart materials: nanoporous zeolites, self-assembled nanoreactors, nanostructures for molecular recognition, the chemistry of nanoelectronics: data memory, lighting, and displays, thin films, OLEDs, sensors: electrochemical sensors, neuro-electronic interfaces.

UNIT-IV: NANOCOMPOSITES & MEMORY DEVICES   9

Introduction - definition - need, constitution: matrix materials (polymer matrix, metal matrix) and reinforcement (fiber), properties and applications of metal matrix composites (MMC), and polymer matrix composites - micro and nanoelectromechanical systems, applications of nanomaterials in memory devices.

UNIT-V: CHEMINFORMATICS   9

Introduction - coordinate-bond, bond length, bond angles, torsional angles - chemical structure - confirmation - representation of structural information - sources - formats - graph theory - molecular numerology - storage of structural data - databases - types - fingerprint - similarity search - applications of cheminformatics in drug designing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able:

- To apply the gained knowledge on different energy sources and storage devices.
- To recognize the principle and concepts in photochemistry and spectroscopy.
- To recommend smart materials and sensors for the development of innovative materials.
- To utilize the different composites and memory devices.
- To identify the structural information about different materials with help of software.

TEXT BOOKS:

1. Shikha Agarwal, "Engineering Chemistry"-Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.
2. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2019.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. S.S. Dara and S.S. Umare, "A Text Book of Engineering Chemistry", 12th Edition, S. Chand & Company LTD, New Delhi, 2018.

3. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Publishing Company LTD, 2023.

4. O. G. Palanna, Engineering Chemistry, McGraw Hill Education (India) Pvt, Ltd, New Delhi, 2017.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-
2	1	1	-	3	3	-	-	-	-	-	-	-	-	-	-	-
3	1	-	1	-	2	-	-	-	-	-	-	1	-	-	1	-
4	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	3	1	-	-	3	-	-	-	-	-	-	-	2	-	-	-
Average	1.6	1.0	1.0	2.0	2.3	-	1.0	-	-	-	1.0	1.0	2.0	-	1.0	-

GE3231   PROBLEM SOLVING AND PYTHON PROGRAMMING   L T P C
(Common to All branches)   **3 0 0 3**

OBJECTIVES:

- To know the basics of Python programming and write simple Python programs.

- To develop Python programs with conditionals and loops.

- To define Python functions and call them.

- To use Python data structures and its implementation – lists, tuples, dictionaries.

- To understand Object Oriented Concept in Python.

UNIT-I: PYTHON BASICS   9

Introduction to Python – Literals – Variables and Identiiers – Data Types – Input Operation – Comments – Reserved words – Indentation – Operators and Expressions – Modes of python. Conditionals: Boolean values and operators - conditional if - alternative if - chained conditional - Iteration, Illustrative programs: Basic Arithmetic Operations, GCD of numbers, Square root (Newton's Method).

UNIT-II: FUNCTIONS, LIST, TUPLES   9

Functions, function definition and use. **Fruitful functions:** return values, parameters, local and global scope, recursion. **Lists:** list operations, list slices, list methods, list loop, mutability, list parameters; **Tuples:** tuple assignment, tuple as return value. Comparison of Lists and tuples. Illustrative programs: exchange the values of two variables, square root, Linear and Binary search. Fibonacci series using functions.

UNIT-III: STRINGS, DICTIONARY, SET   9

Strings: string slices, immutability, string functions and methods, string module. **Dictionaries:** Operations (create, access, add, remove) and methods. (Insert, delete).Set operation (Access, Add, Remove). Illustrative programs: creates a dictionary of radius of a circle and its circumference.

UNIT-IV: FILES, EXCEPTIONS, MODULES AND PACKAGES   9

Files and exception: Text Files, Reading and Writing files, Format operator; Errors and Exceptions, Handling Exceptions, Multiple Except blocks, Modules, Packages; Illustrative programs: word count, copy file, Creating user defined Exceptions.

UNIT-V: CLASSES AND OBJECTS   9

Classes and Objects: Introduction, Classes and Objects, Defining Classes, Creating Objects, Data Abstraction and Hiding, The Class Method and Self Argument, The __init__( ) method, Class Variables and Object Variables, Public and Private data members, Private Methods. Illustrative Programs: Creating Student Class and Objects.

OUTCOMES:

At the end of the course, learners will be able to:

- Develop simple computational problems using control flow statements.

- Decompose a Python program into functions, Modules and Packages.

- Represent compound data using Python lists, tuples, Strings, Set and dictionaries.

- Read and write data from/to files and Exception handling in Python Programs.

- Understand the concepts of Object Oriented Programming and to develop real time applications.

TEXT BOOKS:

1. Reema Thareja, **"**Python Programming using Problem solving Approach", Oxford Higher Education,2018.

2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS:

1. Charles Dierbach, **"**Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.

2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013

3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.

WEB REFERENCES:

1. http://greenteapress.com/wp/think-python/
2. www.docs.python.org
3. https://nptel.ac.in/courses/106/106/106106182/

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2	-	-	-	-	-	2	2	2	-	-	1
2	3	3	3	3	2	-	-	-	-	-	2	2	-	-	3	-
3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	1	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	2	-
5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	1
Average	2.4	2.6	3.0	2.8	1.8	-	-	-	-	-	1.6	2.0	2.5	-	2.0	1.0

GE3211	தமிழரும் தொழில்நுட்பமும்	L T P C
		1 0 0 1

அலகு-I: நெசவு மற்றும் பானைத் தொழில்நுட்பம்   3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு-II: வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்   3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு. சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ – சாரோசெனிக் கட்டிடக் கலை.

அலகு-III: உற்பத்தித் தொழில்நுட்பம் :   3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாகச் செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு-IV: வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்   3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி / வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi – 'Sangam City Civilization on the banks of river Vaigal' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

GE3211   **TAMILS AND TECHNOLOGY**   **L T P C**

1 0 0 1

UNIT-I: WEAVING AND CERAMIC TECHNOLOGY   3

Weaving Industry during sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT-II: DESIGN AND CONSTRUCTION TECHNOLOGY   3

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Priod – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

UNIT-III: MANUFACTURING TECHNOLOGY   3

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – Industries Stone beads – Glass beads – Terracotta beads – Shell beads / bone beats – Archeological evidences – Gem stone types described in Silappathikaram.

UNIT-IV: AGRICULTURE AND IRRIGATION TECHNOLOGY   3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Perio, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.

UNIT-V: SCIENTIFIC TAMIL & TAMIL COMPUTING   3

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

TEXT – CUM – REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி / வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)

9. Keeladi – 'Sangam City Civilization on the banks of river Vaigal' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

GE3233   ENGINEERING GRAPHICS AND DESIGN   L T P C
       (Common to all branches of B.E. / B.Tech. Programmes)   1 0 4 3

OBJECTIVES:

The main learning objective of this course is to impart knowledge

- To draw the conics curves and special curves, use BIS conventions, and specifications for engineering drawing.
- To draw the orthographic projection of lines and plane surfaces
- To draw the projections and solids and Isometric projection of simple solids
- To draw the section of solids and the development of surfaces.
- To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids

CONCEPTS AND CONVENTIONS (Not for Examination)   1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning

UNIT-I: PLANE CURVES AND SPECIAL CURVES   10

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid (Rolling Circle rolls on flat surface only). construction of involutes of square and circle – Drawing of tangents and normal to the above curves

UNIT-II: PROJECTION OF POINTS, LINES AND PLANE SURFACES   16

Orthographic projection- Principles-Principal planes - First angle projection-projection of points at the First Quadrant only. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) which inclined to both the principal planes by rotating object method

UNIT-III: PROJECTION OF SOLIDS AND ISOMETRIC PROJECTION   16

Projection of simple solids like prisms, pyramids, cylinders and cones when the axis is inclined to one of the principal planes by the rotating object method. Principles of isometric projection – isometric scale – Isometric projections of simple solids - Prisms, pyramids, cylinders, cones - isometric view of the object from the 2D coded plan.

UNIT-IV: PROJECTION OF SECTIONED SOLIDS & DEVELOPMENT OF SURFACES 16

Sectioning of the above solids in the simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining the true shape of the section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones

UNIT-V: FREE-HAND SKETCHING AND PERSPECTIVE PROJECTIONS 16

Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects. Perspective projection of simple solids-Prisms and pyramids by visual ray method

TOTAL: (L=15; P=60) 75 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able:

- To construct the conics curves and special curves, use BIS conventions, and specifications for engineering drawing.
- To construct the orthographic projection of lines and plane surfaces
- To construct the projections and solids and Isometric projection of simple solids
- To construct projections of section of solids and development of surfaces
- To construct free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids

TEXT BOOKS:

1. N.D.Bhatt, "Engineering Drawing (Plane and Solid Geometry)", Charotar Publishing House PVT. LTD. 53rd Edition 2019 (Fifth Reprint)
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 15th Edition 2018

REFERENCE BOOKS:

1. T. Jeyapoovan, "Engineering Graphics Using Auto CAD", Vikas Publishing House Pvt. LTD, seventh Edition, 2015
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018

3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.

4. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2011

5. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.

2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering

3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings

4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings

5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus

2. All questions will carry equal marks of 20 each making a total of 100.

3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scales to fit solutions within A3 size

4. The examination will be conducted in appropriate sessions on the same day

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
2	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
3	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
4	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
5	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
Average	2.0	-	3.0	-	1.0	-	-	-	1.0	3.0	-	2.0	2.0	1.0	1.0	1.0

GE3221   **ENGINEERING SCIENCES LABORATORY**   **L T P C**

(Common to all branches of B.E. / B.Tech Programmes)   **0 0 4 2**

OBJECTIVES:

- To gain practical knowledge and to co-relate with the theoretical studies.
- To achieve perfectness in experimental skills and the study of practical applications.
- To bring more confidence and ability to develop and fabricate engineering and technical equipment.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To make the student as an active participant in each part of all lab exercises

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of the electrical conductivity of metals by plotting a current-voltage characteristic curve.
2. Determination of band gap of a semiconductor.
3. Determination of Fermi energy. (Measurement of Fermi energy in copper).
4. Study of I-V characteristics of solar cell and determination of its efficiency
5. Determination of electrical resistivity of metal and alloy –Carey foster Bridge.
6. Measurement of susceptibility of paramagnetic solution by Quinke's method.
7. Study of magnetic Hysteresis-B-H curve.
8. Determination of the dark resistance of light detective resister (LDR).
9. Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the students should be able to:

- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze the laboratory data and to solve problems individually and collaboratively.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.

TEXTBOOKS:

1. Wilson J.D. and Hernandez C.A., ―Physics Laboratory Experiments‖, Houghton Mifflin Company, New York, 2005.

2. S. Srinivasan, A Text Book of Practical physics, S. Sultan Chand publications. 2005

3. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

OBJECTIVES:

- To train the students in basic experimental skills in water contaminants such as copper and chromium.
- To familiarise the students with electroanalytical techniques such as pH metry, potentiometry, and conductometry to determine impurities in aqueous solutions.
- To familiarize the students with the determination of the molecular weight of a polymer by a viscometer.
- To make the student up-to-date with the properties and nature of alloys experimentally.
- To demonstrate the analysis of coal.

LIST OF EXPERIMENTS:

1. Estimation of copper content of the given solution by Iodometry.
2. Determination of strength and amount of acids in a mixture of acids using a conductivity meter.

3. Determination of strength and amount of HCl present in the whole of the given solution using a conductivity meter.
4. Estimation of the iron content of the given solution using a potentiometer.
5. Determination of chromium by EDTA titration.
6. Determination of strength of given hydrochloric acid using a pH meter.
7. Determine the molecular weight of the polyvinyl alcohol using an Ostwald viscometer.
8. Estimation of Nickel in steel.
9. Proximate Analysis of Coal.
10. Corrosion experiment-weight loss method.
11. Determination of COD value of industrial effluents.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the student should be able:

- To find the quality of water samples for copper and chromium present in water.
- To recognize the amount of various ions present in the water sample through volumetric and instrumentation techniques.
- To identify the molecular weight of the polymer using an Ostwald viscometer.
- To recognize an environmental hazardous and threshold limit for industrial effluents.
- To recommend quality of coal and steel when it is exposed to various environment.

TEXT BOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).
2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).
3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
2	2	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-
3	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-
4	2	2	1	1	1	2	2	2	-	-	-	-	-	-	-	-
5	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	2.0	1.4	1.0	1.0	1.2	2.0	2.0	2.0	-	-	-	-	-	-	-	-

GE3232   PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L T P C

0 0 4 2

OBJECTIVES:

- To write, test, and debug simple Python programs.

- To implement Python programs with conditionals and loops.

- Use functions for structuring Python programs.

- Represent compound data using Python lists, tuples, and dictionaries and read and write data from/to files in Python.

- Knowing about Object Oriented Concepts.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number. (Newton's method)
3. Find exponentiation of a number. (power of a number)
4. Find the maximum of a list of numbers.
5. Program for basic calculator operations using functions.
6. Generate Fibonacci series using function.
7. Program for Armstrong number.
8. Program for check the number is Palindrome or Not.
9. Program for sum of array of numbers.
10. How to create, slice, change, add, delete and index elements using list.
11. Linear search and Binary search.
12. Find First n prime numbers.
13. Program to remove duplicate elements from a list.
14. Program for addition and transpose of a matrix.
15. How to create, slice, change, delete and index elements using Tuple.
16. Write a program to reverse the string.
17. How to change, delete, add and remove elements in Dictionary.
18. Create a dictionary of radius of circle and its circumference.
19. Program for count the number of words in a file.
20. Find the most frequent words in a text read from a file.
21. Program for student information system using class and objects.
22. Program for Employee Payroll Processing using class and objects.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL: 60 PERIODS

COURSE OUTCOMES

- Develop solutions to simple computational problems using Python programs.
- Solve problems using conditionals and loops in Python.
- Develop Python programs by defining functions and calling them.
- Use Python lists, tuples and dictionaries for representing compound data.
- Develop Python programs using files and OOPS concept.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	3	3	3	3	-	-	-	-	-	3	2	1	3	-	-
2	3	3	3	3	3	-	-	-	-	-	3	2	-	-	2	-
3	3	3	3	3	2	-	-	-	-	-	2	-	-	3	-	2
4	3	2	-	2	2	-	-	-	-	-	1	-	-	-	1	-
5	1	2	-	-	1	-	-	-	-	-	1	-	1	-	2	2
Average	2.6	2.6	3.0	2.8	2.2	-	-	-	-	-	2.0	2.0	1.0	3.0	1.7	2.0

GE3251   NSS/NSO/YRC & CLUB ACTIVITIES   L T P C
                                                          0 0 0 0

UNIT–1:   NATIONAL SERVICE SCHEME (NSS)

OBJECTIVES:

- To help learners know about NSS in the context of youth, community and voluntary service.
- To teach the importance of health, hygiene and sanitation for a healthy Nation.
- To understand the community in which they work.
- To identify the problems of the community and involve them in problem-solving.
- To develop the capacity to meet emergencies and natural disasters.
- To practice the National integration and social harmony.
- To utilize their knowledge in finding practical solutions to individual and community

Credit:

Total Lecture Hours / Semester	Total Tutorial Hours / Semester	Total Practical Hours / Semester	Credit
6	0	18	1*

    * To be conducted after college hours and week ends

OUTCOME:

Learners will have the knowledge about NSS and its role in the fields of health, hygiene, emergencies & natural disasters and involve them in problem-solvingof the nearest community so as to build a strong country.

Syllabus:

Semester: I&II   Attendance weightage: 50 Activities weightage: 50

Topic-I: Introduction and Basic Concepts of NSS   [8]

a. History – Aim – Objectives of NSS
b. Emblem – Motto – Badge - Song
c. Organizational structure - Roles and Responsibilities of NSS
d. Regular activities
e. Any approved indoor / outdoor programs by the Principal

Topic-II: Youth Leadership, Social Harmony and National Integration   [8]

a. Meaning and types of Leadership
b. Qualities of good leaders and leadership
c. Importance and role of youth leadership
d. Role of youth in peace and Nation building

e. Any approved indoor / outdoor programs by the Principal

Topic-III: Health, Hygiene and Sanitation and Youth Health [8]

a. Definition, Needs and Scope of Health Education

b. Swachh Bharat Abhiyan

c. Healthy Lifestyles

d. HIV, AIDS, Drugs abuse

e. Any approved indoor / outdoor programs by the Principal

Topic-IV: Environment Issues, Emergencies and Disaster Management [8]

a. Environment conservation, enrichment and sustainability

b. Waste management

c. Natural resource management [Rain water harvesting and Energy conservation]

d. Introduction to Disaster Management, Classification of Disasters

e. Any approved indoor / outdoor programs by the Principal

REFERENCES:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.

2. National Youth Policy, Government of India, Ministry of Youth Affairs and Sports, New Delhi.

3. https://nss.gov.in/

NSS/NSO/YRC & CLUB ACTIVITIES   **L T P C**

                                                                           0 0 0 0

YOUTH RED CROSS – Social Service based activities

OBJECTIVES:

- To enhance the societal awareness
- To upgrade the Personality

ACTIVITIES   **5**

1. **HEALTH PROMOTION**-Activities that promotes health (2)

2. **SOCIETAL SERVICE**-Social Service activities (2)

3. **FRIENDSHIP BUILDING**-Friendship building activities between communities (1)

OUTCOMES:

1. Enhanced Social Awareness
2. Personality development of the individual

REFERENCES:

1. IRCS/YRC Handbook
2. htttps://www.indianredcross.org/youth/Guidelines-for-JYRC-LR.pdf

NSS/NSO/YRC & CLUB ACTIVITIES **L T P C**

0 0 0 0

NATIONAL SPORTS ORGANIZATION (NSO)

OBJECTIVES:

- To create awareness about basic fitness and mental strength
- To promote the development of physical fitness
- To develop the sporting activities of the youth
- To create the social responsibilities and social interaction through participation

ACTIVITIES   **5**

INTRODUCTION - Introduction of NSO & Physical Fitness and games Skills Test (1)

PHYSICAL FITNESS ACTIVITIES - Importance of Basic Physical Fitness - BMI Calculation - Identification of deformities, (2)

SPORTS PRACTICE - Games and fitness activities Physical Fitness Activities (2)

OUTCOMES:

- Get basic knowledge about physical and mental fitness
- NSO create self-esteem and self confidence
- NSO provide opportunity get social interaction
- Development of character and personality through participation

REFERENCES:

1. www.google.com
2. https://scholar.google.com/
3. https://www.medindia.net/patients/lifestyleandwellness/five-essential-components-of-physical-fitness-references.htm
4. https://pubmed.ncbi.nlm.nih.gov/

தமிழ் மன்றம்

பாடத்திட்டத்தின் நோக்கங்கள்

- மாணவர்களை சிறந்த மேடைப்பேச்சாளர்களாக உருவாக்குவது
- தாய்மொழியின் மேன்மையை பாதுகாப்பது..

பயிற்சித்திட்டம்

1. பேச்சுக்கலைப் பயிற்சி
2. கவிதை மற்றும் கட்டுரைகள் எழுதும் பயிற்சி
3. அறிவியல் பொறியியல் தொழில்நுட்பங்களைத் தமிழில் எழுதுதல்.
4. பட்டிமன்ற மேடைகளில் பேசும் பயிற்சி.
5. நாட்டுப்புறப்பாடல்கள் பாடுதல் மற்றும் கதைகள் எழுதும் பயிற்சி.

கற்றல் முடிவு

1. பேச்சுக்கலைப் தேர்ச்சி
2. நாட்டுப்புறப்பாடல்கள் பற்றிய புரிதல்

மேற்கோள்கள்

1. https://eegarai.darkbb.com/t63483-topic

2. https://poriyari.in/

NSS/NSO/YRC & CLUB ACTIVITIES   L T P C
                                                                           0 0 0 0

ECLECTIC LINGUA – Skill based activities

OBJECTIVES:

- To enhance the communicative competence of the first-year engineering students by means of creating opportunity for impromptu/ /spontaneous speeches.
- To upgrade the English language skills of students by introducing appropriate vocabulary in different situations.

ACTIVITIES   **5**

1. **Extempore**- Giving expression to thoughts (2)

2. **Building Vocabulary**-Using relevant set of words for different contexts (2)

3. **Pronunciation**- Speaking accurately and fluently (1)

OUTCOMES:

- To enable students to express themselves easily and coherently.
- To help students to speak the language using the right words and pronouncing them correctly.

REFERENCES:

1. https://www.cambridgeenglish.org/learning-english/activities-for-learners/?skill=pronunciation

2. https://www.quillsandquotes.ca/post/12-fun-games-to-get-students-public-speaking

CATALYSIS CLUB

Catalysis – Skill-based activities

Objectives:

- To inculcate a scientific attitude and temper.

- To provide an opportunity to develop constructive, explorative & inventive ideas among the students.

- To develop training in the scientific method of problem-solving for engineering

ACTIVITIES   **5**

1. **Quiz/debate**- the latest advancement in Chemistry towards engineering   (2)
2. **Essay competition/Chart preparation** - Environmental sustainability   (2)
3. **Nature Study - field visit to eco-parks etc.**   (1)

OUTCOMES:

- To promote inquisitiveness among the students and inculcate Scientific mind mapping.

- To develop students, interest and participation in the practical applications of the knowledge related to environmental sciences.

- Take part in practical, hands-on science activities close to nature.

REFERENCES:

1. M. Senapati, Advanced Engineering Chemistry, Infinity science press, New Delhi, 2007.

2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/environmental-sustainability

3. https://www.indiabix.com/general-knowledge/chemistry/

EULER.COM – Skill based activities

OBJECTIVES:

- To enhance the Logical reasoning of the first-year engineering students by means of creating opportunity to improve the aptitude skill.

- To explore the applications of Mathematics in the field of Engineering, Science and Technology and to utilize this skill for their academic activities.

ACTIVITIES 5

1. **OLYMPIAD**- The students will be provided with 25 questions in Engineering Mathematics. This should be completed in one hour. **(1)**

2. **MATHEMATICAL MODELLING**- The students are expected to present physical models (Working as well as static models) based on the application of Engineering Mathematics **(2)**

3. **PAPER PRESENTATION**- Students will be provided 5-7 minutes of time to present their findings in application of Mathematics. **(2)**

OUTCOMES:

- To enable students to explore their mathematical reasoning skills.
- To motivate the students to apply Mathematics in Engineering and Technology and demonstrate their work by means of Physical model and present their research article.

REFERENCES:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiely India Pvt Ltd.
2. https://www.stewartcalculus.com/

FINE ARTS CLUB - VECTORIANS – Skill based activities

OBJECTIVES:

- To enhance the inbuilt talents in arts and crafts and fine arts activities.
- To explore and exhibit their qualities in cultural activities as well as in the leadership.

ACTIVITIES 5

1. **ARTS & CRAFTS** - The students will be given with innovative Theme; they have to Show their talents in one-hour time with basic facilities provided. **(1)**

2. **SINGING & DANCING** - The students are expected to present their talents on spot or with given Theme, either solo or group performance. **(2)**

3. **MIME & DRAMA** - Students will be given 5 - 7 minutes of time to present their variety Entertainments in way of Mono acting or Drama. **(2)**

OUTCOMES:

- To enable students to explore their inbuilt talents in fine arts activities.
- To motivate the students to show case their cultural and leadership qualities.

REFERENCES:

1. https://www.youtube.com/watch?v=1mkESRWiSKc – Teach your own crafts.
2. https://www.youtube.com/watch?v=YHqwrDGywH4 – How to teach Arts & Crafts

SEMESTER III

MA3322   DISCRETE MATHEMATICS   L T P C

3 0 0 3

OBJECTIVES:

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
- To understand the basic concepts of Combinatorics and graph theory.
- To familiarize the applications of algebraic structures.
- To understand the concepts and significance of lattices and Boolean algebra which are widely used in computer science and engineering.

UNIT-I: LOGICS   9L

Propositional logic – Propositional equivalences – Predicates and quantifiers – Rules of inference.

UNIT-II: ADVANCED COUNTING PRINCIPLE   9L

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations - Inclusion and exclusion principle and its applications.

UNIT-III: GRAPH THEORY   9L

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Definitions and Examples of Euler and Hamilton paths.

UNIT-IV: GROUP THEORY   9L

Algebraic systems - Groups – Subgroups – Homomorphism's – Cosets – Lagrange's theorem.

UNIT-V: LATTICES AND BOOLEAN ALGEBRA   9L

Partial ordering – Posets – Lattices as posets – Properties of lattices – Some special lattices – Boolean algebra.

TOTAL: 45L PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Have knowledge of the concepts needed to test the logic of a program.

- Have an understanding in counting principle on many levels.
- To understand the concepts of graphs and its applications in computer science.
- Be exposed to concepts and properties of algebraic structures like groups, subgroups and cosets.
- To understand the concepts of Lattices and Boolean algebra.

TEXTBOOKS:

1. Kenneth H. Rosen . Dr. Kamala Krithivasan, "Discrete Mathematics and Its Applications", (SIE) | 8th Edition, McGraw Hill, Special Indian Edition, 2021.
2. Tremblay, J.P. and Manohar.R, "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill Pub. Co. Ltd, New Delhi 2017.

REFERENCE BOOKS:

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4thEdition, Pearson Education Asia, Delhi, 2007.
2. Veerarajan. T, "Discrete Mathematics ,with graph theory and Combinatorics", McGraw Hill Publication Pvt Ltd. 2018.
3. Sivarama Krishna Dass.P & Vijayakumari. C "Discrete Mathematics" Person Education, 2020.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	-	-	-	-	-	-	-	-	1	-	-	1	-
2	3	3	3	-	-	-	-	-	1	-	-	1	-	-	1	-
3	3	3	2	-	-	-	-	-	1	-	-	1	-	-	1	-
4	3	3	2	-	-	-	-	-	-	-	-	1	-	-	1	-
5	3	3	3	-	-	-	-	-	1	-	-	1	-	-	1	-
Average	3.0	3.0	2.4	-	-	-	-	-	1.0	-	-	1.0	-	-	1.0	-

AD3361   DATA EXPLORATION AND VISUALIZATION   L T P C
                                                        3 0 0 3

OBJECTIVES:

- To outline an overview of exploratory data analysis
- To implement data visualization using Matplotlib
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- To use Data exploration and visualization techniques for multivariate and time series data.

UNIT-I: EXPLORATORY DATA ANALYSIS   9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data - Comparing EDA with classical and Bayesian analysis – Software tools for EDA – Visual Aids for EDA – Data transformation techniques – merging database, reshaping and pivoting, Transformation techniques – Grouping Datasets – data aggregation – Pivot tables and cross- tabulations.

UNIT-II: VISUALIZING USING MATPLOTLIB   9

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotations – customization - Three-dimensional plotting – Geographic Data with Base map – Visualization with seaborn.

UNIT-III: UNIVARIATE ANALYSIS   9

Introduction to Single variable: Distributions and variables – Numerical Summaries of Level and Spread – Scaling and Standardizing – Inequality – Smoothing Time Series.

UNIT-IV: BIVARIATE ANALYSIS   9

Relationship between Two variables – Percentage Tables – Analyzing Contingency Tables - Handling Several Batches – Scatterplots and Resistant Lines – Transformations.

UNIT-V: MULTIVARIATE AND TIME SERIES ANALYSIS   9

Introducing a Third Variable – Casual Explanations – Three-Variable Contingency Tables and Beyond – Longitudinal Data – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the fundamentals of exploratory data analysis.
- Implement the data visualization using Matplotlib.
- Perform univariate data exploration and analysis.
- Apply bivariate data exploration and analysis.
- Use Data exploration and visualization techniques for multivariate and time series data.

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020.
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 1st Edition, 2016.
3. Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008.

REFERENCE BOOKS:

1. Eric Pimpler, "Data Visualization and Exploration with R", Geospatial Training service, 2017.
2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	3	-	-	-	-	-	-	2	-	2	-	-	2
2	2	3	-	3	-	-	-	-	-	2	-	-	-	1	-	-
3	2	-		1	1	-	-	-	3	-	-	2	2	-	2	-
4	-	2	2	1	-	-	-	-	-	2	-	-	1	-	-	3
5	3	-	1	-	1	-	-	-	-	-	-	-	2	-	-	-
Average	2.3	2.5	2.0	2.0	1.0	-	-	-	3.0	2.0	2.0	2.0	1.8	1.0	2.0	2.5

AD3362   DATABASE DESIGN AND MANAGEMENT   L T P C

                                                                    3 0 0 3

OBJECTIVES:

- To introduce database development life cycle and conceptual modeling
- To learn SQL for data definition, manipulation and querying a database
- To learn relational database design using conceptual mapping and normalization
- To learn transaction concepts and serializability of schedules
- To learn data model and querying in object-relational and No-SQL databases

UNIT-I: CONCEPTUAL DATA MODELING   9

Database environment – Database system development lifecycle – Requirements collection – Database design -- Entity-Relationship model – Enhanced-ER model – UML class diagrams.

UNIT-II: RELATIONAL MODEL AND SQL   9

Relational model concepts - Integrity constraints - SQL Data manipulation – SQL Data definition – Views - SQL programming.

UNIT-III: RELATIONAL DATABASE DESIGN AND NORMALIZATION   9

ER and EER-to-Relational mapping – Update anomalies – Functional dependencies – Inference rules – Minimal cover – Properties of relational decomposition – Normalization (upto BCNF).

UNIT-IV: TRANSACTION MANAGEMENT   9

Transaction concepts – properties – Schedules – Serializability – Concurrency Control – Two-phase locking techniques.

UNIT-V: OBJECT RELATIONAL AND NO-SQL DATABASES   9

Mapping EER to ODB schema – Object identifier – reference types – rowtypes – UDTs – Subtypes and supertypes – user-defined routines – Collection types – Object Query Language; No-SQL: CAP theorem – Document-based: MongoDB data model and CRUD operations; Column-based: Hbase data model and CRUD operations.

                                                        TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the database development life cycle and apply conceptual modeling
- Apply SQL and programming in SQL to create, manipulate and query the database

- Apply the conceptual-to-relational mapping and normalization to design relational database
- Determine the serializability of any non-serial schedule using concurrency techniques
- Apply the data model and querying in Object-relational and No-SQL databases.

TEXT BOOKS:

1. Thomas M. Connolly, Carolyn E. Begg, Database Systems – A Practical Approach to Design, Implementation, and Management, Sixth Edition, Global Edition, Pearson Education, 2015.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, Pearson, 2017.

REFERENCE BOOKS:

1. Toby Teorey, Sam Lightstone, Tom Nadeau, H. V. Jagadish, "DATABASE MODELING AND DESIGN - Logical Design", Fifth Edition, Morgan Kaufmann Publishers, 2011.
2. Carlos Coronel, Steven Morris, and Peter Rob, Database Systems: Design, Implementation, and Management, Ninth Edition, Cengage learning, 2012
3. Abraham Silberschatz, Henry F Korth, S Sudharshan, "Database System Concepts'', 6th Edition, Tata Mc Graw Hill, 2011.
4. Hector Garcia-Molina, Jeffrey D Ullman, Jennifer Widom, "Database Systems:The Complete Book", 2nd edition, Pearson.
5. Raghu Ramakrishnan, "Database Management Systems'', 4th Edition, Tata Mc Graw Hill, 2010.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	3	-	-	-	-	-	1	-	-	3	2	-	-
2	-	3	1	-	1	-	-	-	-	2	-	-	2	-	-	1
3	2	-	-	1	-	-	-	-	-	-	1	-	2	-	-	-
4	-	2	3	-	-	-	-	-	1	-	-	2	2	-	2	-
5	3	-	2	-	-	-	-	-	1	-	-	-	2	1	-	1
Average	2.3	2.5	2.3	2.0	1.0	-	-	-	1.0	1.5	1.0	2.0	1.2	1.5	2	1.0

AD3363   **DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION**   **L T P C**

                                                                 3 0 0 3

OBJECTIVES:

- To analyze and design combinational circuits.
- To analyze and design sequential circuits.
- To understand the basic structure and operation of a digital computer.
- To study the design of data path unit, control unit for processor and to familiarize with the hazards.
- To understand the concept of various memories and I/O interfacing.

UNIT-I: COMBINATIONAL LOGIC   9

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - Demultiplexers.

UNIT-II: SYNCHRONOUS SEQUENTIAL LOGIC   9

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters.

UNIT-III: COMPUTER FUNDAMENTALS   9

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language.

UNIT-IV: PROCESSOR   9

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

UNIT-V: MEMORY AND I/O   9

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Design various combinational digital circuits using logic gates
- Design sequential circuits and analyze the design procedures
- State the fundamentals of computer systems and analyze the execution of an instruction
- Analyze different types of control design and identify hazards
- Identify the characteristics of various memory systems and I/O communication.

TEXT BOOKS:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2018.
2. David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020.

REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.
2. William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.
3. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	3	2	2	1	1	-	-	-	-	1	-	2	-
2	3	-	3	-	-	-	-	-	1	1	-	-	2	-	-	-
3	-	3	-	-	-	2	-	-	-	1	-	3	1	-	2	-
4	-	2	-	2	-	-	-	-	-	-	-	-	2	-	-	-
5	2	-	2	-	-	2	1	-	1	-	-	2	1	-	2	-
Average	2.7	2.5	2.5	2.5	2.0	2.0	1.0	1.0	1.0	1.0	-	2.5	1.5	-	2.0	-

IT3361   **PROGRAMMING AND DATA STRUCTURES**   **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce the fundamentals of C programming language
- To learn the concepts of Arrays and Pointers in C
- To learn about the basics of data structure
- To know the concepts of linear data structures
- To get familiarize the concepts of non-linear data structures

UNIT-I: INTRODUCTION TO C PROGRAMMING   9

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Arrays – Single and Multi-Dimensional Arrays.

UNIT-II: ADVANCED CONCEPTS IN C   9

Functions – Recursive Functions, Parameter Passing Techniques, Pointer - Pointer to Structure, Structures.

UNIT-III: LINEAR DATA STRUCTURES   9

Introduction to Data Structures- Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly- Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT-IV: NON LINEAR DATA STRUCTURES - TREES   9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees. Implementation of Binary search tree and its operations, tree traversal methods, finding height of the tree using C, AVL Trees.

UNIT-V: NON LINEAR DATA STRUCTURES – GRAPHS   9

Definition – Representation of Graph – Breadth-first traversal - Depth-first traversal – Topologial Sort – Dynamic programming Technique – Warshall's and Floyd's algorithm – Greedy method – Dijkstra's algorithm – applications of graphs. Implementation of graph, graph traversal methods, finding shortest path using Dijkstra's algorithm in C.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Develop C programs for any real world or technical problem.
- Apply the advanced features of C in problem solving.

- Apply the different linear data structures to problem solutions.

- Apply the different non-linear data structures to problem solutions.

- Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.

TEXT BOOKS:

1. E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316-513-0. (Unit-I and Unit-II)

2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2011 (Unit-III, IV and V).

REFERENCE BOOKS:

1. Pradip Dey, Manas Ghosh, "Programming in C", 2nd Edition, 2018, Oxford University Press, ISBN: 978-01-9949-147-6. (Unit-I and Unit-II)

2. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983. (Unit-III, IV and V)

3. Byron Gottfried, Jitender Chhabra, "Programming with C" (Schaum's Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010. (Unit-I and Unit-II)

4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008. (Unit-III, IV and V)

5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002 (Unit-III).

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	-	-
2	3	3	2	-	-	-	-	-	-	-	-	-	3	2	-	-
3	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-	-
4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-	-
5	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-	-
Average	3.0	2.8	2.6	-	-	-	-	-	-	-	-	-	3.0	2.0	-	-

CS3363   **SOFTWARE ENGINEERING**   **L T P C**

                                                                3 0 0 3

OBJECTIVES:

- To understand the phases in a software project
- To understand fundamental concepts of requirements engineering
- To Understand Analysis Modeling.
- To understand the various software design methodologies.
- To learn various testing and maintenance measures.

UNIT-I: SOFTWARE PROCESS AND AGILE DEVELOPMENT   9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process   Models – Introduction to Agility-Agile process - Extreme programming-XPProcess - Quality management-SQA-SQA plan

UNIT-II: REQUIREMENTS ANALYSIS AND SPECIFICATION   9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets-Data Dictionary.

UNIT-III: SOFTWARE DESIGN   9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT-IV: TESTING AND MAINTENANCE   9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging – Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT-V: PROJECT MANAGEMENT   9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value

Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Identify the key activities in managing a software project, project schedule, estimate project cost and effort required.
- Compare different process models.
- Concepts of requirements engineering and Analysis Modeling.
- Apply systematic procedure for software design and deployment.
- Compare and contrast the various testing and maintenance.

TEXT BOOKS:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", Seventh Edition, Mc Graw-Hill International Edition,2010.
2. Ian Sommerville, "SoftwareEngineering", 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS:

1. Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Pvt Limited, 2009.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
3. Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited,2007.
5. http://nptel.ac.in/.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	3	-	-	-	-	-	-	-	2	2	-	-	-
2	2	-	3	3	-	2	-	-	-	-	-	-	-	2	-	-
3	-	-	3	3	-	-	-	-	-	-	3	-	-	-	2	-
4	-	2	-	-	-	-	-	-	-	2	-	-	-	2	-	-
5	-	2	-	-	-	3	-	-	-	-	3	-	-	-	1	-
Average	2.0	2.0	3.0	3.0	-	2.5	-	-	-	2.0	3.0	2.0	2.0	2.0	1.5	-

AD3364   DATA EXPLORATION AND VISUALIZATION LABORATORY   L T P C

0 0 3 1.5

OBJECTIVES:

- To understand the key techniques behind data visualization
- To learn about various visualization structures
- To evaluate the information visualization systems
- To design and build data visualization systems
- To analyze and identify trends in data sets

LIST OF EXPERIMENTS:

1. Install data Analysis and Visualization tools: R/Python/Tableau Public/Power BI.
2. Perform Exploratory Data Analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
3. Working with Numpy arrays, Pandas data frames, Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot Features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualizations techniques.
6. Perform Data Analysis and representation on a Map using Map data sets with Mouse Rollover effect, user interaction, etc.
7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
8. Perform EDA on Wine Quality Data Set.
9. Use a case study on a data set and apply the various EDA and visualizations techniques and present an analysis report.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the fundamentals of exploratory data analysis.
- Implement the data visualization using Matplotlib.
- Perform univariate data exploration and analysis.
- Apply bivariate data exploration and analysis.
- Use Data exploration and visualization techniques for multivariate and time series data.

Hardware:

Standalone Desktops

Software:

Tools: R. Python, Tableau Public, Power BI, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	1	3	3	-	-	-	-	2	3	3	3	2	2	-	2
2	2	2	2	1	1	-	-	-	3	2	3	1	3	1	-	3
3	2	1	2	1	1	-	-	-	3	2	1	2	2	2	-	1
4	2	2	2	1	-	-	-	-	1	2	1	3	1	3	-	2
5	3	3	1	2	1	-	-	-	3	2	1	2	2	2	-	3
Average	**2.4**	**1.8**	**2.0**	**1.6**	**1.0**	**-**	**-**	**-**	**2.4**	**2.2**	**1.8**	**2.2**	**2.0**	**2.0**	**-**	**2.2**

AD3365   DATABASE DESIGN AND MANAGEMENT LABORATORY   L T P C

                                                                    0 0 3 1.5

OBJECTIVES:

- To understand the database development life cycle
- To learn database design using conceptual modeling, Normalization
- To implement database using Data definition, Querying using SQL manipulation and SQL Programming
- To implement database applications using IDE/RAD tools
- To learn querying Object-relational databases

LIST OF EXPERIMENTS:

1. Database Development Life cycle:
   a. Problem definition and Requirement analysis
   b. Scope and Constraints
2. Database design using Conceptual modeling (ER-EER) – top-down approach
   a. Mapping conceptual to relational database and validate using Normalization
3. Implement the database using SQL Data definition with constraints, Views
4. Query the database using SQL Manipulation
5. Querying/Managing the database using SQL Programming
   a. Stored Procedures/Functions
   b. Constraints and security using Triggers
6. Database design using Normalization – bottom-up approach
7. Develop database applications using IDE/RAD tools (Eg. NetBeans,VisualStudio)
8. Database design using EER-to-ODB mapping / UML class diagrams
9. Object features of SQL-UDTs and sub-types, Tables using UDTs, Inheritance, Method definition
10. Querying the Object-relational database using Objet Query language

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the database development life cycle
- Design relational database using conceptual-to-relational mapping, Normalization
- Apply SQL for creation, manipulation and retrieval of data
- Develop a database applications for real-time problems

- Design and query object-relational databases

HARDWARE:

- Standalone Desktops

SOFTWARE:

- PostgreSQL

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-	1
2	-	2	-	-	1	-	-	-	-	2	-	-	1	-	-	-
3	-	-	3	1	-	-	-	-	-	3	-	2	2	-	-	-
4	2	-	-	-	-	-	-	-	1	-	-	-	2	-	1	2
5	-	3	1	3	1	-	-	-	1	-	-	2	3	1	-	-
Average	2.5	2.5	2.3	2.0	1.0	-	-	-	1.0	2.5	-	2.0	2.0	1.0	1.0	1.5

IT3363   PROGRAMMING AND DATA STRUCTURES LABORATORY   L T P C

0 0 3 1.5

OBJECTIVES:

- To develop C programs using basic constructs
- To implement Linear Data Structures
- To implement Non-Linear Data Structures
- To implement Tree Traversal Algorithms
- To implement Graph Traversal Algorithms

LIST OF EXPERIMENTS:

1. Implement C program using I/O Statements, Operators and Expressions
2. a. Decision-making constructs: if-else, goto, switch-case, break-continue

   b. Loops: for, while, do-while
3. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
4. Array implementation of Stack, Queue and Circular Queue ADTs
5. Implementation of Singly Linked List
6. Linked list implementation of Stack and Linear Queue ADTs
7. Implementation of Polynomial Manipulation using Linked list
8. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion
9. Implementation of Binary Search Trees
10. Implementation of Tree Traversal Algorithms
11. Implementation of Graph Traversal Algorithms
12. Implementation of Dijkstra's Algorithm

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Develop C programs for real world problems
- Implement Linear Data Structures and its applications
- Implement Non-Linear Data Structures and its applications.
- Implement Binary Search tree operations.
- Implement graph algorithms.

HARDWARE:

- Standalone Desktops

SOFTWARE:

- Turbo C

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	3	3	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
4	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-
5	3	3	3	-	2	-	-	-	-	-	-	-	3	2	-	-
Average	2.6	2.3	3.0	-	2.0	-	-	-	-	-	-	-	3.0	2.3	-	-

MA3428	APPLIED MATHEMATICS FOR DATA SCIENCE	L T P C
		2 0 0 2

OBJECTIVES:

- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To introduce the concepts of estimation theory
- To acquaint the knowledge of non- parametric tests which plays an important role in real life problems.
- To acquaint the knowledge of statistical quality control

UNIT-I: RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS   6L

Discrete and continuous random variables – Binomial, Poisson and Normal distribution

UNIT-II: TWO- DIMENSIONAL RANDOM VARIABLES   6L

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression.

UNIT-III: ESTIMATION THEORY   6L

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood

UNIT-IV: NON- PARAMETRIC TESTS   6L

Introduction- Rank - sum tests - The U test - The H test -- The Kolmogorov Tests

UNIT-V: STATISTICAL QUALITY CONTROL   6L

Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 30L PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the fundamental knowledge of the concepts of one dimensional random variables and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of two dimensional random variables and apply them to model engineering problems.
- Understand and apply the concept of estimation theory
- Demonstrate accurate and efficient use of non-parametric tests.

- Apply the basic concepts of statistical quality control used in engineering and management problems.

TEXT BOOKS:

1. Richard I. Levin, David S. Rubin, Masood H. Siddiqui, Sanjay Rastogi, "Statistics for Management", Pearson Education, 8th Edition, 2017.
2. Johnson. R.A., Miller. I.R and Freund. J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
3. John E. Freund, "Mathematical Statistics", Prentice Hall, 5th Edition, 1992.

REFERENCE BOOKS:

1. Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014
4. Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5 th Edition, Elsevier, 2014.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
5	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
Average	3.0	3.0	3.0	-	-	-	-	-	-	-	-	-	-	-	1.0	-

AD3461   ARTIFICIAL INTELLIGENCE - I   L T P C

3 0 0 3

OBJECTIVES:

The objective of this course is to enable the students to

- Understand the basic concepts of Intelligent agents
- Develop general-purpose problem solving agents.
- Understand the Game theory and Constraint Satisfaction Problems
- Learn about logical reasoning agents, and agents that reason under uncertainty
- Employ AI techniques to represent Knowledge and Planning

UNIT-I: INTELLIGENT AGENTS   9

Introduction to AI – Agents and Environments – Concept of Rationality – Nature of Environments – Structure of Agents – Problem solving agents – Search Algorithms – Uninformed Search Strategies.

UNIT-II: PROBLEM SOLVING   9

Informed (Heuristic) Search Strategies – Heuristic functions - Local search and optimization problems – Local search in continuous space – Search with non-deterministic actions – Search in partially observable environments – Online search agents and Unknown environments.

UNIT-III: GAME PLAYING AND CSP   9

Game theory – Optimal decisions in games – Alpha-beta search – Monte-carlo tree search – Stochastic games – Partially observable games – Constraint Satisfaction Problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP.

UNIT-IV: LOGICAL AGENTS   9

Knowledge-based agents – Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic – First-order logic – Syntax and semantics – Knowledge representation and engineering – Inferences in first-order logic – Forward chaining – Backward chaining – Resolution.

UNIT-V: KNOWLEDGE REPRESENTATION AND PLANNING   9

Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information – Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – Non-deterministic domains – Time, schedule, and resources – Analysis.

OUTCOMES:

At the end of the course, the student should be able to:

- Explain Intelligent agents that make effective decisions
- Choose appropriate algorithms for solving given AI problems
- Solve problems in Games and Constraint Satisfaction Problems
- Design and implement logical reasoning agents
- Design methods to represent Knowledge and Planning

TEXT BOOK:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

REFERENCE BOOKS:

1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert System", Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
5. Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases - by Dennis Rothman, 2018

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	3	3	-	-	-	-	2	-	-	-	-	1	-	1
2	2	2	-	-	1	-	-	-	-	-	3	-	-	2	-	2
3	2	-	2	1	-	-	-	-	2	-	-	3	2	2	-	1
4	-	-	2	2	-	-	-	-	2	1	2	2	-	3	-	3
5	-	2	-	-	1	-	-	-	-	-	1	-	2	2	-	1
Average	2.3	2.0	2.3	2.0	1.0	-	-	-	2.0	1.0	2.0	1.5	2.0	2.0	-	1.4

AD3462   DATA AND INFORMATION SECURITY   L P T C

3 0 0 3

OBJECTIVES:

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management
- To become aware of various standards in this area
- To know the technological aspects of Information Security

UNIT-I: INTRODUCTION   9

History, what is Information Security? Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT-II: SECURITY INVESTIGATION   9

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies

UNIT-III: DIGITAL SIGNATURE AND AUTHENTICATION   9

Digital Signature and Authentication Schemes: Digital signature-Digital Signature Schemes and their Variants- Digital Signature Standards-Authentication: Overview-Requirements Protocols - Applications - Kerberos -X.509 Directory Services 83.

UNIT-IV: E-MAIL AND IP SECURITY   9

E-mail and IP Security: Electronic mail security: Email Architecture -PGP – Operational Descriptions- Key management- Trust Model- S/MIME.IP Security: Overview-Architecture - ESP, AH Protocols IPSec Modes – Security association - Key management.

UNIT-V: WEB SECURITY   9

Web Security: Requirements- Secure Sockets Layer- Objectives-Layers -SSL secure Communication-Protocols - Transport Level Security. Secure Electronic Transaction-Entities DS Verification-SET processing – Use cases.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Understand the basics of data and information security

- Understand the legal, ethical and professional issues in information security
- Understand the various authentication schemes to simulate different applications.
- Understand various security practices and system security standards
- Understand the Web security protocols for E-Commerce applications

TEXT BOOKS:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", 6th Edition, 2017.
2. Stallings William. "Cryptography and Network Security: Principles and Practice", Seventh Edition, Pearson Education, 2017

REFERENCE BOOKS:

1. Micki Krause Nozaki, Harold F. Tipton, "Information Security Management Handbook", Vol 6, 6th Edition, 2016.
2. Stuart McClure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw-Hill, Seventh Edition, 2012.
3. Matt Bishop, "Computer Security Art and Science", Addison Wesley Reprint Edition, 2015.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	2	-	-	-	-	-	-	-	3	3	-	1	-
2	-	2	-	2	2	-	-	-	-	-	-	-	3	-	3	-
3	-	-	3	-	1	-	-	-	3	-	1	-	1	-	2	2
4	-	3	1	-	-	-	-	-	-	-	-	3	1	-	1	-
5	3	-	-	-	2	-	-	-	-	-	-	-	2	-	2	2
Average	3.0	2.5	2.0	2.0	1.7	-	-	-	3.0	-	1.0	3.0	2.0	-	1.8	2.0

AD3463   DATA COMMUNICATION AND NETWORKS   L T P C

3 0 0 3

OBJECTIVES:

- To understand the concept of layering in networks.

- To know the functions of protocols of each layer of TCP/IP protocol suite

- To visualize the end-to-end flow of information.

- To learn the functions of network layer and the various routing protocols

- To familiarize the functions and protocols of the Transport layer

UNIT-I: INTRODUCTION AND APPLICATION LAYER   9

Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP

UNIT-II: TRANSPORT LAYER   9

Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control - Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service.

UNIT-III: NETWORK LAYER   9

Switching: Packet Switching - Internet protocol - IPV4 – IP Addressing – Sub netting - IPV6, ARP, RARP, ICMP, DHCP.

UNIT-IV: ROUTING   9

Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF – Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.

UNIT-V: DATA LINK AND PHYSICAL LAYERS   9

Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Explain the basic layers and its functions in computer networks.

- Understand the basics of how data flows from one node to another.

- Analyze routing algorithms.

- Describe protocols for various functions in the network.
- Analyze the working of various application layer protocols.

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Eighth Edition, Pearson Education, 2021.
2. Behrouz A. Forouzan, "Data Communications and Networking with TCP/IP Protocol Suite", Sixth Edition TMH, 2022

REFERENCE BOOKS:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, "Data and Computer Communications", Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, "Computer and Communication Networks", Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	2	3	-	-	-	-	-	-	-	-	3	-	1	-
2	3	2	-	-	2	-	-	-	-	-	-	-	3	-	3	-
3	-	-	3	-	1	-	-	-	3	-	1	2	1	-	3	-
4	-	-	1	3	-	-	-	-	-	-	-	-	1	-	1	-
5	3	3	-	1	-	-	-	-	-	-	-	2	2	-	2	-
Average	3.0	2.5	2.0	2.3	1.5	-	-	-	3.0	-	1.0	2.0	2.0	-	2.0	-

AD3464   FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS   L T P C

3 0 0 3

OBJECTIVES:

- To understand the techniques and processes of data science
- To apply descriptive data analytics
- To visualize data for various applications
- To understand inferential data analytics
- To analysis and build predictive models from data

UNIT-I: INTRODUCTION TO DATA SCIENCE   9

Need for data science - benefits and uses - facets of data - data science process - setting the research goal - retrieving data - cleansing, integrating, and transforming data - exploratory data analysis - build the models - presenting and building applications.

UNIT-II: DESCRIPTIVE ANALYTICS   9

Frequency distributions - Outliers - interpreting distributions – graphs - averages – describing variability - interquartile range - variability for qualitative and ranked data - Normal distributions - z scores – correlation - scatter plots – regression - regression line - least squares regression line - standard error of estimate - interpretation of r2 - multiple regression equations - regression toward the mean.

UNIT-III: INFERENTIAL STATISTICS   9

Populations – samples - random sampling - Sampling distribution - standard error of the mean - Hypothesis testing - z-test - z-test procedure - decision rule – calculations - decisions - interpretations - one-tailed and two-tailed tests – Estimation - point estimate - confidence interval - level of confidence - effect of sample size.

UNIT-IV: ANALYSIS OF VARIANCE   9

t-test for one sample - sampling distribution of t - t-test procedure - t-test for two independent samples - p-value - statistical significance - t-test for two related samples. F-test – ANOVA – Two-factor experiments - three f-tests - two-factor ANOVA - Introduction to chi-square tests.

UNIT-V: PREDICTIVE ANALYTICS   9

Linear least squares - implementation - goodness of fit - testing a linear model - weighted resampling. Regression using Stats Models - multiple regression - nonlinear relationships - logistic regression - estimating parameters - Time series analysis - moving averages - missing values - serial correlation - autocorrelation. Introduction to survival analysis.

OUTCOMES:

At the end of the course, the student should be able to:

- Explain the data analytics pipeline
- Describe and visualize data
- Perform statistical inferences from data
- Analyze the variance in the data
- Build models for predictive analytics

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

REFERENCE BOOKS:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
2. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
3. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.
4. Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress, 2021.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	2	1	-	-	-	-	-	-	-	2	3	-	-	1
2	1	-	2	-	2	-	-	-	2	2	-	-	3	1	-	-
3	-	-	3	-	1	-	-	-	-	-	-	-	2	-	-	1
4	-	3	-	3	-	-	-	-	-	-	3	3	3	2	-	-
5	2	-	-	1	-	-	-	-	1	-	-	-	2	-	-	2
Average	1.3	3.0	2.3	1.7	1.5	-	-	-	1.5	2.0	3.0	2.5	2.6	1.5	-	1.3

IT3461   OPERATING SYSTEMS   **L T P C**
                                                                    3 0 0 3

OBJECTIVES:

- To learn the basic concepts and functions of operating systems.
- To analyze scheduling algorithms and Deadlock.
- To analyze various memory management schemes.
- To be familiar with I/O management and file systems.
- To be familiar with Mobile OS and Linux OS

UNIT-I: INTRODUCTION   9

Introduction to Operating System: Operating System Operations- Operating System Structures: Operating System-Services - User Operating System Interface - System Calls – System programs – Operating System Structure (monolithic, layered, modular, micro-kernel models).

UNIT-II: PROCESS MANAGEMENT   9

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-Process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Process Synchronization - The Critical-Section problem –Semaphores, Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT-III: MEMORY MANAGEMENT   9

Main Memory: Swapping- Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Virtual Memory - Demand Paging – Copy on Write – Page Replacement - Allocation of Frames –Thrashing.

UNIT-IV: STORAGE MANAGEMENT   9

File-System Interface -File concept - Access methods - Directory Structure – Protection. - File System Implementation - File System Structure – File System Operations - Directory implementation - Allocation Methods - Free Space Management; Mass Storage system – Disk Structure - Disk Scheduling –Disk Management- Swap-Space Management.

UNIT-V: MOBILE OS AND CASE STUDIES   9

Mobile OS - iOS and Android. The Linux System: Design Principles-Kernel Modules-Process Management-Scheduling-Memory Management-File Systems - Input and Output- Inter process communication.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Analyze various main concepts, key ideas, strengths and limitations of operating systems.
- Design various scheduling algorithms.
- Design and implement memory management schemes
- Understand various file management systems
- Understand the Mobile OS and Linux

TEXT BOOKS:

1. Silberschatz Abraham, Greg Gagne, Peter B. Galvin, "Operating System Concepts", Ninth Edition, Wiley, 2014.(Unit-I-V)
2. Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi.(Unit-II,III,IV).

REFERENCE BOOKS:

1. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018
3. Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	2	-	-	-	-	-	-	-	-	-	2	-	-
2	2	2	3	1	-	-	-	-	-	-	-	-	-	2	-	-
3	1	3	2	2	1	-	-	-	-	-	-	-	-	2	-	-
4	1	3	3	3	-	-	-	-	-	-	-	-	-	2	-	-
5	3	1	2	1	1	-	-	-	-	-	-	-	-	2	-	-
Average	2.0	2.0	2.4	1.8	1.0	-	-	-	-	-	-	-	-	2.0	-	-

GE3451   **NCC Credit Course Level - I**   **L T P C**

                   (Common to Army, Navy & Air)   **3 0 0 3**

OBJECTIVES:

- To know the basic structure of NCC and Role of NCC
- To improve the cadet's personality skill and leadership quality
- To make the interest of cadets to involve in social activities
- Preventing the potential damage and suffering
- To destruction of the enemy's ability to fight and will to fight

UNIT-I: INTRODUCTION TO NCC   9

Aims, Objectives & Organization of NCC, Incentives, Duties of NCC Cadet, NCC Camps and Types National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security.

UNIT-II: PERSONALITY DEVELOPMENT   9

Personal Transformation, Personal Productivity Skills - time management, organizational and planning skills, problem solving and decision-making abilities, basics of psychology, Leadership, Meditation

UNIT-III: SOCIAL SERVICE AND COMMUNITY DEVELOPMENT   9

Basics, Rural Development Programmes, NGOs, Contribution of Youth, Protection of Children and Women Safety, Road / Rail Travel Safety, New Initiatives, Cyber and Mobile Security Awareness

UNIT-IV: DISASTER MANAGEMENTS AND ITS AWARENESS   9

Importance of Hazards and Disaster, Types of disasters, Earthquakes and its types, flood types and its management, landside and its managements case studies of disasters in Sikkim, Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management

UNIT-V: WAR AND PEACE IN CONTEMPORARY WORLD   9

Conceptual framework of War and Peace, Concepts of theories and approaches, Modern /war fare: Conventional, nuclear, Guerilla and Irregular Warfare, Limited and Specialized Warfare with reference to mountain, desert and jungle warfare, terrorism as a new mode of conflict, War as an Economic Problem, Defence and Development, Defence and Development, Defence and Development

                                             TOTAL: 45 PERIODS

Note: NCC Credit Course Level – I is offered for NCC students only. The grades earned by the students will be recorded in the mark sheet, however the same shall not be considered for the computation of CGPA

OUTCOMES:

At the end of the course, the student should be able to:

- Understand their roles and responsibilities
- Demonstrate the knowledge of human values and morals
- Actively participate in social service and development activities
- Understand the importance of disaster management
- Analyse the issues related to war and its effects.

TEXT BOOKS:

1. R. Gupta's NCC Handbook of NCC Cadets 'A', 'B' and 'C' certificate Examiantions

REFERENCE BOOKS:

1. V. B. RAO, Personality Development and Soft Skills, BS Publications
2. Harish K. Gupta, Disaster Management, Universities press

AD3465   ARTIFICIAL INTELLIGENCE – I LABORATORY   L T P C
0 0 3 1.5

OBJECTIVES:

- Understand simple PEAS descriptions for given AI tasks.
- Apply and implement simulated annealing and genetic algorithms.
- Solve problems using searching and backtracking.
- Design and Implement simple reasoning systems using inference mechanisms.
- Understand the Implementation of inference mechanisms and planning algorithms.

LIST OF EXPERIMENTS:

1. Develop PEAS descriptions for given AI tasks
2. Study of PROLOG
3. Implement basic search strategies for selected AI applications
4. Implement A* and memory bounded A* algorithms
5. Implement genetic algorithms for AI tasks
6. Implement simulated annealing algorithms for AI tasks
7. Implement alpha-beta tree search
8. Implement backtracking algorithms for CSP
9. Implement local search algorithms for CSP
10. Implement propositional logic inferences for AI tasks
11. Implement resolution based first order logic inferences for AI tasks
12. Implement classical planning algorithms

TOTAL: 45 PERIODS

COURSE OUTCOMES

- **At the end of the course, the student should be able to:**
- Implement simple PEAS descriptions for given AI tasks.
- Develop programs to implement simulated annealing and genetic algorithms.
- Demonstrate the ability to solve problems using searching and backtracking.
- Ability to Implement simple reasoning systems using inference mechanisms.
- Will be able to choose and implement planning algorithms.

SOFTWARE:

Python, PROLOG, C++ or Java Software

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	3	-	-	-	-	-	-	-	1	2	2	-	-
2	-	2	-	3	-	-	-	-	-	2	-	-	1	3	-	-
3	3	-	3	-	1	-	-	-	1	-	-	-	-	1	-	3
4	-	-	-	1	1	-	-	-	2	-	-	-	-	2	-	1
5	3	-	-	-	1	-	-	-	-	-	2	3	3	3	-	-
Average	2.7	2.0	3.0	2.3	1.0	-	-	-	1.5	2.0	2.0	2.0	2.0	2.2	-	2.0

AD3466   DATA COMMUNICATION AND NETWORKS LAB   L T P C
0 0 3 1.5

OBJECTIVES:

- To understand examine the network protocol and analyzer
- To learn to implement TCP sockets
- To visualize the Simulation of DNS
- To build simulating ARP /RARP protocols
- To study Network simulator

LIST OF EXPERIMENTS:

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyser and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets
6. Write a code simulating ARP / RARP protocols.
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of Distance Vector/ Link State Routing algorithm.
10. Simulation of an error correction code (like CRC).

TOTAL: 45 PERIODS

List of Equipment: (30 Students per Batch)

Java, HTML5, NS2 simulator (Open source software)

OUTCOMES:

At the end of the course, the student should be able to:

- Understand and examine the network protocol and analyzer
- Learn and implement TCP sockets.
- Visualize the Simulation of DNS.
- Build simulating ARP /RARP protocols
- Experience the Network simulator.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	3	-	-	-	-	-	-	-	-	3	-	1	-
2	-	2	-	2	2	-	-	-	-	-	-	-	3	-	3	-
3	2	-	3	-	1	-	-	-	3	-	1	-	-	-	3	-
4	-	3	-	3	-	-	-	-	-	-	-	3	-	-	1	-
5	3	-	-	1	2	-	-	-	-	-	-	-	2	-	2	-
Average	2.7	2.5	3.0	2.3	2.5	-	-	-	3.0	-	1.0	3.0	2.7	-	2.0	-

AD3467   DATA SCIENCE AND ANALYTICS LABORATORY   L T P C
                                                         0 0 3 1.5

OBJECTIVES:

- To develop data analytic code in python
- To be able to use python libraries for handling data
- To develop analytical applications using python
- To perform data visualization using plots

LIST OF EXPERIMENTS:

Tools: Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh

1. Working with Numpy arrays
2. Working with Pandas data frames
3. Basic plots using Matplotlib
4. Frequency distributions, Averages, Variability
5. Normal curves, Correlation and scatter plots, Correlation coefficient
6. Regression
7. Z-test
8. T-test
9. ANOVA
10. Building and validating linear models
11. Building and validating logistic models
12. Time series analysis

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Write python programs to handle data using Numpy and Pandas
- Perform descriptive analytics
- Perform data exploration using Matplotlib
- Perform inferential data analytics
- Build models of predictive analytics

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	3	-	-	-	-	-	-	-	-	3	2	-	-
2	-	2	-	-	2	-	-	-	1	-	3	-	3	2	-	1
3	2	-	-	2	-	-	-	-	3	-	-	2	2	3	-	-
4	-	3	-	-	2	-	-	-	-	3	-	-	2	1	-	3
5	3	-	1	-	2	-	-	-	1	-	-	3	2	2	-	-
Average	2.3	2.5	1.0	2.5	2.0	-	-	-	1.7	3.0	3.0	2.5	2.4	2.0	-	2.0

AD3561   **EMBEDDED SYSTEMS AND IoT**   **L T P C**
                                                              3 0 0 3

OBJECTIVES:

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing I/O devices to the processor.
- To introduce the evolution of the Internet of Things (IoT).
- To build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.
- To apply the concept of Internet of Things in real world scenario

UNIT–I: 8-BIT EMBEDDED PROCESSOR   9

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling.

UNIT-II: EMBEDDED C PROGRAMMING   9

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.

UNIT-III: IOT AND ARDUINO PROGRAMMING   9

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

UNIT-IV: IOT COMMUNICATION AND OPEN PLATFORMS   9

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT-V: APPLICATIONS DEVELOPMENT   9

Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.

                                                    .TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the architecture of embedded processors.
- Write embedded C programs.
- Design simple embedded applications.
- Compare the communication models in IOT
- Design IoT applications using Arduino/Raspberry Pi /open platform.

TEXT BOOKS:

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014

2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

REFERENCE BOOKS:

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.

2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, Second Edition, 2012.

3. Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.

4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	1	-	-	-	-	-	-	-	-	3	-	1	-
2	3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
3	2	-	3	3	-	-	-	-	-	-	-	-	2	-	-	2
4	2	2	3	2	-	-	-	-	-	-	-	-	1	-	2	2
5	3	2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
Average	2.6	2.5	2.5	2.0	-	-	-	-	-	-	-	-	2.0	-	2.0	2.0

AD3562   **MACHINE LEARNING**   **LT P C**

                                                                          3 0 0 3

OBJECTIVES:

- To understand the basic concepts of machine learning.
- To understand and build supervised learning models.
- To understand and build unsupervised learning models.
- To apply the machine learning algorithms to a real world problem
- To evaluate the algorithms based on corresponding metrics identified

UNIT–I: INTRODUCTION TO MACHINE LEARNING   9

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT-II: SUPERVISED LEARNING   9

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

UNIT-III: ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING   9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT-IV: NEURAL NETWORKS   9

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

UNIT-V: DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS   9

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

COURSE OUTCOMES:

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

- Explain the basic concepts of machine learning.
- Construct supervised learning models.
- Construct unsupervised learning algorithms.
- Apply the machine learning algorithms
- Evaluate and compare different models.

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Second Edition", CRC Press, 2014.

REFERENCE BOOKS:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
4. Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packt publishing, 3rd Edition, 2019.
5. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	2	1	-	-	-	-	3	3	2	2	2	2	-	-
2	1	3	3	1	2	-	-	-	2	2	2	-	3	-	-	-
3	2	1	3	3	2	-	-	-	-	-	-	-	-	2	-	-
4	2	3	3	2	1	-	-	-	3	2	3	2	-	2	-	-
5	1	1	3	3	1	-	-	-	3	-	-	3	3	3	-	2
Average	1.6	1.8	2.8	2.0	1.5	-	-	-	2.8	2.3	2.3	2.3	2.7	2.3	-	2.0

AD3563   **TEXT AND SPEECH ANALYSIS**   **L T P C**

                                                                    3 0 0 3

COURSE OBJECTIVES:

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT-I: NATURAL LANGUAGE BASICS   9

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model – Text Similarity (Similarity Metrics used in Text Analytics).

UNIT-II: TEXT CLASSIFICATION   9

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

UNIT-III: QUESTION ANSWERING AND DIALOGUE SYSTEMS   9

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems.

UNIT-IV: TEXT-TO-SPEECH SYNTHESIS   9

Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

UNIT-V: AUTOMATIC SPEECH RECOGNITION   9

Speech recognition: Feature Extraction - Acoustic modeling – HMM, HMM-DNN systems – Language Models – LSTM – Decoding Strategies – Evaluation of ASR systems – Word Error rate, Recognition accuracy.

                                                            TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain existing and emerging deep learning architectures for text and speech processing
- Apply deep learning techniques for NLP tasks, language modelling and machine translation
- Explain coreference and coherence for text processing
- Build question-answering systems, chatbots and dialogue systems
- Apply deep learning models for building speech recognition and text-to-speech systems

TEXT BOOK:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

REFERENCES:

1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress, Second Edition, 2019.
2. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	1	3	-	-	-	1	2	1	2	3	1	-	-
2	3	1	2	1	3	-	-	-	2	2	1	3	3	3	-	1
3	2	2	1	3	1	-	-	-	3	3	1	2	3	2	-	-
4	2	1	1	1	2	-	-	-	2	1	2	2	2	1	-	1
5	1	3	2	2	1	-	-	-	3	2	1	1	1	3	-	-
Average	2.2	1.8	1.8	1.6	2.0	-	-	-	2.2	2	1.2	2.0	2.4	2	-	1

OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution.
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To develop the cloud application using various programming model of Hadoop and Aneka.
- To explore the roster of AWS services and illustrate the way to make applications in AWS.
- To understand the various cloud applications.

UNIT- I: VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE   9

Building cloud computing environments - Basics of Virtual Machines - Characteristics of virtualized environments – Taxonomy of virtualization techniques – Virtualization and cloud computing – Pros and cons of virtualization – Technology examples.

UNIT- II: CLOUD PLATFORM ARCHITECTURE   9

Cloud Computing: Definition, Characteristics - The cloud reference model - Cloud deployment models: public, private, hybrid, community – Economics of the cloud – Open challenges.

UNIT- III: PROGRAMMING MODEL   9

Aneka: Building Aneka clouds, Cloud programming and management, Multithreading with Aneka - Multithreading with Aneka - Programming applications with Aneka threads - Aneka task based programming - Aneka MapReduce programming

UNIT- IV: CLOUD PLATFORMS   9

Amazon Web Services: AWS Platform – Services: Compute, Storage, Communication & Additional Services - Google App Engine: Application, Architecture and Cost Model -. Windows Azure: Origin of Windows Azure, Features - SQL Azure - Windows Azure platform appliance.

UNIT- V: CLOUD APPLICATIONS   9

Scientific applications - Business and consumer application – Market-based management of clouds - Federated clouds / Inter Cloud – Third-party cloud services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Employ the concepts of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using various Cloud computing programming models.
- Develop the Cloud Application in AWS, Google Api & Azure platform
- Identify services using various Cloud Applications.

TEXT BOOKS:
1. Rajkumar Buyya, Christian Vacchiola, S.ThamaraiSelvi, "Mastering Cloud Computing", MCGrawHill Education (India) Pvt. Ltd., 2024.

REFERENCES:
1. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
2. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
3. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
4. Sriram Krishnan, Programming: Windows Azure, O'Reilly, 2010.
5. John W.Ritting house and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
6. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guide, McGraw-Hill Osborne Media, 2009.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	-	-	-	-	-	-	-	-	-	-	3	-	1	-
2	3	3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
3	2	2	2	-	-	-	-	-	-	-	-	-	3	-	-	2
4	2	3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
5	3	-	3	-	-	-	-	-	-	-	-	-	2	-	3	-
Average	2.4	2.5	2.5	-	-	-	-	-	-	-	-	-	2.0	-	2.0	2.0

CE3531   **ENVIRONMENTAL STUDIES**   **L T P C**
2 0 0 2

OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT- I: ENVIRONMENT AND BIODIVERSITY   6
Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity –endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ and Wild Life Act.

UNIT- II: ENVIRONMENTAL POLLUTION   6
Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts, Environmental policies and various Environmental Programmes conducted around the world.

UNIT- III: RENEWABLE SOURCES OF ENERGY   6
Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT- IV: SUSTAINABILITY AND MANAGEMENT   6

Definition of Sustainability, Aspects of Sustainability, Transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs). The Role of UN and the Need for SDGs and Adoption by the World, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs Design for sustainability, Thinking Alternatives and Innovation, Causal Mapping, Systemic Mapping and Problem Identification Identifying probable interventions for Sustainable Development, Framework and Structuring of Seventeen SDGs.

UNIT- V: SUSTAINABILITY PRACTICES   6

Zero waste and 3R concept, ISO 14000 Series, Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.

2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.

3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.

5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. Edition 2010.

2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.

3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.

4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.

5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-	-
Average	2.8	1.8	1.0	1.0	-	2.2	2.4	-	-	-	-	1.8	-	-	-	-

GE3551   **NCC CREDIT COURSE LEVEL - II**   **L T P C**
                   (Common to Army, Navy & Air)   3 0 0 3

OBJECTIVES:

- To know the basic principles of adventure program and creating awareness for social
- To improve the cadet's knowledge in firefighting and their health's
- To create an interest in handling the weapons and read the map
- To know the handling of the situation on ground in army battle
- To know about anchors, ropes and communication procedure in the Naval wing

UNIT- I: ADVENTURE AND SOCIAL AWARENESS PROGRAM   9

Parasailing, Slithering, Rock Climbing, Cycling and Trekking, Obstacle training. Basic Social Service and its needs, Rural Development Programmes. NGOs: Role and Contribution, Responsibility of Swachh Bharat Abhiyanm, Contribution of Youth towards Social Welfare, Social Security Schemes, Social Evils viz Dowry/ Female Foeticide/ Child abuse and trafficking etc. Protection of Children.

UNIT- II: FIRE FIGHTING AND HEALTH AND HYGIENE   9

Types of fire, Triangle of fire- Types of fire-fighting, water markings in the ship, NBCD organization and structure, Damage control, Aims of First Aid, Principle of First Aid, Motto of First Aid, List of items in First aid Box, Types of Bandages, Types of Fracture, Dislocation, Types of Wounds, Burns and Scalds, Sprain, Strain, Asphyxia, Drowning, Poison, Shock, Snake bite, Sun and Heat Stroke, Insect bite, Dog bite, Hanging, Artificial Respiration, Artificial respiration, carriage of sick and wounded

UNIT- III: WEAPON TRAINING AND MAP READING   9

Characteristics of a rifle/rifle ammunition and its fire power, Stripping, assembling, care and cleaning and sight setting of .22 rifle, Loading, cocking and unloading, The lying posn, holding and Aiming – 1, Range procedure and safety precautions, Theory of group and snap shooting, Introduction of types of Maps and conventional signs, Scales and Grid system, Topographical forms and technical terms, Relief, contours and Gradients, Cardinal points and types of north, Types of Bearings and use of service protracto, Prismatic compass and its use and GPS, Setting a map, finding north and own position, Map to Ground, Ground to Map, Point to Point March

UNIT- IV: FIELD CRAFT AND BATTLE CRAFT   9

Introduction, Judging Distance, Description of ground, Recognition, description and indication of landmarks and targets, Observation, Camouflage and Concealment, Field Signals, Section Formations, Fire Control Orders, Fire and Movement, Types of knots and lashings

UNIT- V: SEAMANSHIP AND NAVAL COMMUNICATIONS   9

Anchor - parts of Anchor, parts of cable Types of Anchor, Rigging- Rope, Types of ropes, Care and maintenance of rope, Bends and Hitches, Shackles and Blocks, Introduction to naval modern communication, purpose and principles, duties of various communications department, Semaphore, letters and prosigns, reading and transmission of messages, phonetic alphabets, radio telephony procedure Sonar and Radar.

TOTAL: 45 PERIODS

Note: NCC Credit Course Level – II is offered for NCC students only. The grades earned by the students will be recorded in the marksheet, however the same shall not be considered for the computation of CGPA.

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the responsibilities of the social works and adventure
- Learnt about the techniques of firefighting and importance of hygiene
- Capable to handle the weapons (Rifle .22) and read the map
- Understand the importance of field and battle craft
- Devolve the skills about seamanship and naval communication techniques.

TEXT BOOKS:

1. E- Book , NCC Red Book, Director General NCC, Ministry of Defence, RK Puram New Delhi (link: **red book 26-5-2017.pmd (s3waas.gov.in))**
2. Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, by RPH Editorial Board, Kindle Edition.

AD3564   EMBEDDED SYSTEMS AND IoT LABORATORY   LT P C

                                                                0 0 3 1.5

OBJECTIVES:

- To learn Assembly and Embedded C languages and perform basic operations.
- To learn the Arduino programming.
- To perform different communication methods with IoT devices.
- To learn Raspberry PI platform and python programming.
- To build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.

LIST OF EXPERIMENTS:

1. Write 8051 Assembly Language experiments using simulator.
2. Test data transfer between registers and memory.
3. Perform ALU operations.
4. Write Basic and arithmetic Programs Using Embedded C.
5. Introduction to Arduino platform and programming.
6. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
7. Introduction to Raspberry PI platform and python programming.
8. Interfacing sensors with Raspberry PI.
9. Communicate between Arduino and Raspberry PI using any wireless medium.
10. Setup a cloud platform to log the data.
11. Log Data using Raspberry PI and upload to the cloud platform.
12. Design an IOT based system.

                                                        TOTAL: 45 PERIODS

LIST OF EQUIPMENTS: (30 Students per Batch)

   8051 Simulator, Arduino Kit (IDE, UNO Board, USB Cable, Joystick Module, Zigbee Module, Bluetooth Module), Raspberry Pi Kit, Thonny IDE, IR Sensors and Ultra sensors

OUTCOMES:

At the end of this course, the students will be able to:

- Write embedded C programs.
- Design simple embedded applications.

- Compare the communication models in IoT.
- Write Python code for simple applications using Raspberry PI.
- Design IoT applications using Arduino/Raspberry Pi /open platform.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	-	-	-	-	-	-	-	-	-	-	3	-	1	-
2	3	3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
3	2	2	2	-	-	-	-	-	-	-	-	-	3	-	-	2
4	2	3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
5	3	-	3	-	-	-	-	-	-	-	-	-	2	-	3	-
Average	2.4	2.5	2.5	-	-	-	-	-	-	-	-	-	2.0	-	2.0	2.0

OBJECTIVES:

- To understand the data sets and apply suitable algorithms for selecting the appropriate features for analysis.

- To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance.

- To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.

- To build the graph based learning models for standard data sets.

- To compare the performance of different ML algorithms and select the suitable one based on the application.

LIST OF EXPERIMENTS:

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

2. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file and compute the accuracy with a few test data sets.

5. Implement naïve Bayesian Classifier model to classify a set of documents and measure the accuracy, precision, and recall.

6. Write a program to construct a Bayesian network to diagnose CORONA infection using standard WHO Data Set.

7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms.

8. Write a program to implement *k*-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.

9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select an appropriate data set for your experiment and draw graphs.

LIST OF EQUIPMENTS: (30 Students per Batch)

The programs can be implemented in either Python or R.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Apply suitable algorithms for selecting the appropriate features for analysis.
- Implement supervised machine learning algorithms on standard datasets and evaluate the performance.
- Apply unsupervised machine learning algorithms on standard datasets and evaluate the performance.
- Build the graph based learning models for standard data sets.
- Assess and compare the performance of different ML algorithms and select the suitable one based on the application.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	2	1	-	-	-	-	-	2	3	3	3	2	-	-
2	2	1	1	3	2	-	-	-	3	2	3	2	3	-	-	-
3	2	2	1	1	2	-	-	-	-	-	-	-	2	3	-	3
4	2	2	3	3	2	-	-	-	-	2	3	-	-	2	-	2
5	2	2	3	1	2	-	-	-	3	-	-	-	2	-	-	2
Average	2.0	1.8	2.0	1.4	2.0	-	-	-	3.0	2.0	3.0	2.5	2.5	2.3	-	2.3

AD3566   TEXT AND SPEECH ANALYSIS LABORATORY   LT P C

0 0 3 1.5

OBJECTIVES:

- To understand natural language processing basics.
- To apply Morphological analysis on Natural Language text.
- To build question-answering and dialogue systems.
- To identify Named Entities which are important in information extraction applications.
- To develop a speech synthesizer.

LIST OF EXPERIMENTS:

1. Create Regular expressions in Python for detecting word patterns and tokenizing text.
2. Perform Morphological analysis.
3. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams.
4. Accessing Text Corpora using NLTK in Python.
5. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.
6. Implement the Word2Vec model.
7. Perform Name entity recognition (NER) on given text.
8. Use a transformer for implementing classification.
9. Design a Chabot with a simple dialog system.
10. Convert text to speech and find accuracy.
11. Design a speech recognition system and find the error rate.

TOTAL: 45 PERIODS

SOFTWARE:

Python

OUTCOMES:

At the end of this course, the students will be able to:

- Explain natural language processing basics.
- Apply Morphological analysis on Natural Language text.
- Build question-answering and dialogue systems.

- Identify Named Entities which are important in information extraction applications.
- Implement and Develop a speech synthesizer.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	1	3	-	-	-	1	-	-	2	3	1	-	-
2	3	1	2	1	3	-	-	-	-	2	1	3	-	3	-	1
3	2	2	1	3	1	-	-	-	-	-	1	2	3	2	-	-
4	2	1	1	1	2	-	-	-	-	1	2	-	-	1	-	1
5	1	3	2	2	1	-	-	-	3	-	1	-	1	-	-	-
Average	2.2	1.8	1.8	1.6	2.0	-	-	-	2.0	1.5	1.3	2.3	2.3	1.8	-	1.0

SEMESTER VI

AD3661   BIG DATA ANALYTICS   **L T P C**

3 0 0 3

OBJECTIVES:

- To understand Big Data
- To learn and use NoSQL big data management
- To learn Map Reduce analytics using Hadoop and related tools
- To work with Map Reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

UNIT-I: UNDERSTANDING BIG DATA   9

Introduction to Big data – Convergence of key trends – Unstructured data – Industry examples of Big data – web analytics – Big data applications – Big data technologies – Introduction to Hadoop - Open source technologies – Cloud and big data – Mobile Business Intelligence – Crowd sourcing Analytics – Inter and trans firewall analytics.

UNIT-II: NOSQL DATA MANAGEMENT   9

Introduction to NOSQL – Aggregate data models – Key-value and document data models – relationships – Graph databases – Schema less databases – Materialized views - distribution Models – Master-Slave replication – Consistency – Cassandra – Cassandra data model - Cassandra examples – Cassandra clients.

UNIT-III: BASICS OF HADOOP   9

Data format – Analyzing data with Hadoop – Scaling out – Hadoop streaming – Hadoop Pipes – Design of Hadoop Distributed File System (HDFS) – HDFS concepts – Java Interface – Data flow – Hadoop I/O – Data integrity – Compression – Serialization – Avro - File-based data structures – Cassandra – Hadoop integration

UNIT-IV: MAP REDUCE APPLICATIONS   9

MapReduce workflows – Unit tests with MRUnit – Test data and Local tests – Anatomy of MapReduce job run – Classic Map-reduce – YARN – Failures in classic Map-reduce and YARN – Job scheduling – Shuffle and Sort – Task execution – MapReduce types – Input Formats – Output formats.

UNIT-V: HADOOP RELATED TOOLS   9

Hbase – Data model and implementations – Hbase clients – Hbase examples – praxis. Pig - Grunt – Pig data model – Pig Latin – Developing and testing Pig Latin Scripts. Hive

–Data Types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL Queries.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Describe Big data and use cases from selected business domains
- Explain NoSQL Big data management
- Install, Configure , and run Hadoop and HDFS.
- Perform Map-reduce analytics using Hadoop
- Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for Big data analytics.

TEXT BOOKS:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businessess", Wiley, 2013
2. Eric Sammer, "Hadoop Operations",O'Reilley, 2012.
3. Sdalage, Pramod.J. "NoSQl distiller", 2021.

REFERENCES:

1. E.Capriolo, D.Wampler, and J.Rutherglen, "Programming Hive",O'Reilley, 2012
2. Lars George, "HBase: The Definitive Guide", O'Reilley , 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010
4. Alan Gates, " Programming Pig", O'Reilley, First Edition, 2011

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	3	-	-	-	2	2	3	1	1	3	-	3
2	3	3	2	3	2	-	-	-	2	2	3	3	2	3	-	2
3	3	3	3	2	3	-	-	-	2	2	1	2	2	3	-	3
4	2	3	3	3	3	-	-	-	2	2	3	2	3	3	-	2
5	3	3	3	3	3	-	-	-	3	1	3	2	3	2	-	3
Average	2.8	3.0	2.8	2.8	2.8	-	-	-	2.2	1.8	2.6	2.0	2.2	2.8	-	2.6

AD3662   **DISTRIBUTED COMPUTING**   **L T P C**

                                                         3 0 0 3

OBJECTIVES:

- To introduce the computation and communication models of distributed systems
- To illustrate the issues of synchronization and collection of information in distributed systems
- To describe distributed mutual exclusion and distributed deadlock detection techniques
- To elucidate agreement protocols and fault tolerance mechanisms in distributed systems
- To explain the cloud computing models and the underlying concepts

UNIT-I: INTRODUCTION   9

Introduction: Definition-Relation to Computer System Components – Motivation – Message - Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

UNIT-II: LOGICAL TIME AND GLOBAL STATE   9

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT-III: DISTRIBUTED MUTEX AND DEADLOCK   9

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart- Agrawala's Algorithm —— Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

UNIT-IV: CONSENSUS AND RECOVERY   9

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm - - Algorithm for Asynchronous Checkpointing and Recovery.

UNIT-V: CLOUD COMPUTING   9

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the foundations of distributed systems
- Solve synchronization and state consistency problems
- Use resource sharing techniques in distributed systems.
- Apply working model of consensus and reliability of distributed systems
- Explain the fundamentals of cloud computing.

TEXT BOOKS:

1. Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011
2. Mukesh Singhal, Niranjan G Shivaratri, "Advanced Concepts in Operating systems", Mc-Graw Hill Publishers, 2022.

REFERENCES:

1. George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012
2. Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3. Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007

4. Liu M L, "Distributed Computing: Principles and Applications", Pearson Education, 2004

5. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, 2003

6. Arshdeep Bagga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", Universities Press, 2014

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	3	3	1	-	-	-	2	1	3	3	2	-	1	1
2	1	3	2	1	2	-	-	-	2	2	2	2	1	-	3	2
3	2	2	1	3	3	-	-	-	3	2	1	1	1	-	2	1
4	1	2	2	3	1	-	-	-	3	3	2	1	3	-	1	1
5	3	3	1	2	3	-	-	-	3	3	3	1	3	-	2	3
Average	1.8	2.4	1.8	2.4	2	-	-	-	2.6	2.2	2.2	1.6	2	-	1.8	1.6

IT3662   MOBILE COMPUTING   L T P C
                                                                      3 0 0 3

OBJECTIVES:
- Infer knowledge about mobile communications and its services.
- Identifying several communication access techniques.
- To get a complete knowledge of the network layer routing protocols.
- Perceive knowledge about TCP and failure recovery method.
- To know the protocols used in OSI Upper layers.

UNIT-I: INTODUCTION   9

Introduction to Mobile Computing - Architecture of Mobile Computing – Novel Applications – Limitations - GSM System Architecture - Radio Interface –Protocols - Localization and Calling - Handover – Security- GPRS.

UNIT-II: DATA LINK LAYER   9

Medium Access Control Protocol - Wireless MAC Issues - Hidden and exposed terminals- near and far terminals – SDMA – FDMA – TDMA – CDMA.

UNIT-III: MOBILE NETWORK LAYER   9

Mobile IP – Goals – Assumption - Entities and Terminology - IP Packet Delivery – Agent Advertisement and Discovery – Registration - Tunneling and Encapsulation -Dynamic Host Configuration Protocol.

UNIT-IV: MOBILE TRANSPORT LAYER   9

Traditional TCP - Indirect TCP - Snooping TCP - Mobile TCP - Fast Retransmit and Fast Recovery - Transmission /Time-Out Freezing - Selective Retransmission – Transaction Oriented TCP.

UNIT-V: MOBILE APPLICATION LAYER   9

WAP Model- Mobile Location based services -WAP Gateway –WAP protocols – WAP user agent profile- caching model-wireless bearers for WAP - WML – WML Scripts – WTA.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the students will be able to:
- Understand the basics of mobile telecommunication system.
- Illustrate the various protocols of datalink layer.
- Determine the functionality of network layer.

- Understand the concepts of routing protocol for the Ad hoc networks and Transport layer.
- Understand the functionality of Application layer

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", PHI, Second Edition, 2008.
2. Jochen Burkhardt, Pervasive Computing: Technology and Architecture of Mobile Internet Applications, Addison-Wesley Professional; 3rd edition, 2012.
3. William Stallings, "Wireless Communications and Networks", Pearson Education, 2011.

REFERENCE BOOKS:

1. Maritn Sauter, "From GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband", John Wiley and Sons, 2021.
2. Asoke K. Talukder, Hasan Ahmed, Roopa R. Yavagal, "Mobile Computing", Tata McGraw Hill Pub, 2nd Edition, Aug 2017.
3. Introduction to Wireless and Mobile Systems by Agrawal and Zeng, Brooks/ Cole (Thomson Learning), First edition, 2015

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	-	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
4	-	2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Average	3.0	2.0	3.0	-	-	-	-	-	-	-	-	-	-	2.0	1.5	-

AD3663   BIG DATA ANALYTICS LABORATORY   **LT P C**

                                                     0 0 3 1.5

OBJECTIVES:

- To get familiar with Hadoop distributions, Configuring Hadoop and Performing File Managements tasks.
- To understand HDFS concepts and interfacing with HDFS.
- To learn Map Reduce analytics using Hadoop for processing Big Data.
- To Practice programming tools HIVE and HBase in Hadoop eco-system.
- To examine data processing operators and compare with traditional databases.

LIST OF EXPERIMENTS:

1. Downloading and Installing Hadoop: Understanding different Hadoop modes, Startup Scripts, Configuration files
2. Hadoop Implementation of file management tasks, such as Adding files and directories Retrieving files and Deleting files.
3. Implement of Matrix Multiplications with Hadoop Map Reduce.
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Installation of HIVE along with practice examples
6. Installation of HBase, Installing thrift along with Practice examples.
7. Practice importing and exporting data from various databases.

                                                     TOTAL: 45 PERIODS

LIST OF EQUIPMENTS: (30 Students per Batch)

    Cassandra, Hadoop, Java, Pig, Hive and HBase.

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the technologies for Handling Big Data and Hadoop Ecosystem.
- Understand various file managements tasks.
- Apply Hadoop, Map Reduce, HIVE, HBase to solve sample and real time problems.
- Perform Map-reduce analytics using Hadoop and to acquire clear understanding of programming tools.
- Understand the use of traditional database

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	3	3	-	-	-	-	-	2	-	-	1	3	-	-
2	3	2	-	3	-	-	-	-	2	-	2	-	2	3	-	-
3	-	3	3	-	2	-	-	-	-	2	-	2	2	3	-	3
4	-	-	3	2	2	-	-	-	-	2	-	-	3	3	-	2
5	3	-	-	-	2	-	-	-	-	-	-	2	3	2	-	2
Average	3.0	2.5	3.0	2.6	2.0	-	-	-	2.0	2.0	2.0	2.0	2.2	2.8	-	2.3

EN3649   PROFESSIONAL COMMUNICATION LABORATORY   L T P C
                                                     0 0 2 1

OBJECTIVES:

- To enhance the Employability and Career Skills of students.
- To orient the students towards grooming as a professional.
- To learn how to speak in Group Discussions
- To make them employable Graduates and help them attend interviews successfully.
- To develop their confidence and help them express views clearly

UNIT- I: **6**

English for competitive exams —general awareness of current affairs – multiple choice – cloze – vocabulary structure.

UNIT- II: **6**

Introduction to soft skills - Interpersonal communication - Introducing oneself to the audience —– answering questions – writing a message – memo –mail – asking for comments – giving information – agreeing to requests – apologizing – Complaining – Business proposal – short report – summarizing.

UNIT- III: **6**

Introduction to Group Discussion— participating in Group Discussions – questioning and clarifying – GD strategies –monologues – dialogues

UNIT- IV: **6**

Interview etiquette – Portfolio development - attending job interviews – FAQs related to job interviews - Interview types – expressing opinions – present circumstances - past experiences – future plans

UNIT- V: **6**

Recognizing differences between groups and teams -   networking professionally- respecting social protocols- understanding career management- developing a long- term career plan- making career changes. – organizing a larger unit of discourse – expressing and justifying opinions – negotiating – collaborating – disagreeing – speculating – decision taking**.**

                                                        Total: 30 Periods

The lab course is offered as an Employability Enhancement Course

 The course is offered as a one credit paper with an End Semester Examination.

OUTCOMES:

At the end of the course learners will be able to:

• Make effective presentations and participate confidently in Group Discussions

• Attend job interviews and interacting in different situations.

• Able to write business reports, proposals and related correspondence.

• Develop adequate Soft Skills required for the workplace

REFERENCE BOOKS:

1. Butterfield, Jeff, "Soft Skills for Everyone", Cengage Learning: New Delhi, 2015

2. Interact English Lab Manual for Undergraduate Students, Orient Blackswan: Hyderabad, 2016.

3. E.Suresh Kumar, "Communication for Professional Success", Orient Blackswan: Hyderabad, 2015

4. Raman, Meenakshi and Sangeeta Sharma, "Professional Communication", Oxford University Press: Oxford, 2014

5. S. Hariharan, "Soft Skills", MJP Publishers: Chennai, 2010.

6. Successful Presentations: DVD and Student's Book. A video series teaching business communication skills for adult professionals by John Huges and Andrew Mallett- OUP 2012.

7. Goodheart-Willcox, "Professional Communication", First Edition, 2017. Online test book

8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 Edition, 2015

9. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

AD3641   **MINI PROJECT**   **L T P C**
                                                                                0 0 4 2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.
- To develop the ability to perform testing in the developed work.
- To understand the project management in an efficient way.
- To improve effective team building and good coordination.

LIST OF EXPERIMENTS:

The students in a group of 5 to 6 works on a topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department

                                           TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Analyze the literature survey in a specific domain as a team / individual in an ethical way.
- Plan an experimental design to solve engineering / societal problems using modern tools
- Develop lifelong learning to keep abreast of latest technologies.
- Analyze and implement the design to provide sustainable solutions
- Evaluate and interpret the experimental results and analyze the impact on society and environment

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	1	-	-	-	-	-	-	-	-	3	-	-	-
2	-	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	3	1	-	-	-	-	-	-	-	-	-	-	3	-
4	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
5	-	-	-	-	3	-	-	-	-	-	-	-	2	3	1	3
Average	3.0	3.0	3.0	1.0	3.0	-	-	-	-	-	-	-	2.0	2.3	2.0	3.0

SEMESTER VII

AD3761   **ARTIFICIAL INTELLIGENCE - II**   **L T P C**

                                                                   3 0 0 3

OBJECTIVES:

- To know the underlying structure behind intelligence mathematically.
- To know the logical implications in probabilistic Reasoning.
- To know the automated learning techniques.
- To explore the techniques in Reinforcement Learning.
- To explore artificial intelligence techniques for Robotics.

UNIT-I: PROBABILISTIC REASONING I   9

Acting under uncertainty – Bayesian inference – Naive Bayes models Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT-II: PROBABILISTIC REASONING II   9

Probabilistic reasoning over time – time and uncertainty – inference in temporal models – Hidden Markov Models – Kalman filters – Dynamic Bayesian networks, Probabilistic programming.

UNIT-III: DECISIONS UNDER UNCERTAINTY   9

Basis of utility theory – utility functions – Multiattribute utility functions – decision networks – value of information – unknown preferences – Sequential decision problems – MDPs – Bandit problems – partially observable MDPs – Multiagent environments – non-cooperative game theory – cooperative game theory – making collective decisions.

UNIT-IV: LEARNING PROBABILISTIC MODELS   9

Statistical learning theory – maximum-likelihood parameter learning – naive bayes models – generative and descriptive models – continuous models – Bayesian parameter learning – Bayesian linear regression – learning Bayesian net structures – density estimation EM Algorithm – unsupervised clustering – Gaussian mixture models – learning Bayes net parameters – learning HMM – learning Bayes net structures with hidden variables.

UNIT-V: REINFORCEMENT LEARNING AND ROBOTICS   9

Definition of Learning from rewards – passive reinforcement learning – active reinforcement learning – generalization in reinforcement learning – policy search – inverse reinforcement learning – applications – Robots – robotic perception – planning

movements – reinforcement learning in robotics – Robotic frameworks -- applications of robotics - Philosophy, ethics, and safety of AI – the future of AI.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the probabilistic reasoning using Bayesian inference.
- Apply appropriate Probabilistic reasoning techniques for solving uncertainty problems.
- Explain use of game theory for decision making.
- Explain and apply probabilistic models for various use cases.
- Apply AI techniques for robotics.

TEXT BOOKS:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

REFERENCES:

1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, Third Edition, 2017.
3. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006.
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013. (http://nptel.ac.in/)

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
2	3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
3	2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
4	3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
5	3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	2.8	3	2.6	-	-	-	-	-	-	-	-	-	-	2.6	-	-

AD3762　　　　　DEEP LEARNING　　　　　　　　　　　LT P C
**　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3**

OBJECTIVES:

- To understand and need and principles of deep neural networks
- To understand CNN and RNN architectures of deep neural networks
- To comprehend advanced deep learning models
- To learn the evaluation metrics for deep learning models
- To learn the auto encoders and generative models

UNIT-I:　　DEEP NETWORKS BASICS　　　　　　　　　　　　9

Linear Algebra: Scalars - Vectors - Matrices and tensors; Probability Distributions - Gradient based Optimization – Machine Learning Basics: Capacity - Overfitting and underfitting - Hyperparameters and validation sets - Estimators - Bias and variance - Stochastic gradient descent - Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization - Optimization.

UNIT-II:　　CONVOLUTIONAL NEURAL NETWORKS　　　　　　9

Convolution Operation - Sparse Interactions - Parameter Sharing - Equivariance - Pooling - Convolution Variants: Strided - Tiled - Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions - Loss Functions - Regularization - Optimizers - Gradient Computation.

UNIT-III:　　RECURRENT NEURAL NETWORKS　　　　　　　　9

Unfolding Graphs - RNN Design Patterns: Acceptor - Encoder -Transducer; Gradient Computation - Sequence Modelling Conditioned on Contexts - Bidirectional RNN - Sequence to Sequence RNN – Deep Recurrent Networks - Recursive Neural Networks - Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM.

UNIT-IV:　　MODEL EVALUATION　　　　　　　　　　　　9

Performance metrics - Baseline Models - Hyperparameters: Manual Hyperparameter - Automatic Hyperparameter - Grid search - Random search - Debugging strategies.

UNIT-V:　　AUTOENCODERS AND GENERATIVE MODELS　　　9

Autoencoders: Undercomplete autoencoders - Regularized autoencoders - Stochastic encoders and decoders - Learning with autoencoders; Deep Generative Models: Variational autoencoders – Generative adversarial networks.

**　　　　　　　　　　　　　　　　　　　　　　　TOTAL: 45 PERIODS**

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the basics in deep neural networks.

- Apply Convolution Neural Network for image processing.

- Apply Recurrent Neural Network and its variants for text analysis.

- Apply model evaluation for various applications.

- Apply autoencoders and generative models for suitable applications.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

2. Andrew Glassner, "Deep Learning: A Visual Approach", No Starch Press, 2021.

REFERENCES:

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, "A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.

2. Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.

3. Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.

4. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.

5. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	3	1	-	-	-	2	3	1	2	3	-	2	2
2	2	2	2	3	3	-	-	-	1	2	2	3	1	-	-	1
3	3	3	3	3	3	-	-	-	2	1	1	2	-	1	3	-
4	3	3	1	1	1	-	-	-	1	3	1	3	-	1	-	-
5	3	2	2	2	3	-	-	-	2	3	2	2	2	-	1	1
Average	2.8	2.4	2	2.4	2.2	-	-	-	1.6	2.4	1.4	2.4	2.0	1.0	2.0	1.3

BA3711   **HUMAN VALUES AND ETHICS**   **L T P C**

                                                          2 0 0 2

OBJECTIVES:

- To introduce and educate the students on the concept of Human Values.
- To support students to understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living.
- To help the students to understand social ethics and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

UNIT- I: HUMAN VALUES   6

Human value – needs, Values and its Types - Ethics. Moral values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character

UNIT- II: VALUE EDUCATION   6

Value Education: Definition, Concept and Need for Value Education. The Content and Process of Value Education. Basic Guidelines for Value Education.

UNIT- III: HARMONY   6

Harmony in the Family- the basic unit of human interaction, Trust and Respect, Harmony of the Self with the Body: Self -regulation and Health. Harmony in Society: Dimensions system of Human Order. Harmony in Nature: The Four Orders in Nature.

UNIT- IV: SOCIAL ETHICS   6

The Basics for Ethical Human conduct - Defects in Ethical Human Conduct - Holistic and Universal order - Universal Human Order and Ethical Conduct.

UNIT- V: ETHICS IN PROFESSION   6

Professional Integrity, Respect & Equality, Privacy, Positive co-operation, Respecting the competence of other professions. - Business ethics - Environmental ethics - Internet ethics - Engineers as expert witnesses and advisors.

                                                          TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Students will be able to understand the significance of value inputs in a classroom and start applying them in their life and profession.

- Students will be able to understand the need, basic guidelines, content and process of value education.

- Students will be able to the role of a human being in ensuring harmony in society and nature.

- Students will be able to understand social ethics.

- Students will be able to Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

REFERENCES:

1. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013.
2. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill - 2003.
3. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Professional Ethics and Human Values", Prentice Hall of India, New Delhi, 2013.
5. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 3rd edition (2017).
6. R. Subramanian, 'Professional Ethics' Oxford University Press, 2nd Edition 2017
7. R. S. Nagarazan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015.
8. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.
9. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
10. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press, 2003.
11. Suresh Jayshree, 2003, Human Values and Professional Ethics, S. Chand Publishing, Third Revised Edition.

E-BOOK :

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.

2. R. S. Nagarazan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	-	-	1.0	1.5	-	-	1.0	-	-	-	-	-	-	-	-	-

AD3763   ARTIFICIAL INTELLIGENCE – II LABORATORY   L T P C
                                                           0 0 3 1.5

OBJECTIVES:

- To impart knowledge about Artificial Intelligence.

- To understand the main abstractions and reasoning for intelligent systems.

- To implement decision problems for suitable applications.

- To implement the models of Artificial Intelligence.

- To understand the use of Artificial Intelligence in various applications.

LIST OF EXPERIMENTS:

1. To implement Bayesian Belief networks

2. Approximate inferences in Bayesian network

3. To implement decision problems for various real-world applications

4. To learn various Bayesian parameters

5. Implementation of Hidden Markov Models

6. Implement EM algorithm for HMM

7. Implement the Reinforcement learning for various reward based applications

8. Mini-Project.

                                                    TOTAL: 45 PERIODS

SOFTWARE:

Python/Java with Machine Learning packages

OUTCOMES:

At the end of this course, the students will be able to:

- Solve basic AI based problems.

- Implement the concept of Bayesian Network.

- Apply AI techniques to real-world problems to develop intelligent systems.

- Implement HMM for real-world application.

- Use Reinforcement Learning to implement various intelligent systems.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	2	-	-	3	-	-	-	-	-	-	-	2	-	-
2	-	-	2	-	3	-	3	-	-	-	-	-	-	-	3	-
3	-	2	-	-	3	-	3	-	-	-	-	-	-	-	3	-
4	1	2	-	-	-	-	-	3	-	-	-	-	2	-	2	-
5	-	1	-	2	-	-	-	-	-	-	-	-	-	-	2	-
Average	1.5	1.6	2.0	2.0	3.0	3.0	3.0	3.0	-	-	-	-	2.0	2.0	2.4	-

AD3764   DEEP LEARNING LABORATORY   LT P C

0 0 3 1.5

OBJECTIVES:

- To understand the tools and techniques to implement deep neural networks.
- To apply different deep learning architectures for solving problems.
- To implement generative models for suitable applications.
- To learn to build and validate different models.
- To explore real world applications with deep neural networks.

LIST OF EXPERIMENTS:

1. Solving XOR problem using DNN.
2. Character recognition using CNN.
3. Face recognition using CNN.
4. Language modeling using RNN.
5. Sentiment analysis using LSTM.
6. Parts of speech tagging using Sequence to Sequence architecture.
7. Machine Translation using Encoder-Decoder model.
8. Image augmentation using GANs.
9. Mini-project on real world applications databases.

TOTAL: 45 PERIODS

LIST OF EQUIPMENTS: (30 Students per Batch)

Understanding on Working of Colab and Transfer Learning Networks.

OUTCOMES:

At the end of this course, the students will be able to:

- Apply deep neural network for simple problems.
- Apply Convolution Neural Network for image processing.
- Apply Recurrent Neural Network and its variants for text analysis.
- Apply generative models for data augmentation.
- Develop real-world solutions using suitable deep neural networks.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	-	-	-	-	-	-	2	1	-	-	2	3	2
2	-	3	1	2	2	-	-	-	3	-	-	-	-	2	2	-
3	3	2	-	2	-	-	-	-	-	-	2	-	-	2	2	3
4	3	3	-	2	-	-	-	-	-	-	-	-	-	1	2	-
5	3	2	2	3	2	-	-	-	2	-	-	-	-	2	3	2
Average	3.0	2.4	1.5	2.3	2.0	-	-	-	2.5	2.0	1.5	-	-	1.8	2.4	2.3

SEMESTER VIII

AD3841   **PROJECT WORK**   **L T P C**
                                                          0 0 20 10

OBJECTIVES:
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.
- To develop the ability to perform testing in the developed work.
- To understand the project management in an efficient way.
- To improve effective team building and good coordination.

       The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:
- Analyze the literature survey in a specific domain as a team / individual in an ethical way.
- Plan an experimental design to solve engineering / societal problems using modern tools
- Develop lifelong learning to keep abreast of latest technologies.
- Analyze and implement the design to provide sustainable solutions
- Evaluate and interpret the experimental results and analyze the impact on society and environment

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	-	-	-	-	1	3	2	-	2	2	-	-	-
2	3	3	3	2	3	2	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	-	1	3	3	3	-	-	-	2	-
4	2	-	2	3	-	2	-	-	-	-	-	-	3	-	3	-
5	3	2	3	3	2	2	2	-	2	3	3	-	-	-	-	3
Average	2.8	2.7	2.5	2.7	2.0	2.0	2.0	1.0	2.7	2.7	3.0	2.0	2.5	3.0	2.5	3.0

MANAGEMENT ELECTIVES

MAN101   PRINCIPLES OF MANAGEMENT   **L T P C**
                                                                  2 0 0 2

OBJECTIVES:

- To study the principles of management, functions and their application in an organization.
- To educate the students on the concept of planning and decision-making.
- To understand the dynamics of human relations in organizations.
- To learn about motivation, communication and leadership aspects.
- To study the process of controlling and the various techniques involved in controlling.

UNIT- I: INTRODUCTION TO MANAGEMENT   6

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers, managerial roles and skills –Evolution of Management – Scientific, human relations, system and contingency approaches. Current trends and issues in Management.

UNIT- II: PLANNING   6

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management –types of strategies.

UNIT- III: ORGANISING   6

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning.

UNIT- IV: DIRECTING   6

Motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – the process of communication – barrier in communication.

UNIT- V: CONTOLLING   6

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Quality control and Inventory Control - Productivity problems and management.

OUTCOMES:

At the end of this course, the students will be able to:

- Have a clear understanding of managerial functions.

- Have the knowledge to apply planning techniques and decision-making.

- Understand the concept of Human Resource Management.

- Understand motivation, leadership and communication principles.

- Apply control techniques in the organization.

TEXTBOOKS:

1. Stephen P. Robbins & Mary Coulter, "Management", 14th Edition, Pearson, 2017

2. AF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson, 2004.

REFERENCES:

1. R.S.N. Pillai, S. Kala, "Principles of Management", S. Chand Publishing, 2013.

2. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 10th Edition, Pearson Education, 2016.

3. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.

4. Harold Koontz & Heinz Weihrich "Essentials of management" Tata Mc Graw Hill, 2006.

5. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 6th edition 2017

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
4	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	1.0	1.5	1.0	-	1.0	-	-	-	-	-	-	-	-	-	-	-

MAN102   TOTAL QUALITY MANAGEMENT   **L T P C**

                                                          2 0 0 2

OBJECTIVES:

- To understand the Total Quality Management Concepts and Dimensions of Customers quality.

- To familiarize the various contributions of Quality Gurus.

- To understand the Framework of Quality Management.

- To educate about tools and techniques in Quality Management.

- To impart knowledge to implement the Quality Management System.

UNIT- I: INTRODUCTION   6
Introduction - Need for quality - Evolution of quality - Definition of quality, Benefits and Obstacles, Quality – vision, mission and policy statements - Attitude and involvement of top management, Customer Focus – customer perception - Customer retention. Introduction to SERVQUAL.

UNIT- II: OVERVIEW OF THE CONTRIBUTIONS   6
Philosophies of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa - Concept of Quality circle

UNIT- III: TQM FRAMEWORK   6
Culture, Leadership – Quality Council, Employee Involvement, Motivation, Empowerment, Recognition and Rewards, International / National Quality Awards.

UNIT- IV: TOOLS AND TECHNIQUES   6
Six Sigma, Kaizen, 5S, 7QC Tools, Quality function deployment (QFD) – Benefits, Voice of customer, Information Organization, Building a House of Quality (HOQ), Bench marking and Poka-Yoke.

UNIT- V: QUALITY MANAGEMENT   6
Quality Audits – Quality Council. ISO 9001:2015 (Quality Management) AS9100 (Aerospace), ISO 14001(Environment), ISO/TS 16949 (Automotive), ISO 17025 (Testing/FDA), TL 9000 (Telecommunication), ISO 13485 (Medical Devices), ISO 27001 (Information Security), ISO 29001 (Oil / Gas).

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Have an understanding of Quality Management concepts and Customers.

- Apply Quality principles provided by the authors and implement.

- Have an understanding of Framework of Quality Management.
- Apply tools and techniques to improve business process.
- Understand Quality System available.

REFERENCES:

1. James R. Evans, William M. Lindsay, "Total Quality Mangement"10 th Edition, Cengage, Phillippine Edition, 2019

2. Ray Tricker, "Quality Management Systems: A Practical Guide to Standards Implementation", Routledge, 1st edition, 2019

3. Poornima M. Charantimath, "Total Quality Management", Pearson Education, 2nd Edition,2017.

4. Dale H. Besterfield, Carol Besterfield, Michna, Glen H. Besterfield, Mary Besterfield, Sacre, Hermant, Urdhwareshe, Rashmi Urdhwareshe, "Total Quality Management", Revised 4th Edition, Pearson Education, 2013

5. Shridhara Bhat K, "Total Quality Management – Text and Cases", Himalaya Publishing House, 2 nd Edition 2010.

6. Douglas C. Montgomory, "Introduction to Statistical Quality Control", Wiley Student Edition, 7 th Edition, Wiley India Pvt Limited, 2012.

7. Indian Standards – Quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Average	1.0	2.0	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-

MAN103　　HUMAN RESOURCES MANAGEMENT　　　　　　　**L　T　P　C**

　　　　　　　　　　　　　　　　　　　　　　　　　　　2　0　0　2

OBJECTIVES:

- To enable students to gain knowledge on Human resource management concepts and principles.
- To familiarize students about HRP process and Job Analysis.
- To illustrate the techniques and tools for Training and Development and Performance appraisal.
- Students will be able to illustrate the techniques and tools for compensation.
- To understand concepts of Performance evaluation, Industrial Relations System and Grievance redressal mechanism

UNIT- I:　INTRODUCTION TO HUMAN RESOURCE MANAGEMENT　　6

Meaning – Definition – Nature – Scope and significance – Evolutionary growth of HRM – Functions of HRM - Role of Human resource manager – Personnel Management vs HRM

UNIT– II:　TALENT MANAGEMENT　　　　　　　　　　　　6

Job Analysis – Job description & specification - Human Resource Planning – Forecasting human resource requirement –Recruitment - Selection –Induction

UNIT- III:　TRAINING AND DEVELOPMENT　　　　　　　　6

Need for Training – Process -Types of Training methods – On the job & Off the job - Purpose – Benefits – Management development programmes – Training vs Development -Effectiveness of training

UNIT– IV:　COMPENSATION MANAGEMENT　　　　　　　　6

Introduction – Compensation – Forms & Types of compensation – Determinants of compensation – Components of Pay structure – Significance in Employee morale.

UNIT– V:　PERFORMANCE MANAGEMENT AND CONTROL PROCESS　　6

Performance Management System – Process – Appraisal methods – Evaluation of managerial Implications – Control process – Importance – Methods – Requirement of effective control systems

　　　　　　　　　　　　　　　　　　　　　TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Gain knowledge on Human resource management concepts and principles.
- Do human forecasting and handle HRM issues in the context of outsourcing.

- Design and implement appropriate Training and Development programmes.
- Develop relevant Compensation system to meet individual and organizational strategic needs.
- Develop Performance appraisal system and effectively handle Disciplinary and grievance mechanisms.

REFERENCES:

1. Gary Dezzler & Biju Vaarkey, "Human Resource Management", Pearson 16th edition 2020
2. S S Khanka, "Human Resource Management (Text and Cases)", S. Chand Publishing, 2019.
3. Decenzo and Robbins, "Fundamentals of Human Resource Management", Wiley, 11th Edition,2013.
4. Luis R. Gomez-Mejia, David B. Balkin, Robert L Cardy, " Managing Human Resource", PHILearning, 2012.
5. Bernadin, "Human Resource Management", Tata Mc Graw Hill, 8th Edition 2012.
6. Wayne Cascio, "Managing Human Resource", Mc Graw Hill, 9th Edition, 2012.
7. Ivancevich, "Human Resource Management", Mc Graw Hill, 2012.
8. Uday Kumar Haldar, Juthika Sarkar, "Human Resource Management", Oxford 2012.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Average	-	1.0	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-

MAN104   **ENTERPRENEURSHIP DEVELOPMENT**   **L T P C**

                                                    2 0 0 2

OBJECTIVES:

- Develop and strengthen entrepreneurial qualities and entrepreneur's role in economic growth
- Impart understanding on Entrepreneurial Training and Development Programs.
- Develop understanding on the business environment and to manage projects.
- Create an understanding on project finance and accounting principles.
- Create awareness on entrepreneurial support offered through government agencies and schemes.

UNIT- I: INTRODUCTION   6

Entrepreneur –   Types of Entrepreneurs – Entrepreneurship as a Career – Entrepreneurial Personality - women entrepreneurship, rural and urban entrepreneurship, Entrepreneur – Knowledge and Skills of Entrepreneur. Difference between Entrepreneur and Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT- II: ENTREPRENEURIAL MOTIVATION   6

Major Motives Influencing an Entrepreneur, motivation theories - Maslow's Need Hierarchy Theory – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT- III: BUSINESS ENVIRONMENT AND PROJECT MANAGEMENT   6

Business Environment - Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT- IV: FINANCING AND ACCOUNTING   6

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, and Management of working Capital. Accounting – Double Entry system of accounting.

UNIT- V: SUPPORT TO ENTREPRENEURS   6

Entrepreneur Support Organizations - Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government

Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Gain knowledge and skills needed to run a business.
- Understanding the concept on entrepreneurial motivation.
- Formulate project proposals based on understanding on business environment.
- Evaluate accounting and financial aspects of business.
- Understanding on project funding and support agencies.

TEXT BOOKS:

1. Khanka S. S," Entrepreneurial Development", S. Chand &Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F. Kuratko, "Entrepreneurship – Theory, Process and Practice", 10th Edition, Cengage Learning, 2017.

REFERENCE BOOKS:

1. Hisrich R. D, Peters M. P, "Entrepreneurship" 10th Edition, Tata McGraw-Hill, 2017.
2. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis", 2nd Edition Dream tech, 2005.
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII, "Faculty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Average	1.0	2.0	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-

MANDATORY COURSES I

MBA101   INTRODUCTION TO GENDER STUDIES   **L T P C**

                                                                                              3 0 0 0

OBJECTIVES:

- To provide awareness on how gender operates on Institutional and cultural context.
- To understand about gender roles in society.
- To understand the institutions of family and its influence on women's status.
- To educate students on the gender issues.
- To familiarize students with women development with gender perspective.

UNIT – I: INTRODUCTION TO WOMEN STUDIES   9

Women and Gender Studies Perspectives & Practices - Need, Scope and challenges of Women's Studies – Need for Gender Sensitization - Women's Movements – global and local - National Committees and Commissions for Women.

UNIT- II: FEMINIST THINKERS AND THEORIES   9

Liberal Feminism, Marxist Feminism, Radical Feminism, Socialist Feminism, Indian Feminism, Black Feminism, Eco-Feminism - New Feminist Debates- Contemporary Contestations - Feminist thinkers in 18th, 19th, 20h and 21st Century

UNIT - III: WOMEN, WORK AND EMPLOYMENT   9

Concept of Work – Productive and non – productive work – Use value and market value - Gender Division of Labour – Mode of Production – Women in organized and unorganized sector - New Economic Policy and its impact on Women's Employment – Globalization – Structural Adjustment Programs.

UNIT - IV: GENDER AND ENTREPRENEURSHIP   9

Concept and meaning, Importance of Entrepreneurship, Entrepreneurial traits, Factors contributing to Entrepreneurship, enabling environment, small Enterprises, women in agri-business - Gender and emerging Technology – Impact -Self-help Groups and Micro Credit.

UNIT - V: WOMEN DEVELOPMENT   9

Theories of Development, Alternative approaches – Women in Development (WID), Women and Development (WAD) and Gender and Development (GAD) - Empowerment- Concept and indices: Gender Development Index (GDI), Gender Inequality Index (GII), Global Gender Gap Index (GGGI) - Women Development approaches in Indian Five –

Year Plans - Women and leadership– Panchayati Raj and Role of NGOs and Women Development - Sustainable Development Goals, Policies and Programmes.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Have an understanding on gender and its operations on Institutional and cultural context.
- Understand about gender roles in society.
- Understand the institutions of family and its influence on women's status.
- Get educated on the gender issues.
- Be familiarized on women development with gender perspective.

REFERENCES:

1. Susan Shaw and Janet Lee, "Women's Voices, Feminist Visions", McGraw Hill Pub, 6th edition, 2014.
2. Rege, Sharmila (ed), "Sociology of Gender: The Challenge of Feminist Sociological Knowledge", Sage, New Delhi, 2003.
3. Bonnie G. Smith, 2013, "Women's Studies: The Basics", Routledge
4. Uma Chakravarti, "Gendering Caste: Through a Feminist Lens", Sage, 2018.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Average	-	-	-	1.0	-	-	1.0	-	-	-	-	-	-	-	-	-

MEN101   **ELEMENTS OF LITERATURE**   **L T P C**

                                                          3 0 0 0
OBJECTIVES:

- To make the students aware of the finer sensibilities of human existence through an art form
- To enable students to appreciate different forms of literature
- To help students understand that literature is an expression of life's experience.
- To improve the aesthetic sense of the students by exposing them to various forms of literature
- To improve the creative abilities of students by giving them opportunities to review forms of literature

UNIT – I: INTRODUCTION TO ELEMENTS OF LITERATURE   9

- Reading, thinking, discussing and writing skills
- Finer sensibility for better human relationship
- Understanding of the problem of humanity without bias
- Space to reconcile and get a cathartic effect

  Assessment- Declamation /Solioquy

UNIT – II: ELEMENTS OF FICTION   9

- Plot, character and perspective
- Analysing works of literature
- Character analysis
- Short story reading

  Assessment- Short Story Analysis

UNIT – III: ELEMENTS OF POETRY   9

- Emotions and imaginations
- Figurative language
- Simile, metaphor, conceit, symbol, pun and irony
- Personification and animation

  Assessment – Appreciation Poetry

UNIT – IV: ELEMENTS OF DRAMA   9

- Drama as representational art
- Content, mode and elements

- Features of tragedy, comedy and satire

Assessment – Presenting a play/Skit/ Street Play

UNIT – V: IMPACT OF LITERATURE ON SOCIETY   9

- Translation of original literature in English
- Comparative literature
- Expression of finer feelings in different forms of literature.
- Influence of literature in society

Assessment-Project: Under the guidance of the teachers, the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context (sociological, psychological, historical, autobiographical etc.)

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the relevance of literature in human life.
- Appreciate the aspects of literature in developing finer sensibilities.
- Enhance reading, thinking, discussing opinions and to understand finer feelings.
- Identify the creative uses of language in literary texts.
- Write reviews and comments about forms of literature.

REFERENCE BOOKS:

1. Seasons of Life: A Poetic Anthology (Literary Classics) by Nigel Collins, Jim Herrick, John Pearce (ISBN: 9781573927710)
   Web Link: https: //www.amazon.co.uk/ Seasons-Life-Anthology-Literary-Classics/ dp/ 1573927716

2. New One-Act Plays for Acting Students: A New Anthology of Complete One-Act Plays for One, Two or Three Actors Paperback – by Norman Bert (Author), Deb Bert (Editor)
   Web Link: https: //www.amazon.in/ New-One-Act-Plays-Acting-Students/ dp/ 1566080843

3. Student Text (Drama Essentials: An Anthology of Plays) Paperback –by Matthew C. Roudane (Editor)
   Web Link: https: //www.amazon.in/Drama-Essentials-Student-Anthology-Plays/ dp/ 0618474773

4. Famous Novels and Short stories in English.(to be recommended by teachers to individual students)

5. Collection of poems by Robert Frost, William Wordsworth, Rabindranath Tagore, Walt Whitman , Maya Angelou, Rudyard Kipling (to be recommended by teachers to individual students)

MBA102   **PATENT DRAFTING FOR BEGINNERS**   L T P C

                                                        3 0 0 0

OBJECTIVES:

- To recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights.
- To identify the significance of practice and procedure of Patents.
- To make the students to understand the statutory provisions of different forms of IPRs in simple forms.
- To learn the procedure of obtaining Patents, Copyrights, Trade Marks and Industrial Design
- To enable the students to keep their IP rights alive

UNIT– I: UNDERSTANDING AND OVER VIEW OF THE IPR REGINE   9

Introduction, types of intellectual property- Industrial property, Artistic and literary Property, Need for intellectual property rights, Rationale for protection of IPR, Impact of IPR on development, health, agriculture, and genetic resources, IPR in India- Genesis and development, IPR in abroad- some important examples of IPR, International organizations, agencies, and treaties.

UNIT- II: PATENTS   9

Need for patent, Macro-economic impact of the patent system, Classification of patents in India, Classification of patents by WIPO, Categories of Patent, Special Patents, Patenting Biological products, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models, Case Study.

UNIT- III: COPYRIGHT   9

Rights and protection covered by copy right- law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, obtaining copyright registration, notice of copy rights, international copyright law, infringement of copy right under copyright Act.

UNIT- IV: TRADEMARKS AND TRADE SECRET   9

Overview of Trademarks and Trade Secret, Importance of Trademarks and Trade secret, Rights of Trademark and Trade Secret, Types of Trademarks, Registration process for Trademark &Trade Secret, Duration of Trademark and trade secret, Case Study.

UNIT- V: GEOGRAPHICAL INDICATIONS AND TRADE SECRETS   9

Overview of Geographical Indications, Importance of Geographical Indication Protection. Geographical Indication of Goods- Type, why and how GI need protection and GI Laws. Indian GI Act. Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigations

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Define need and importance of intellectual property rights.
- Rules and process for IPR registration.
- Patent Searching, Patent Drafting, filing, Protection and duration of a patent in India and abroad.
- Legal concepts in Science, Engineering, Technology and Creative Design.
- Clarity on the influence of Geographical Indications on Trade Secrets.

REFERENCES:

1. Watal,Jayashree, "Intellectual Property Rights In The WTO And Developing Countries", Oxford University Press
2. R. Anita Rao and Bhanoji Rao, "Intellectual Property Rights- A Primer", Eastern Book Co.
3. Shiv Sahai Singh, "The Law Of Intellectual Property Rights", Eastern Book Co.
4. Deepa Goeland Shomini Parashar, "IPR, Biosafety and Bioethics", Pearson publisher.
5. Pandey, Neeraj, Dharni, Khushdeep, "Intellectual Property Rights", PHI, 2020.
6. Sople, Vinod V. "Managing Intellectual Property: The Strategic Imperative", PHI, 2020

CO	PO												PSO			
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1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Average	1.0	2.0	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-

MBA103   **INDUSTRIAL PSYCHOLOGY**   **L   T   P   C**

                                                        3   0   0   0

OBJECTIVES:

- To understand the core concepts, history, and significance of Industrial Psychology
- To analyze factors influencing employee attitudes, behaviors, and well-being.
- To apply principles of ergonomics and human factors to improve workplace design and safety.
- To evaluate different theories of motivation and their practical applications in organizational settings.
- To assess team dynamics, cultural diversity, and organizational change processes in modern workplaces.

UNIT- I: FOUNDATIONS OF INDUSTRIAL PSYCHOLOGY AND JOB ANALYSIS

                                                                    9

Definition, Characteristics, Goals, and Importance of Industrial Psychology - Brief History of Industrial Psychology - Major Fields in Industrial Psychology - Research Methods in Industrial Psychology - Job Analysis: Methods and Techniques - Performance Measurement: Concepts and Practices - Performance Rating and Evaluation - The Social Context of Performance Evaluation

UNIT- II: EMPLOYEE ATTITUDES, BEHAVIOUR, AND WELL-BEING   9

Work Attitudes and Employee Engagement - Job Satisfaction and Organizational Commitment - Positive Employee Behaviors - Worker Stress: Sources, Consequences, and Coping Strategies

UNIT- III: ERGONOMICS AND ENGINEERING PSYCHOLOGY   9

Principles of Ergonomics and Human Factors - Work Design for Productivity and Well-being - Psychological Aspects of Workplace Safety - Human-Technology Interaction.

UNIT- IV: MOTIVATION IN THE WORKPLACE   9

Defining and Theories of Motivation - Need-Based Theories of Motivation (e.g., Maslow's Hierarchy of Needs, Alderfer's ERG Theory) - Behaviour-Based Theories of Motivation (e.g., Skinner's Reinforcement Theory) - Job Design Theories of Motivation (e.g., Hackman and Oldham's Job Characteristics Model) - Motivation and Performance - Practical Techniques to Enhance Motivation

UNIT- V: GROUP DYNAMICS AND ORGANIZATIONAL CULTURE   9

Defining Work Groups and Teams - Types of Teams and Team Processes - Group Decision- Making and Effectiveness - Diversity and Multiculturalism in Teams - Organizational Culture and Development - Social Dynamics and Change Management.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand Industrial Psychology by practicing Management theories in solving Industrial relations problems.
- Apply critical thinking with regard to human attitudes and behavior for better decision making.
- Enhance the managerial competencies by employing human factor with suitable ergonomics in workplace.
- Inculcate value based leadership abilities amongst students in achieving individual as well as organizational goals.
- Withhold cultural diversity in globalized business and engage in lifelong learning.

REFERENCES

1. Aamodt, M. G. (2016). "Industrial/Organizational Psychology: An Applied Approach", (6th Edition), Cengage Learning.
2. Landy, F. J., & Conte, J. M. (2016). "Work in the 21st Century: An Introduction to Industrial and Organizational Psychology", (4th Edition), Wiley.
3. Riggio, R. E. (2017). "Introduction to Industrial and Organizational Psychology", (6th Edition), Routledge.
4. Salvendy, G. (2006). "Handbook of human factors and ergonomics", (3rd ed.). New York: Wiley.
5. Levy, P. E. (2017). "Industrial/Organizational Psychology: Understanding the Workplace", (5th Edition), Macmillan Learning
6. Culbertson, S. S., & Muchinsky, P. M. (2022). "Psychology Applied to Work", (13th Edition), Hypergraphic Press.
7. Spector, P. E. (2017). "Industrial and Organizational Psychology: Research and Practice", (7th Edition), Wiley.

8. Truxillo, D. M., Bauer, T. N., & Erdogan, B. (2016). "Psychology and Work: Perspectives on Industrial and Organizational Psychology", (1st Edition), Routledge

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5	-	-	-	3	-	-	-	2	-	-	-	-	-	-	-	-
Average	2.0	3.0	2.0	2.0	1.0	1.0	1.0	1.5	-	-	-	-	-	-	-	-

MBA104   INDIAN CONSTITUTION   L T P C

3 0 0 0

OBJECTIVES:

- To create an awareness on the constitution of India and its amendments.
- To educate the students with fundamental duties and rights of the citizens.
- To equip with the functions of central government and its' structure.
- To learn the state government structure and its' functions.
- To understand the judiciary structure and its functions in India.

UNIT- I: INTODUCTION   9

Introduction to constitution of India – Philosophical Foundations and Historical Background – Preamble – Schedule – 42nd Amendment - 44th Amendment – 73rd Amendment - 74th Amendment – Articles Related to Amendments.

UNIT- II: FUNDAMENTAL DUTIES AND RIGHTS OF CITIZENS   9

Citizenship – Citizenship Amendment Act (CAA) – Union of States - Union Territories - Fundamental Rights – Directive Principles of State Policy (DPSP) – Fundamental Duties - Reference of Articles for Granting of Special Status to Various States in the Country.

UNIT- III: CENTRAL GOVERNMENT STRUCTURE AND FUNCTIONS   9

Government at Central Level – President of India – Powers of President of India – Structure of Central Government – Functions of Central Government – Vice President – Powers of Vice President – Powers of Prime Minister – Powers of Cabinet Ministers – Powers of Parliament.

UNIT- IV: STATE GOVERNMENT STRUCTURE AND FUNCTIONS   9

Government at State Level – Structure of State Government – Functions of State Government – Governor – Powers of Governor – Chief Minister – Powers of Chief Minister – State Legislature – Powers of Cabinet Ministers in State Legislature – Cabinet Ministers Responsibilities in State Government.

UNIT- V: JUDICIARY STRUCTURE AND FUNCTIONS   9

Supreme Court of India – Judiciary System in Indian Constitution – Judicial Systems Central Government Level – Judiciary System in State Government Level – High Courts and Subordinate Courts – Election Commission of India – Case Studies of Major Disputes.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the constitution of India and its' amendments.
- Analyze the fundamental duties and rights of citizens.
- Narrate the central government structure and its functions.
- Discuss the state government structure and its functions.
- Derive judiciary structure and its functions.

REFERENCES:

1. Basu, D. D. (1966). Introduction to the Constitution of India. LexisNexis, India.
2. Khosla, Madhav (2012). The Indian Constitution. Oxford University Press, India.
3. R.C.Agarwal (1997). Indian Political System. SChand Company Ltd., India.
4. Bakshi, P. (2023). The Constitution of India. LexisNexis, India.
5. V. N. Shukla (2017). Constitution of India, 13th Ed., Eastern Book Company.

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3	2	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-
4	2	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-
5	2	-	2	1	2	1	1	-	-	-	-	-	-	-	-	-
Average	2.0	3.0	2.3	1.2	2.5	1.5	1.0	1.0	-	-	-	-	-	-	-	-

MANDATORY COURSES II

MGE201   WELL BEING WITH TRADITIONAL PRACTICES – YOGA,   L T P C

AYURVEDA AND SIDDHA   3 0 0 0

OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health
- To adopt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost-effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT- I: HEALTH AND ITS IMPORTANCE   9

Health: Definition - Importance of maintaining health - More importance on prevention than treatment - Ten types of health one has to maintain - Physical health - Mental health - Social health – Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health – Environmental health. Occupational/Professional health. **Present health status** - The life expectancy- present status - mortality rate - dreadful diseases - Non- communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. **Causes of the above diseases / disorders - Importance of prevention of illness** - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time.

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI-Importance and actions to be taken.

UNIT- II: DIET   9

Role of diet in maintaining health - energy one needs to keep active throughout the day – nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like

diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions.

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes. Different cooking methods, merits and demerits of each method.

UNIT- III: ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH

9

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (TriDosha Theory) - Udal Thathukkal.

Prevention of illness with our traditional system of medicine.

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder.

UNIT- IV: MENTAL WELLNESS   9

Emotional health - Definition and types - Three key elements: the subjective experience – the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances – Leading a healthy life with emotions - Practices for emotional

health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life -Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity.

UNIT- V: YOGA   9

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for Individuals according to the Age - The Eight Limbs of Yoga - Simple yoga asanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL: 45 PERIODS

OUTCOMES:

After completing the course, the students will be able to:

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health
- Understand the practice of yoga

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California.
3. Yoga and Empowerment, WCSC-VISION for Wisdom, 3rd Edition 2018, Vethathiri Publications, Erode
4. SIDDHA MEDICINE HANDBOOK OF TRADITIONAL REMEDIES Kindle Edition by Paul Joseph Thottam (Author) 2012.
5. The Ayurvedic Pharmacopoeia of India Part-I Volume-VII First Edition [Minerals & Metals] by Central Council for Research in Ayurveda and Siddha, 2008

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.

2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001.

3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/

4. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-betterhealth#:~:text=Make%20your%20new%20healthy%20habitt%20have%20 time%20to%20cook.

5. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html

6. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926

7. Benefits of healthy eating https://www.cdc.gov/nutrition/resources- publications/ benefitsof-healthy-eating.html

8. Foodadditives:https://www.betterhealth.vic.gov.au/health/conditionsand treatments /foodadditives

9. BMI: https://www.hsph.harvard.edu/nutritionsource/healthy-weight/

10. https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle-who recommendations

11. Yoga: https://www.healthifyme.com/blog/types-of-yoga/ https://yogamedicine.com/guide-types-yoga-styles/

12. Ayurveda:https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in Ayurveda.

13. Siddha: http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp

MGE202   HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA   L T P C

3 0 0 0

OBJECTIVES:

- To know the contributions of the scientists for the development of society over a period of time.
- To understand the Science and Technological developments that lead to human welfare.
- To appreciate the Science and Technological contributions for the development of various sectors of the country.
- To identify the technical transfer versus economic progress of the countries.
- To know the students get a holistic view of the development of science and technology as a historical and cultural phenomenon.

UNIT- I: HISTORICAL PERSPECTIVE OF SCIENCE AND TECHNOLOGY 9

The nature of science and technology, Roots of science and technology in India, Science and society, Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Indian contribution to science and technology (from Ancient to Modern). Aryabhata, Charaka, Bhaskara II, Sushruta, J C Bose, C V Raman, Homi J Bhaba, Dr APJ Abdul kalam

UNIT- II: SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA   9

Scientific and Technological Developments in Medieval India; Influence of the Islamic world and Europe; The role of maktabs, madrasas and karkhanas set up. Developments in the fields of Mathematics, Chemistry, Astronomy and Medicine. Innovations in the field of agriculture - new crops introduced new techniques of irrigation etc

UNIT- III: SCIENCE AND TECHNOLOGY IN COLONIAL INDIA   9

Early European Scientists in Colonial India- Surveyors, Botanists, Doctors, under the Company's Service- Indian Response to new Scientific Knowledge, Science and Technology in Modern India- Development of research organizations like CSIR and DRDO; Establishment of Atomic Energy Commission; Launching of the space satellites.

UNIT- IV: IMPACT OF SCIENCE AND TECHNOLOGY IN MAJOR AREAS   9

Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology Ocean Development – Objectives of ocean development, Biological and mineral resources, Marine research and capacity building. Defence Research – Spin-off

technologies for civilian use, Biotechnology – Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry. Energy – Research and development in conservation of energy, India's nuclear energy program, technology spin-offs.

UNIT- V: NEXUS BETWEEN TECHNOLOGY TRANSFER AND DEVELOPMENT   9

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology- Criteria and selection of Appropriate technology: Technology assessment, Technological forecasting, Technological innovations and barriers of technological change. Social implications of new technologies like the Information Technology and Biotechnology

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course students must obtain a sufficient level of knowledge about:

- The origins of scientific knowledge, Names, major milestones in the life and work of prominent scientists and engineers.
- Periodization of the history of science and technology.
- Major events, dates of the most significant achievements in the development of science and technology at different stages of history.
- Features of the network of scientific and technical institutions, the history of formation and development of leading research centers, in particular higher education institutions as centers of basic and applied research.
- Features of science and technology and it development

TEXT BOOKS:

1. Kalpana Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi – 58.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd., New Delhi.

REFERENCES:

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Developlemnt, K., Nayudamma Memorial Science Foundation, Chennai-8.
2. Kohili, G.R., The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.

3. Government of India, Five Year Plans, Planning Commission, New Delhi.
4. Sharma K.D., and Quresh M.A., Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

ONLINE LINK

Swayam online course History of Science and Technology:

https://onlinecourses.swayam2.ac.in/arp19_ap87/preview

ASSESSMENT:

Quizzes

Assignment,

Case Study / Presentation

Continuous Assessment Test

MCY201   AWARNESS OF CYBER SECURITY AND CYBER LAW   L T P C
                                                         3 0 0 0

OBJECTIVES:

- To understand the basics of cyber security and cyber law,
- To understand the problems and issues associated with it,
- To understand the various act or regulations,
- To understand the various approaches for incident analysis and response.
- To understand the ethical laws of computer for different countries.

UNIT I: INTRODUCTION TO CYBER SECURITY AND CYBER CRIME   9

Introduction - Cyber Crime: Definition and origins - Cyber crime and information Security - Cyber criminals– Classification of Cyber crimes.

UNIT II: LEGAL PERSPECTIVES   9

Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India.

UNIT III: CYBER ACT   9

Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

UNIT IV: CYBER LIABILITY   9

Private ordering solutions, Regulation and Jurisdiction for global Cyber security, Copy Right– source of risks, Pirates, Internet Infringement, Fair Use, postings, criminal liability, First Amendments, Data Losing.

UNIT V: CYBER CHANGES   9

Ethics, Legal Developments, Cyber security in Society, Security in cyber laws case studies, General law and Cyber Law–a Swift Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand key terms and concepts in cyber security and cyber law, intellectual property and cyber– crimes, trademarks and domain theft.
- Determine computer technologies, digital evidence collection.
- Determine evidentiary reporting in forensic acquisition.

- Secure both clean and corrupted systems, protecting personal data, securing simple computer networks, and safe Internet usage
- Incorporate approaches for incident analysis and response.

TEXT BOOKS:

1. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Pvt. Ltd, 2011.
2. Jonathan Rosenoer, "Cyber Law: The law of the Internet", Springer–Verla.

REFERENCES:

1. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.
2. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency– Faridabad.

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1	2	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-
2	-	2	-	2	-	2	-	-	-	-	-	-	-	-	2	1
3	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-
4	-	3	2	-	-	-	-	2	-	-	-	2	-	-	2	2
5	2	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-
Average	2.0	2.5	2.0	2.0	-	2.0	-	2.0	-	-	-	2.0	1.0	2.0	2.0	1.5

OBJECTIVES:

- To discuss the basic approaches of the organizations and safety measures.
- To discuss the concept of Work design and facility planning.
- To comprehend the accident investigation process and accident reports.
- To discuss the principles of safety performance monitoring.
- To elaborate the methods of safety education and training.

UNIT I: BASICS OF SAFETY ENGINEERING AND ACTS   9

Evolution of modern safety concept – Safety audit – Acts: Factories act – 1948 –Statutory authorities – Tamil Nadu factories Rules 1950 under safety and health – Environment act – 1986 – Air act 1981, Water act 1974 – other acts; Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process. Introduction to Electrical Acts.

UNIT II: SAFETY MANAGEMENT   9

History of Safety movement – Evolution of modern safety concept General concepts of Management – Planning for safety for optimization of productivity, quality and safety line and staff functions for safety, budgeting for safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT III: ACCIDENT INVESTIGATION AND REPORING   9

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – Principles of accident prevention, Supervisory role – Role of safety committee – Accident causation models Cost of accident. Overall accident investigation process Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, Functions of investigator, Four types of evidences, Records of accidents, Accident reports Class exercise with case study.

UNIT IV: SAFETY PERFORMANCE MONITORING   9

Reactive and proactive monitoring techniques, Permanent total disabilities, Permanent partial disabilities, Temporary total disabilities – Calculation of accident indices, Frequency rate, Severity rate, Frequency severity incidence, Incident rate, Accident rate, Safety "t" score, Safety activity rate problems.

Importance of training identification of training needs training methods – programme, seminars, conferences, competitions – method of promoting safe practice motivation – communication role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Learn the basic approaches of the organizations and safety management.
- Perform work design and facility planning.
- Study the accident investigation process and accident reports.
- Learn the principles of safety performance monitoring.
- Study the methods of safety education and training.

TEXT BOOKS:

1. L M Deshmukh, Industrial safety management, TATA McGraw Hill, 2017.
2. Heinrich H.W., Industrial Accident Prevention, McGraw Hill Company, New York, 2001.

REFERENCES:

1. Garg, HP, Maintenance Engineering, S. Chand Publishing, 2012
2. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

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3	2	-	-	2	-	-	1	-	-	2	-	2	-	-	-	-
4	2	-	3	-	-	2	-	-	2	-	1	-	-	-	-	-
5	-	2	-	-	2	-	-	1	-	-	-	1	-	-	-	-
Average	2.3	1.5	2.0	2.0	2.0	2.0	1.0	1.5	1.5	2.0	1.0	2.6	-	-	-	-

PROFESSIONAL ELECTIVES

VERTICAL I: INFORMATION ANALYTICS

PAD101   **BIO-INSPIRED OPTIMIZATION TECHNIQUES**   **L T P C**

                                                    3 0 0 3

OBJECTIVES:

- To understand fundamental topics in bio-inspired optimization techniques
- To Learn the collective systems such as ACO, PSO, and BCO
- To develop skills in biologically inspired algorithm design with an emphasis on solving real world problems
- To understand the most appropriate types of algorithms for different data analysis problems and to introduce   some of the most appropriate implementation strategies.
- To implement the Bio-inspired technique with other traditional algorithms.

UNIT-I: INTRODUCTION   **9**

Optimization Techniques: Introduction to Optimization Problems – Single and Muti-objective Optimization – Classical Techniques – Overview of various Optimization methods – Evolutionary Computing: Genetic Algorithm and Genetic Programming: Basic concept – encoding – representation – fitness function – Reproduction – differences between GA and Traditional optimization methods – Applications – Bio- inspired Computing (BIC): Motivation – Overview of BIC – usage of BIC – merits and demerits of BIC.

UNIT-II: SWARM INTELLIGENCE   **9**

Introduction – Biological foundations of Swarm Intelligence – Swarm Intelligence in Optimization – Ant Colonies: Ant Foraging Behavior – Towards Artificial Ants – Ant Colony Optimization (ACO) – S-ACO – Ant Colony Optimization Metaheuristic: Combinatorial Optimization – ACO Metaheuristic – Problem solving using ACO – Other Metaheuristics – Simulated annealing – Tabu Search – Local search methods – Scope of ACO algorithms.

UNIT-III: NATURAL TO ARTIFICIAL SYSTEMS   **9**

Biological Nervous Systems – artificial neural networks – architecture – Learning Paradigms – unsupervised learning – supervised learning – reinforcement learning – evolution of neural networks – hybrid neural systems – Biological Inspirations in problem

solving – Behaviour of Social Insects: Foraging –Division of Labor – Task Allocation – Cemetery Organization and Brood Sorting – Nest Building – Cooperative transport.

UNIT-IV: SWARM ROBOTICS   **9**

Foraging for food – Clustering of objects – Collective Prey retrieval – Scope of Swarm Robotics – Social Adaptation of Knowledge: Particle Swarm – Particle Swarm Optimization (PSO) – Particle Swarms for Dynamic Optimization Problems – Artificial Bee Colony (ABC) Optimization biologically inspired algorithms in engineering.

UNIT-V: CASE STUDIES   **9**

Other Swarm Intelligence algorithms: Fish Swarm – Bacteria foraging – Intelligent Water Drop Algorithms – Applications of biologically inspired algorithms in engineering. Case Studies: ACO and PSO for NP-hard problems – Routing problems – Assignment problems – Scheduling problems – Subset problems – Machine Learning Problems – Travelling Salesman problem.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Familiarity with the basics of several biologically inspired optimization techniques.
- Familiarity with the basics of several biologically inspired computing paradigms.
- Ability to select an appropriate bio-inspired computing method and implement for any application and data set.
- Theoretical understanding of the differences between the major bio-inspired computing methods.
- Learn Other Swarm Intelligence algorithms and implement the Bio-inspired technique with other traditional algorithms.

TEXT BOOKS:

1. E. Elben and J. E. Smith, "Introduction to Evolutionary Computing", Springer, 2010.
2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	1	3	1	-	-	-	3	1	1	3	2	1	3	2
2	2	3	2	3	2	-	-	-	2	2	2	1	2	3	2	2
3	1	1	1	1	3	-	-	-	1	3	1	2	3	3	1	3
4	3	2	1	2	2	-	-	-	2	3	3	3	3	1	3	3
5	2	2	3	1	2	-	-	-	1	1	3	1	1	1	3	1
Average	2.2	2.0	1.6	2.0	2.0	-	-	-	1.8	2.0	2.0	2.0	2.2	1.8	2.4	2.2

PAD103   IMAGE AND VIDEO ANALYTICS   LT P C
                                                            3 0 0 3

OBJECTIVES:

- To understand the basics of image processing techniques for computer vision.
- To learn the techniques used for image pre-processing.
- To discuss the various object detection techniques.
- To understand the various Object recognition mechanisms.
- To elaborate on the video analytics techniques.

UNIT–I: INTRODUCTION   9

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT- II: IMAGE PRE-PROCESSING   9

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration.

UNIT-III: OBJECT DETECTION USING MACHINE LEARNING   9

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures.

UNIT-IV: FACE RECOGNITION AND GESTURE RECOGNITION   9

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition DeepFace solution by Facebook-FaceNet for Face Recognition-Implementation using FaceNetGesture Recognition.

UNIT-V: VIDEO ANALYTICS   9

Video Processing – use cases of video Analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections - Inception Network - GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the basics of image processing techniques for computer vision and video analysis.

- Explain the techniques used for image pre-processing.

- Develop various object detection techniques.

- Understand the various face recognition mechanisms.

- Elaborate on deep learning-based video analytics.

TEXT BOOKS:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.

2. Vaibhav Verdhan, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, Apress 2021(UNIT-III,IV and V)

REFERENCES:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited, Second Edition, 2021.

2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.

3. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, Second Edition, 2012.

4. E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	2	2	-	-	-	3	3	2	1	2	1	-	-
2	2	2	3	3	3	-	-	-	3	2	1	1	2	2	-	1
3	1	2	2	2	3	-	-	-	1	2	1	2	1	1	-	-
4	1	2	3	2	3	-	-	-	2	2	2	3	2	2	-	1
5	3	2	1	3	2	-	-	-	2	1	1	3	3	2	-	-
Average	2.0	1.8	1.2	2.2	2.6	-	-	-	2.2	2.0	1.4	2.0	2.0	1.6	-	1.0

PAD104   **HEALTH CARE ANALYTICS**   **L T P C**
                                                                 3 0 0 3

OBJECTIVES:

- To understand the health data formats, health care policy and standards.
- To learn the significance and need of data analysis and data visualization.
- To understand the health data management frameworks.
- To learn the use of machine learning and deep learning algorithms in healthcare.
- To apply healthcare analytics for critical care applications.

UNIT-I: INTRODUCTION TO HEALTHCARE ANALYSIS   9

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning, Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

UNIT-II: ANALYTICS ON MACHINE LEARNING   9

Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model: Sensitivity, Specificity, PPV, NPV, FPR, Accuracy, ROC, Precision Recall Curves, Valued target variables –Python: Variables and types, Data Structures and containers, Pandas Data Frame: Operations – Scikit –Learn: Pre-processing, Feature Selection.

UNIT-III: HEALTH CARE MANAGEMENT   9

IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.

UNIT-IV: HEALTHCARE AND DEEP LEARNING   9

Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.

UNIT-V: CASE STUDIES   9

Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT – Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis.

                                                        TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Use machine learning and deep learning algorithms for health data analysis.
- Apply the data management techniques for healthcare data.
- Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications.
- Design health data analytics for real time applications.
- Design emergency care system using health data analysis.

TEXT BOOKS:

1. Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.
2. Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.
3. Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
4. Hui Jang, Eva K.Lee, "HealthCare Analysis : From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016.
5. Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, "Big Data Analytics in HealthCare", Springer, 2020.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	1	3	-	-	-	3	2	1	1	2	2	2	-
2	3	1	1	3	1	-	-	-	3	2	3	1	3	3	3	-
3	2	1	2	1	2	-	-	-	2	2	1	3	3	2	1	-
4	2	2	3	3	1	-	-	-	2	3	1	2	3	2	2	-
5	1	2	2	1	1	-	-	-	1	3	3	2	2	2	2	-
Average	2.2	1.8	2.2	1.8	1.6	-	-	-	2.2	2.4	1.8	1.8	2.6	2.2	2.0	-

PAD106   **BUSINESS ANALYTICS**   **L T P C**
                                                                        3 0 0 3

OBJECTIVES

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence
- To understand various types of analytics for business Forecasting.
- To model the supply chain management for Analytics.
- To apply analytics for different functions of a business.

UNIT-I: INTRODUCTION TO BUSINESS ANALYTICS   9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modelling – Validation and Evaluation – Interpretation – Deployment and Iteration.

UNIT-II: BUSINESS INTELLIGENCE   9

Data Warehouses and Data Mart – Knowledge Management – Types of Decisions - Decision Making Process – Decision Support Systems – Business Intelligence – OLAP Analytic functions.

UNIT-III: BUSINESS FORECASTING   9

Introduction to Business Forecasting and Predictive analytics – Logic and Data Driven Models- Data Mining and Predictive Analysis Modelling – Machine Learning for Predictive analytics.

UNIT-IV: HR & SUPPLY CHAIN ANALYTICS   9

Human Resources – Planning and Recruitment – Training and Development - Supply Chain Network – Planning Demand , Inventory and Supply – Logistics – Analytics Applications in HR & Supply Chain – Applying HR Analytics to make a prediction of the Demand for hourly employees for a year.

UNIT-V: MARKETING & SALES ANALYTICS   9

Marketing Strategy, Marketing Mix, Customer Behaviour – Selling Process – Sales Planning – Analytics applications in Marketing and Sales – Predictive analytics for Customer's behaviour in marketing and sales.

                                                      TOTAL: 45 PERIODS

OUTCOMES:

After the completion of this course, students will be able to:

- Explain the real world business problems and model with analytical solutions.
- Identify the business process for extracting Business Intelligence.

- Apply predictive analytics for business fore-casting.
- Apply analytics for supply chain and logistics management.
- Use analytics for marketing and sales.

TEXT BOOKS:

1. R. Evans James, Business Analytics, 3rd Edition, Pearson, 2021.
2. R.N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016.
3. Philip Kotler and Kevin Keller, Marketing Management, 15th Edition, PHI, 2022.
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2015.
5. Mahadevan B, "Operations Management – Theory and Practice", 3rd Edition, Pearson Education, 2016.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	3	1	1	-	-	-	1	2	1	1	3	2	-	1
2	3	3	3	2	3	-	-	-	1	2	2	2	3	1	-	2
3	2	2	3	3	2	-	-	-	3	1	1	3	3	1	-	2
4	2	1	1	2	2	-	-	-	3	3	2	1	1	3	-	1
5	2	3	2	3	2	-	-	-	3	3	1	3	3	1	-	1
Average	2.2	2.2	2.4	2.2	2	-	-	-	2.2	2.2	1.4	2	2.6	1.6	-	1.4

PAD108   **GAME THEORY**   **L T P C**
                                                             3 0 0 3

OBJECTIVES:

- To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in 41odelling applications.
- To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.
- To introduce contemporary topics in the intersection of game theory, computer science, and economics.
- To apply game theory in searching, auctioning and trading.

UNIT-I: **INTRODUCTION**   **9**

Introduction — Making rational choices: basics of Games — strategy — preferences — payoffs — Mathematical basics — Game theory — Rational Choice — Basic solution concepts-non-cooperative versus cooperative games — Basic computational issues — finding equilibria and learning in games- Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets)

UNIT-II: **GAMES WITH PERFECT INFORMATION**   **9**

Games with Perfect Information — Strategic games — prisoner's dilemma, matching pennies - Nash equilibria —mixed strategy equilibrium — zero-sum games.

UNIT-III: **GAMES WITH IMPERFECT INFORMATION**   **9**

Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions — Information aspects — Illustrations — Extensive Games with Imperfect — Information — Strategies — Nash Equilibrium —Repeated Games — The Prisoner's Dilemma — Bargaining.

UNIT-IV: **NON-COOPERATIVE GAME THEORY**   **9**

Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analysing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games— Computing Nash equilibria of two-player, zero-sum games — Computing Nash equilibria of two-player, general- sum games — Identifying dominated strategies.

Aggregating Preferences — Social Choice — Formal Model — Voting — Existence of social functions — Ranking systems — Protocols for Strategic Agents: Mechanism Design — Mechanism design with unrestricted preferences.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

- Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.
- Discuss the use of Nash Equilibrium for other problems.
- Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.
- Identify some applications that need aspects of Bayesian Games.
- Implement a typical Virtual Business scenario using Game theory.

TEXT BOOKS:

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2020.
3. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2011.
4. A. Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.

REFERENCES:

1. YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2009.
2. Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, "Game Theory in Wireless and Communication Networks", Cambridge University Press, 2012.
3. Y.Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific, 2014.
4. William Spaniel, "Game Theory 101: The Complete Textbook", CreateSpace Independent Publishing, 2011.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	3	3	-	-	-	3	2	1	2	3	2	3	-
2	3	3	3	2	3	-	-	-	2	2	2	1	3	3	1	1
3	1	1	3	3	3	-	-	-	3	3	1	2	3	2	2	-
4	2	1	1	1	1	-	-	-	2	3	3	3	2	2	2	1
5	2	2	3	2	1	-	-	-	3	3	2	2	3	3	2	-
Average	2.2	2	2.4	2.2	2.2	-	-	-	2.6	2.6	1.8	2	2.8	2.4	2	1

PAD109   **ETHICS AND AI**   **L T P C**
                                                                                   3 0 0 3

OBJECTIVES:

- To study the morality and ethics in AI
- To learn about the Ethical initiatives in the field of artificial intelligence
- To study about AI standards and Regulations
- To study about social and ethical issues of Robot Ethics
- To study about AI and Ethics- challenges and opportunities

UNIT-I: **INTRODUCTION**   **9**

Definition of morality and ethics in AI-Impact on Society-Impact on human psychology - Impact on the legal System-Impact on the environment and the planet-Impact on trust

UNIT-II: **ETHICAL INITIATIVES IN AI**   **9**

International ethical Initiatives-Ethical harms and Concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.

UNIT-III: **AI STANDARDS AND REGULATION**   **9**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT-IV: **ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS**

                                                                                       9

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional ResponsibilityRoboethics Taxonomy.

UNIT-V: **AI AND ETHICS- CHALLENGES AND OPPORTUNITIES**   **9**

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in Industries-National and International Strategies on AI.

                                                  TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

- Learn about morality and ethics in AI and Acquire the knowledge of real time application ethics, issues and its challenges.
- Understand the ethical harms and ethical initiatives in AI

- Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
- Understand the concepts of Roboethics and Morality with professional responsibilities. Learn about the societal issues in AI with National and International Strategies on AI

TEXT BOOKS:

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, "The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020

2. Patrick Lin, Keith Abney, George A Bekey, "Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.

REFERENCES:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017

2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020

WEB LINK:

1. https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65

2. https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteenchallenges-and-opportunities/

3. https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/

4. https://sci-hub.mksa.top/10.1159/000492428

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	3	1	-	-	-	1	2	1	1	3	1	1	-
2	2	1	1	2	1	-	-	-	1	2	1	1	3	3	1	1
3	2	3	1	1	3	-	-	-	2	1	1	2	3	2	2	-
4	3	1	3	3	2	-	-	-	2	2	3	1	2	1	3	1
5	3	1	1	3	3	-	-	-	2	3	3	3	1	3	3	-
Average	2.6	1.6	1.8	2.4	2.0	-	-	-	1.6	2	1.8	1.6	2.4	2	2	1

VERTICAL II: CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES

PIT201	**DATA WAREHOUSING**	**L T P C**
		3 0 0 3

OBJECTIVES:

- To know the details of data warehouse Architecture.
- To understand the OLAP Technology.
- To understand the partitioning strategy.
- To differentiate various schema.
- To understand the roles of process manager & system manager.

UNIT-I: INTRODUCTION TO DATA WAREHOUSE   9

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse.

UNIT-II: ETL AND OLAP TECHNOLOGY   9

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

UNIT-III: META DATA, DATA MART AND PARTITION STRATEGY   9

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition.

UNIT-IV: DIMENSIONAL MODELING AND SCHEMA   9

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Data warehouse Tools.

UNIT-V: SYSTEM & PROCESS MANAGERS   9

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System

Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Design data warehouse architecture for various Problems.

- Apply the OLAP Technology.

- Analyse the partitioning strategy.

- Critically analyze the differentiation of various schema for given problem.

- Frame roles of process manager & system manager.

TEXT BOOKS:

1. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw Hill Edition, Thirteenth Reprint 2017. (Unit-II).

2. Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013. (Unit-IV & V)

REFERENCES:

1. Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012. (Unit-III)

2. K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006. (Unit-I)

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
2	3	2	2	2	3	-	-	-	-	-	-	-	3	3	-	-
3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-	-
4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-	-
5	3	2	2	2	-	-	-	-	-	-	-	-	3	3	-	-
Average	3.0	2.6	2.6	2.4	2.5	-	-	-	-	-	-	-	3.0	3.0	-	-

PIT202   **STORAGE TECHNOLOGIES**   **L T P C**

                                                                           3 0 0 3

OBJECTIVES:

- Characterize the functionalities of logical and physical components of storage.

- Describe various storage networking technologies.

- Identify different storage virtualization technologies.

- Discuss the different backup and recovery strategies.

- Understand common storage management activities and solutions.

UNIT- I: **STORAGE SYSTEMS**   **9**

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT- II: **INTELLIGENT STORAGE SYSTEMS AND RAID**   **9**

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale out storage Architecture.

UNIT- III: **STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**   **9**

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT- IV: **BACKUP, ARCHIVE AND REPLICATION**   **9**

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of

replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS)

UNIT-V: **SECURING STORAGE INFRASTRUCTURE** **9**

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
- Illustrate the usage of advanced intelligent storage systems and RAID.
- Interpret various storage networking architectures - SAN, including storage subsystems and virtualization.
- Examine the different role in providing disaster recovery and remote replication technologies
- Infer the security needs and security measures to be employed in information Storage Management.

TEXT BOOKS:

1. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Information Storage and Management, EMC Corporation, Wiley 2012, (Unit-I to V).
2. Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017. (Unit-III & V).).
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, Storage Networks Explained, Second Edition, Wiley, 2009 (Unit-II to IV)

REFERENCES:

1. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003. (Unit – III).

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	3	2	3	-	-	-	1	1	1	3	1	2	1	-
2	3	1	3	2	3	-	-	-	3	2	3	2	2	3	1	-
3	1	1	2	3	2	-	-	-	3	1	1	2	2	3	3	-
4	3	2	2	3	2	-	-	-	1	1	3	1	3	2	1	-
5	1	3	1	2	2	-	-	-	1	2	3	1	3	2	1	-
Average	1.8	1.8	2.2	2.4	2.4	-	-	-	1.8	1.4	2.2	1.8	2.2	2.4	1.4	-

PIT203   **VIRTUALIZATION**   **L T P C**

                                                       3 0 0 3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines.
- To gain expertise in server, network and storage virtualization.
- To explore the aspects of high level language virtual machines.
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions.

UNIT- I: **VIRTUALIZATION**   **9**

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization - Management Virtualization-Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization.

UNIT- II: **VIRTUALIZATION INFRASTRUCTURE**   **9**

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization -Implementation levels of Virtualization – Virtualization structure – Virtualization of CPU, Memory and I/O devices – Virtual clusters and Resource Management- Virtualization for Data center automation.

UNIT- III: **HIGH LEVEL LANGUAGE VIRTUAL MACHINES AND**   **9**
                         SERVER VIRTUALIZATION

HLL virtual machines: Pascal P-Code – Object Oriented HLLVMs - Java VM architecture - Java Native Interface - Common Language Infrastructure. Server virtualization: Partitioning techniques - virtual hardware - uses of virtual servers - server virtualization platforms.

UNIT- IV: **NETWORK AND STORAGE VIRTUALIZATION**   **9**

Design of Scalable Enterprise Networks – Layer2 Virtualization – VLAN - VFI - Layer 3 Virtualization – VRF - Virtual Firewall Contexts - Network Device Virtualization - Data-Path Virtualization - Routing Protocols. Hardware Devices – SAN backup and recovery techniques – RAID – Classical Storage Model – SNIA Shared Storage Model – Virtual Storage: File System Level and Block Level.

Practical Virtualization Solutions: Comparison of Virtualization Technologies: Guest OS/ Host OS – Hypervisor – Emulation – Kernel Level – Shared Kernel, Enterprise Solutions: VMWare Server – VMWare ESXi – Citrix Xen Server – Microsoft Virtual PC – Microsoft Hyper-V – Virtual Box, Server Virtualization: Configuring Servers with Virtualization – Adjusting and Tuning Virtual servers – VM Backup – VM Migration, Desktop Virtualization: Terminal services – Hosted Desktop – Web-based Solutions – Localized Virtual Desktops, Network and Storage Virtualization: Virtual Private Networks – Virtual LAN – SAN and VSAN – NAS.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Basics of virtualization and its importance.
- Analyse the concepts of Infrastructure of virtualization and their structure.
- Employ the concepts of storage virtualization, network virtualization and its management.
- Analyze the intricacies of server, storage and network virtualization.
- Design and develop applications on virtual machine platforms.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

2. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", McGraw-Hill Osborne Media, 2009. Unit (1), Unit(5)

REFERENCES:

1. Kenneth Hess, Amy Newman, "Practical Virtualization Solutions: Virtualization from the Trenches", Prentice Hall, 2010.

2. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

3. Kumar Reddy, Victor Moreno, "Network virtualization", Cisco Press, July, 2006.

4. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress 2005.

5. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	1	-	3	-	-	-	-	-	-	-	-	3	-	-
2	3	1	2	-	3	-	-	-	-	-	-	-	-	3	-	-
3	3	2	1	-	3	-	-	-	-	-	-	-	-	3	-	-
4	3	1	2	-	3	-	-	-	-	-	-	-	-	3	-	-
5	3	1	2	-	3	-	-	-	-	-	-	-	-	3	-	-
Average	3.0	1.4	1.6	-	3.0	-	-	-	-	-	-	-	-	3.0	-	-

PIT204   **CLOUD SERVICES AND MANAGEMENT**   **L T P C**

                                                                                3 0 0 3

OBJECTIVES:

- Introduce Cloud Service Management terminology, definition & concepts.
- Compare and contrast cloud service management with traditional IT service management.
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services.
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment.
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world Problems.

UNIT- I: CLOUD SERVICE MANAGEMENT FUNDAMENTALS   9

The Essential Characteristics, Cloud Service Models, Cloud Service Concumptions, Cloud Service Deployment Models, Cloud Ecosystem, Basics of Information Technology Service Management and Cloud Service Management, Cloud Reference Architecture.

UNIT- II: CLOUD SERVICES STRATEGY   9

Cloud Service Architecture,Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture.

UNIT- III: CLOUD SERVICE MANAGEMENT   9

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT- IV: CLOUD SERVICE ECONOMICS   9

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT- V: CLOUD SERVICE GOVERNANCE & VALUE   9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model

Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the key terminologies, definitions, and concepts related to Cloud Service Management.
- Understand the unique challenges, approaches, and considerations involved in managing cloud services compared to managing traditional IT services.
- Exhibit cloud-design skills to build and automate business solutions using cloud technologies.
- Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services.
- Solve the real world problems using Cloud services and technologies.

TEXT BOOKS:

1. Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era", Enel Publications 2020.
2. Thomas Erl, Ricardo Puttini, Zaigham Mohammad, "Cloud Computing: Concepts, Technology & Architecture", Pearson 2013.
3. Thomas Erl, Robert Cope, Amin Naserpour, "Cloud Computing Design Patterns", Prentice Hall Service Technology 2015.

REFERENCES:

1. Praveen Ayyappa, "Economics of Cloud Computing", LAP Lambert Academic Publishing 2020.
2. Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi, "Mastering Cloud Computing Foundations and Applications Programming", Morgan Kaufmann 2013.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	1	1	1	-	-	-	2	1	3	2	2	1	3	1
2	3	1	2	3	2	-	-	-	1	2	3	1	2	2	2	2
3	1	1	3	1	3	-	-	-	3	3	1	1	3	2	1	3
4	1	1	1	2	3	-	-	-	2	3	3	1	1	1	1	2
5	1	3	3	2	2	-	-	-	1	3	1	2	1	3	2	3
Average	1.8	1.8	2.0	1.8	2.2	-	-	-	1.8	2.4	2.2	1.4	1.8	1.8	1.8	2.2

PIT205   **SECURITY AND PRIVACY IN CLOUD**   **L T P C**

                                                      3 0 0 3

OBJECTIVES:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT- I: **FUNDAMENTALS OF CLOUD SECURITY CONCEPTS**   **9**

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT- II: **SECURITY DESIGN AND ARCHITECTURE FOR CLOUD**   **9**

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.

UNIT- III: **ACCESS CONTROL AND IDENTITY MANAGEMENT**   **9**

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.

UNIT- IV: **CLOUD SECURITY DESIGN PATTERNS**   **9**

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.

UNIT- V: **MONITORING, AUDITING AND MANAGEMENT**   **9**

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services,

Secure Management, User management, Identity management, Security Information and Event Management.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the cloud concepts and fundamentals.
- Explain the security challenges in the cloud.
- Define cloud policy and Identity and Access Management.
- Understand various risks and audit and monitoring mechanisms in the cloud.
- Define the various architectural and design considerations for security in the cloud.

TEXT BOOKS:

1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, "Cloud Computing:", Wiley 2013
2. Dave shackleford, "Virtualization Security", SYBEX a Wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011.

REFERENCES:

1. Mark C. Chu-Carroll —Code in the Cloud, CRC Press, 2011.
2. RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi, "Mastering Cloud Computing Foundations and Applications Programming", Elsevier 2013.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	2	-	-	-	-	-	-	-	2	-	-	-	2	-
2	-	2	2	1	2	-	-	-	-	-	-	2	2	-	-	1
3	-	2	2	2	-	-	-	-	-	-	-	2	-	2		1
4	2	-	-	2	-	-	1	-	-	1	2	-	-	-	1	-
5	3	-	2	2	2	-	-	-	-	1	-	-	2	-	1	-
Average	2.3	2.0	2.0	1.7	2.0	-	1.0	-	-	1.0	2.0	2.0	2.0	2.0	1.3	1.0

PIT206   **SOFTWARE DEFINED NETWORKING**   **L T P C**

                                                         3 0 0 3

OBJECTIVES:

- To understand the need for SDN and its data plane operations.
- To understand the functions of control plane.
- To comprehend the migration of networking functions to SDN environment.
- To explore various techniques of network function virtualization.
- To comprehend the concepts behind network virtualization.

UNIT- I: **SDN: INTRODUCTION**   **9**

Elements of Modern Networking - History of Software Defined Networking (SDN) – The SDN Approach – SDN architecture - Evolution of SDN - SDN Data Plane, Control plane and Application Plane – SDN Applications.

UNIT- II: **SDNSDN DATA PLANE AND CONTROL PLANE**   **9**

Data Plane functions and protocols – Open FLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, Open Daylight, ONOS - Distributed Controllers.

UNIT- III: **SDN APPLICATIONS**   **9**

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Cloud Data Scalability – Security – Data Center Networking – Mobile Virtual Machines.

UNIT- IV: **NETWORK FUNCTION VIRTUALIZATION**   **9**

Network Virtualization - Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks - NFV Concepts – Benefits and Requirements – OpenDaylight's Virtual Tenant Network – Software Defined Infrastructure.

UNIT- V: **NFV FUNCTIONALITY**   **9**

NFV Concepts – NFV Benefits and Requirements - NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV.

                                                    TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Describe the motivation behind SDN.

- Identify the functions of the data plane and control plane.
- Design and develop network applications using SDN.
- Orchestrate network services using NFV.
- Explain various use cases of SDN and NFV.

TEXT BOOKS:

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015.

REFERENCES:

1. Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
4. Paul Goransson, ChuckBlack Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
5. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2ndEdition, O'Reilly Media, 2017.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	3	1	3	-	-	-	2	3	1	3	1	2	1	-
2	2	1	2	2	3	-	-	-	2	2	2	2	1	3	2	-
3	2	2	2	3	3	-	-	-	3	1	1	2	1	3	3	-
4	2	2	2	3	1	-	-	-	1	3	1	2	2	2	2	-
5	3	3	1	1	3	-	-	-	1	2	1	2	2	1	3	-
Average	2.0	2.0	2.0	2.0	2.6	-	-	-	1.8	2.2	1.2	2.2	1.4	2.2	2.2	-

VERTICAL III: CYBER SECURITY AND DATA PRIVACY

PCY301   **MODERN CRYPTOGRAPHY**   **L T P C**

                                                              3 0 0 3

OBJECTIVES:

- To learn about Modern Cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudorandom permutation.
- To construct Basic cryptanalytic techniques.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT- I: **INTRODUCTION**   **9**

Basics of Symmetric Key Cryptography- Basics of Asymmetric Key Cryptography- Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI- Hard Core Predicate- Trap-door permutation- Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT- II: **FORMAL NOTIONS OF ATTACKS**   **9**

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA)- Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2)- Attacks under Message Non-malleability: NM-CPA and NM-CCA2- Inter-relations among the attack model.

UNIT- III: **RANDOM ORACLES**   **9**

Provable Security and asymmetric cryptography- hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction- Construction of more powerful PRG- Relation between One-way functions and PRG- Pseudo Random Functions (PRF).

UNIT- IV: **BUILDING A PSEUDORANDOM PERMUTATION**   **9**

The LubyRackoff Construction: Formal Definition- Application of the LubyRackoff Construction to the construction of Block Ciphers- The DES in the light of LubyRackoff Construction.

UNIT- V: **MESSAGE AUTHENTICATION CODES**   **9**

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs- Using a PRF as a MAC- Variable length MAC. Public Key Signature Schemes: Formal Definitions-

Signing and Verification- Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Interpret the basic principles of cryptography and general cryptanalysis.
- Determine the concepts of symmetric encryption and authentication.
- Identify the use of public key encryption, digital signatures, and key establishment.
- Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
- Express the use of Message Authentication Codes

TEXT BOOKS:

1. Jonathan Katz, Yehuda Lindell (2020). "Introduction to Modern Cryptography", 3rd Edition, Springer.
2. Prof. Dr. Hans Delfs and Helmut Knebl, "Introduction to Cryptography: Principles and Applications", Springer Verlag second edition 2007.
3. Wenbo Mao, "Modern Cryptography, Theory and Practice", Pearson Education (Low Priced Edition) 2003.

REFERENCES:

1. Sanjay Kumar, Dinesh Goyal (2019), "Modern Cryptography: Theory and Practice", 1st Edition, Wiley.
2. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI   sixth Edition, 2014.
3. Czesław Koscielny, Mirosław Kurkowski, "Modern Cryptography Primer Theoretical   Foundations and Practical Application", Springer 2013.
4. Shaffi Goldwasser and Mihir Bellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.(2004).

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	-	-	-	1	-	-	-	1	-	-	-	-	-	-
2	2	-	-	-	2	-	-	1	-	-	-	2	-	2	-	-
3	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-
4	-	-	2	-	1	-	2	-	-	-	2	-	3	-	2	-
5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
Average	2	2	2	2	1.5	1	2	1	2	1	2	2	3	2	1.5	2

PCY302   CRYPTO CURRENCY AND BLOCKCHAIN TECHNOLOGIES   L T P C

3 0 0 3

OBJECTIVES:

- To learn about Bit coin, Cryptocurrency.

- To understand the concepts of block chain

- To explore the concepts of Ethereum.

- To learn about Hyperledger Fabric model and its architecture.

- To integrate ideas from blockchain technology into projects.

UNIT- I: INTRODUCTION TO CRYPTOCURRENCY   9

Bitcoin – Digital keys and addresses: Private and public keys, Base58check encoding, vanity addresses – Transactions: transaction life cycle, transaction data structure, types of transactions – Mining – Bitcoin Network and Payments – Wallets - Bitcoin Payments.

UNIT- II: BITCOIN CLIENTS AND APIS   9

Bitcoin installation: Types of Bitcoin Core clients, setting up a Bitcoin node, source node, bitcoin.conf, settin up a node in testnet, regtest. Alternative coins – Theoretical Foundations - Bitcoin limitations – Name coin – Lite coin – Prime coin.

UNIT- III: INTRODUCTION TO BLOCK CHAIN AND ETHEREUM   9

Block Chain - History of Block Chain – Types of Block Chain – Consensus – CAP Theorem and Block Chain – Decentralization using Block Chai. Ethereum network – Components of the Ethereum ecosystem – Programming Languages – Ethereum Development Environment – Development Tools and Frameworks. Illustrative: Setup the Ethereum development environment.

UNIT- IV: WEB3 AND HYPERLEDGER   9

Introduction to Web3 – Contract Deployment – Development Frameworks – Hyperledger as a protocol – Reference Architecture – Hyperledger Fabric – Sawtooth Lake – Corda. Illustrative: Creating and deploying a business network on Hyperledger Composer Playground.

UNIT- V: BLOCK CHAIN APPLICATIONS   9

IoT with Block Chain – Block Chain based voting system - Border Control – Medical Record Management System - Alternative Blockchains – Kadena – Ripple – Rootstock – Quorum - Scalability – Privacy.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the functional /operational aspects of Cryptocurrency Ecosystem
- Understand the basic concepts of Block Chain Technologies.
- Develop application using Ethereum.
- Compute models for Block Chain Technology.
- Illustrate Blockchain with IoT and track the emerging trends in Blockchain.

TEXT BOOKS:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.

2. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.

REFERENCES:

1. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos, 1st Edition, 2018

2. Building Blockchain Projects by Narayan Prusty, 2017.

3. Mastering Bitcoin: Unlocking Digital Cryptocurrencies by Andreas M. Antonopoulos, 2015

WEB REFERENCES:

1. https://developer.ibm.com/technologies/blockchain/
2. https://www.edx.org/course/introduction-to-hyperledger-blockchain-technologie/
3. https://nptel.ac.in/courses/106104220/blockchain technology and applications/
4. https://blockgeeks.com/

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	-	-	-	1	-	-	-	1	-	-	-	-	-	-
2	2	-	2	-	2	-	-	1	-	-	-	2	-	2	-	-
3	-	-	-	-	-	-	-	-	2	2	-	-	-	-	1	-
4	1	-	2	-	1	-	2	-	-	-	2	-	3	-	2	-
5	-	3	-	2	-	-	-	2	-	-	-	-	-	-	-	2
Average	1.5	2.5	2	2	1.5	1	2	1.5	2	1.5	2	2	3	2	1.5	2

PCY303   ETHICAL HACKING   **L T P C**

                                                                         3 0 0 3

OBJECTIVES:

- Introduces the concepts of Ethical Hacking.
- Gives the students the opportunity to learn about different tools and techniques in Ethical hacking and security.
- Practically apply Ethical hacking tools to perform various activities.
- Understand the core concepts related to vulnerabilities and their causes.
- Study the challenges and limitations associated with hacking.

UNIT- I: INTRODUCTION   9

Ethical hacking process, Hackers behavior & mindset, Vulnerability versus Penetration test, Penetration Test. Categories of Penetration test–Black box–White box–Grey box–Types of Penetration Test.

UNIT- II: INFORMATION GATHERING TECHNIQUES   9

Active Information Gathering–Passive Information Gathering–Sources of Information Gathering– NeoTrace–Traceroute–ICMP Traceroute–TCP Traceroute–UDP Traceroute – WhatWeb – Netcraft– Interacting with DNS Servers.

UNIT- III: SNOOPING ATTACKS &PORT SCANNING TECHNIQUES   9

Enumerating SNMP–Problem with SNMP–Sniffing SNMP Passwords–SNMP Brute Force Tool– SMTP Enumeration–Types of Port Scanning– Anonymous Scan Types–OS Fingerprinting–Advanced Firewall/IDS Evading Techniques.

UNIT- IV: VULNERABILITY ASSESSMENT & NETWORK SNIFFING   9

Vulnerability Scanners–Vulnerability Assessment with Nmap–Nessus Vulnerability Scanner– Types of Sniffing–MITM Attacks–ARP Attacks–Using ARP Spoof to Perform MITM Attacks– Hijacking Session with MITM Attack–Sniffing Session Cookies with Wireshark.

UNIT- V: EXPLOITATION   9

Remote Exploitation–Attacking Network Remote Services–Overview of Brute Force Attacks– Common Target Protocols–Client Side Exploitation–Methods–Post exploitation–Escalating Privileges–Installing a Backdoor–MSFVenom–Cracking the Hashes–Rainbow Crack– Identifying and Exploiting Further Targets.

                                                          TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Apply the theory of data, information and knowledge as they pertain to Ethical Hacking.
- Understand ethics behind hacking and vulnerability disclosure.
- Appreciate the impact of hacking.
- Exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies.
- Exploit the challenges and limitations associated with hacking.

TEXT BOOKS:

1. Tushar Sharma (2019). "Ethical Hacking: A Hands-on Introduction to Breaking In", 1st Edition, Packt Publishing.
2. Baloch, R, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2015.

REFERENCES:

1. Rafay Baloch (2020), "Mastering Ethical Hacking", 1st Edition, Packt Publishing
2. Davidoff S and Ham J, "Network Forensics Tracking Hackers through Cyberspace", Prentice Hall, 2012.
3. McClure S, Scam bray J, and Kurtz G, "Hacking Exposed", Tata McGraw–Hill Education, 6TH Edition, 2009

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	3	-	3	-	-	2	-	-	-	-	-	2			-
2	3	2	-	-	3	-	-	2	-	-	-	-	-	3	2	-
3	3	2	-	-	2	-	-	2	-	-	2	-	3	-	-	1
4	2	-	-	1	3	-	-	-	-	1	2	-	-	3	2	3
5	1	3	2	1	2	-	-	-	2	2	3	1		2	3	1
Average	2.2	2.5	2.0	1.6	2.5	-	2.0	2.0	2.0	1.5	2.3	1.0	2.5	2.6	2.3	1.3

PCY304   SOCIAL ENGINEERING   **L T P C**

                                                                            3 0 0 3

OBJECTIVES:

- To understand the concept of Social Engineering attacks and related applications.
- To learn knowledge representation using Social Engineering.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.
- To understand the applications of Social Entrepreneurship.

UNIT- I: INTRODUCTION   9

Introduction to Social Engineering – Importance – Social Ethics – Vision & Mission towards Society- Individual Social Responsibility (ISR) UNSDGs- Relevance & impact of SDGs.

UNIT- II: PHYSICAL SOCIAL ENGINEERING   9

Real World Example of Collecting OSINT – Non technical OSINT – Tools of the Trade – Profiling People Through Communication: The Approach – Enter the DISC.

UNIT- III: SOCIAL MARKETING   9

Social Marketing-Marketing Mix-Process-Social Entrepreneurship-History-Impact-Types -Social Entrepreneurs-Social Enterprises-Social Business model canvas.

UNIT- IV: HACKING THE HUMANS   9

An Equal Opportunity Victimizer – The Principles of the Pentest – Phishing- Vishing- SMishing- Impersonation- Reporting – Legal implications of social engineering – Ethical behaviour and responsible use of knowledge.

UNIT- V: SOCIAL ENGINEERING ATTACKS   9

Social Engineering Attacks-Develop Actionable and Realistic Policies- Real-World Check-ups-Security Awareness Programs – Open source Intelligence (OSINT) – Online Research and Profiling – Data aggregation and correlation.

                                                            TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Develop web related applications and attacks.
- Represent knowledge using Social Engineering.
- Predict human behaviour in social web and related communities.
- Visualize social networks.

- Improve Social Security Awareness.

TEXT BOOKS:

1. Christopher Hadnagy, Social Engineering: The Art of Human Hacking, Wiley Publications, 2nd Edition, 2018.

REFERENCES:

1. Joe Navarro, "Social Engineering: A Guide to Manipulation and Influence", 1st Edition, 2019.
2. Christopher Hadnagy and Michele Fincher, "Phishing Dark Waters: The Offensive and Defensive Sides of Malicious Emails", Wiley Publications, 1st Edition, 2015.
3. Kevin D. Mitnick and William L. Simo, "The Art of Deception: Controlling the Human Element of Security", Wiley Publications, 1st Edition, 2007.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
2	-	2	2	1	2	-	-	-	-	-	-	2	2	-	-	1
3	-	2	2	2	-	-	-	-	-	-	-	2	-	2	-	1
4	2	-	-	2	-	-	1	-	-	1	2	-	-	-	1	-
5	3	-	2	2	2	-	-	-	-	1	-	-	2	-	1	-
Average	2.3	2.0	2.0	1.7	2.0	-	1.0	-	-	1.0	2.0	2.0	2.0	2.0	1.3	1.0

PCY305   BIG DATA SECURITY   **L T P C**

                                              3 0 0 3

OBJECTIVES:

- To learn tips and tricks for Big Data use cases and solutions.
- To learn about reliable, scalable, distributed systems with Apache Hadoop.
- To explore the concepts of Hadoop Architecture.
- To apply Hadoop ecosystem components.
- To understand the concepts of Hive, HBase and HIVEQL.

UNIT- I: INTRODUCTION TO BIG DATA   **9**

Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, big data analytics, big data applications. Algorithms using map reduce, Matrix- Vector Multiplication by Map Reduce.

UNIT- II: INTRODUCTION TO HADOOP   **9**

Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

UNIT- III: HADOOP ARCHITECTURE   **9**

Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write andRead., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering – Monitoring & Maintenance.

UNIT- IV: HADOOP ECOSYSTEM AND YARN   **9**

Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

UNIT- V: SECURITY AND STORING SYSTEM   **9**

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the fundamental concepts of Big Data and Big Data Analytics with its
- Identify about the Hadoop Framework and the Map Reduce procedure
- Illustrate the operational aspects of Hadoop Distributed File System and examine the process of MapReduce paradigm
- Demonstrate the different versions of Map Reduce model to process the big data along with Hadoop tools.
- Apply tools like HIVE, HIVEQL and HBase on real time applications and build applications using Zookeeper.

TEXT BOOKS:

1. Vangelis K. Iliadis, Rania Kora, and Konstantinos G. Vamvoudakis (2019). Big Data Security and Privacy, 1st Edition, Springer.
2. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
3. Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill, 2012.
4. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packet Publishing 2013.

REFERENCES:

1. Kennesaw State University, Big Data Security and Privacy Group (2018). Privacy and Security in Big Data, 1st Edition, Springer.
2. Tom White, "HADOOP: The definitive Guide", O Reilly 2012.
3. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
4. Jy Liebowitz, "Big Data and Business analytics", CRC press, 2013.

WEB REFERENCES

1. http://www.bigdatauniversity.com/

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	1	-	-	1	-	-	-	3	-	-	-	-	-	-
2	2	-	-	-	2	-	-	3	-	-	-	2	-	2	-	-
3	-	2	-	-	-	-	-	-	2	-	-	-	-	-	1	-
4	-	-	2	-	1	-	2	-	-	-	2	-	3	-	-	-
5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
Average	2.0	2.0	1.5	2.0	1.5	1.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	2.0	1.0	2.0

PCY306   DATA PRIVACY   L T P C

                                                                      3 0 0 3

OBJECTIVES:

- To understand basics of Data Privacy.
- To understand the sets of standards and safeguards.
- To understand the Privacy Regulations.
- To understand the Data classifications.
- To understand necessary Approaches and Techniques to build protection mechanisms in order to secure data.

UNIT- I: PRIVACY, DATA AND YOUR BUSINESS   9

Introduction to Privacy Engineering and Its Importance -Understanding the Need for Privacy Engineering in Modern Business -Scaling Privacy Engineering-Managing and Protecting Data Flows-Adopting a Privacy - Navigating Privacy Regulations and Ensuring Compliance- Leveraging Privacy Technologies and Tools for Data Protection.

UNIT- II: UNDERSTANDING DATA AND PRIVACY   9

Privacy and What It Entails: An Overview- Privacy, Data Systems, and Policy Enforcement- Integrating Privacy into Business Growth Strategies- Case Studies: Privacy Violations – Equifax, OPM - Privacy and the Regulatory Landscape: Key Considerations - The Impact of Regulations on Products and Users.

UNIT- III: DATA CLASSIFICATION   9

Data Classification and Context- Necessity of Data Classification- Data Classification in Governance- Industry Benchmarks for Classification- Unstructured Data Governance- Improving with Data Classification- Data Classification and Access- Privacy Laws and Classification- Collaborating on Data Classification.

UNIT- IV: DATA INVENTORY   9

Data inventory - Data inventory tags, Machine-readable tags: A specific example - Creating a baseline - The technical architecture, Structured and unstructured data - Data inventory architectural capabilities, Data inventory workflow - metadata definition process - The metadata discovery process- Data inventory level 1, level 2, level 3.

UNIT- V: DATA SHARING   9

The Need for Data Sharing in Business- Ensuring Safe Data Sharing Through Security Measures- Obfuscation Techniques to Protect Privacy- Techniques for Safe Data Sharing- Data Anonymization and Universal ID Mapping- Use Case 1: Single Session per

Dataset- Measuring Privacy Impact with K-Anonymity and L-Diversity- Privacy and Data Protection Impact Assessments (PIA & DPIA).

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Develop advanced theoretical or practical research skills in the area of privacy.
- Students will make original research contributions.
- Become familiar with the basics of privacy.
- Understand how privacy is formalized.
- Understand the common data privacy techniques.

TEXT BOOKS:

1. Gerardus Blokdyk, "Data Privacy and Security: A Complete Guide", First Edition, 5STARCooks, 2024.
2. Katharine Jarmul, "Practical Data Privacy", First Edition, O'Reilly Media,2023.

REFERENCES:

1. Shikha Ahuja, "Data Privacy and Protection", First Edition, Wiley India, 2024.
2. Nishant Bhajaria, "Data Privacy: A Runbook for Engineers", 1st Edition, Manning Publications, 2022

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2		2	-	-	-	-	-	-	-	2	-	-	-	2	-
2	-	2	2	1	2	-	-	-	-	-	-	2	2	-	-	1
3	-	3	2	2	-	-	-	-	-	-	-	2	-	3	-	1
4	2	-	-	1	-	-	1	-	-	1	3	-	-	-	1	-
5	3	-	2	2	2	-	-	-	-	2	-	-	2	-	1	-
Average	2.3	2.5	2.0	1.5	2.0	-	1.0	-	-	1.5	2.5	2.0	2.0	3.0	1.3	1.0

PIT401   MULTIMEDIA DATA COMPRESSION AND STORAGE   L T P C

3 0 0 3

OBJECTIVES:

- To understand the basics of compression techniques.
- To understand the categories of compression for text, image and video.
- To explore the modalities of text, image and video compression algorithms.
- To know about basics of consistency of data availability in storage devices.
- To understand the concepts of data streaming services

UNIT- I: BASICS OF DATA COMPRESSION   9

Introduction —Lossless and Lossy Compression– Basics of Huffmann coding- Arithmetic coding Dictionary techniques- Context based compression.

UNIT- II: IMAGE COMPRESSION   9

Lossless Image compression – JPEG-CALIC-JPEG LS-P – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding.

UNIT- III: VIDEO COMPRESSION   9

Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1-MPEG-2- H.263.

UNIT- IV: DATA PLACEMENT ON DISKS   9

Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system.

UNIT- V: DISK SCHEDULING METHODS   9

Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the basics of text, Image and Video compression.
- Understand the various compression algorithms for multimedia content.

- Explore the applications of various compression techniques.
- Explore knowledge on multimedia storage on disks.
- Understand scheduling methods for request streams

TEXT BOOKS:

1. Khalid Sayood, "Introduction to Data Compression", Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition. (UNIT-I, II, III).
2. Philip K. C. Tse, "Multimedia Information Storage and Retrieval: Techniques and Technologies", 2008 (UNIT IV, V).

REFERENCES:

1. Yun-Qing Shi, "Image and Video Compression for Multimedia Engineering Fundamentals Algorithms and Standards", Taylor& Francis,2021.
2. Lenald Best, "Best's Guide to Live Stream Video Broadcasting", BCB Live Teaching series, 2017.
3. David Salomon, A concise introduction to data compression, 2008.
4. Irina Bocharova, "Compression for Multimedia", Cambridge University Press; 1st edition,2009.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2	-
2	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2	-
3	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2	-
4	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2	-
5	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2	-
Average	3.0	2.0	2.0	2.0	1.4	-	-	-	-	-	-	-	2.0	2.0	2.0	-

PIT402   VIDEO CREATION AND EDITING   L T P C

                                                                          3 0 0 3

OBJECTIVES:

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording.
- To apply different media tools to add and edit.
- To learn and understand the concepts of AVID XPRESS DV 4.

UNIT- I: FUNDAMENTALS   9

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression – risks associated with altering reality through editing.

UNIT- II: STORYTELLING   9

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions -mechanics of digital editing - pointer files - media management.

UNIT- III: USING AUDIO AND VIDEO   9

Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.

UNIT- IV: WORKING WITH FINAL CUT PRO   9

Working with clips and the Viewer - working with sequences, the Timeline, and the canvas – Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques -Working with Audio - Using Media Tools - Viewing and Setting Preferences.

UNIT- V: WORKING WITH AVID XPRESS DV 4   9

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording -Importing Files - Organizing with Bins - Viewing and Making Footage -Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

                                                            TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Compare the strengths and limitations of Nonlinear editing.
- Identify the infrastructure and significance of storytelling.
- Apply suitable methods for recording to CDs and VCDs.

- Address the core issues of advanced editing and training techniques.
- Design and develop projects using AVID XPRESS DV 4.

TEXT BOOKS:

1. Robert M. Goodman and Partick McGarth, "Editing Digital Video: The Complete Creative and Technical Guide", Digital Video and Audio, McGraw – Hill 2003.
2. Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.

REFERENCES:

1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	3	1	2	1	1	-	-	-	1	2	3	2	3	1	1
2	2	2	3	3	3	1	-	-	-	1	2	2	1	1	1	1
3	3	2	2	3	3	1	-	-	-	3	1	1	1	2	1	2
4	3	2	2	2	2	1	-	-	-	3	1	1	1	2	2	2
5	3	2	1	3	3	1	-	-	-	3	2	1	2	2	2	1
Average	2.4	2.2	1.8	2.6	2.4	1	-	-	-	2.2	1.6	1.6	1.4	2	1.4	1.4

PIT403   MULTIMEDIA AND ANIMATION   L T P C

3 0 0 3

OBJECTIVES:

- To grasp the fundamental knowledge of Multimedia elements and systems
- To get familiar with Multimedia file formats and standards
- To learn the process of Authoring multimedia presentations
- To learn the techniques of animation in 2D and 3D and for the mobile UI
- To explore different popular applications of multimedia

UNIT- I: INTRODUCTION TO MULTIMEDIA   9

Definitions, Elements, Multimedia Hardware and Software, distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning.

UNIT- II: MULTIMEDIA FILE FORMATS AND STANDARDS   9

File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web.

UNIT- III: MULTIMEDIA AUTHORING   9

Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image and Audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulation.

UNIT- IV: ANIMATION   9

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Key frame, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.

UNIT- V: MULTIMEDIA APPLICATIONS   9

Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, online social networking, multimedia ontology, Content based retrieval from digital libraries.

OUTCOMES:

At the end of this course, the students will be able to:

- Get the bigger picture of the context of Multimedia and its applications.
- Use the different types of media elements of different formats on content pages.
- Author 2D and 3D creative and interactive presentations for different target multimedia applications.
- Use different standard animation techniques for 2D, 21/2 D, 3D applications.
- Understand the complexity of multimedia applications in the context of cloud, security, bigdata streaming, social networking, CBIR etc.

TEXT BOOKS:

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)
2. Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles River Media, 2006.

REFERENCES:

1. John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016.
2. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018.
3. Prabhat K.Andleigh, Kiran Thakrar, "Multimedia System Design", Pearson Education, 1 st Edition, 2015.
4. Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.
5. Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	2	3	-	-	-	3	2	1	2	3	2	3	-
2	3	3	3	3	3	-	-	-	3	3	2	2	3	2	3	-
3	3	3	3	3	3	-	-	-	3	3	2	3	3	2	3	-
4	3	3	3	3	3	2	-	-	3	3	3	3	3	3	3	-
5	3	3	3	3	3	2	-	-	3	3	3	3	3	3	3	-
Average	3	2.8	3	2.8	3	2	-	-	3	2.8	2.2	2.6	3	2.4	3	-

PIT404   AUGMENTED REALITY AND VIRTUAL REALITY   L T P C

                                                              3 0 0 3

OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in developing AR/VR-enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in developing AR/VR-based applications.

UNIT- I: AUGMENTED REALITY   9

Introduction to Augmented Reality - Examples and Related Fields - Displays - Multimodal Displays - Visual Perception - Spatial Display Model - Visual Displays - Tracking, Calibration, and Registration - Coordinate Systems - Characteristics of Tracking Technology - Stationary Tracking Systems - Mobile Sensors - Optical Tracking - Sensor Fusion.

UNIT- II: AUGMENTED REALITY IN COMPUTER VISION   9

Computer Vision for AR-Interaction - Visual Coherence - Modelling and Annotation – Navigation - Wearable devices.

UNIT- III: VR MODELING   9

The Three I's Of Virtual Reality - Virtual Reality in the 21st Century - Components of Classical and Modern Virtual Reality Systems - Input Devices: Trackers, Navigation, Gesture and Neural Interfaces - Output Devices: Graphics Displays - Display Technologies - Personal Graphics Displays - Three-Dimensional Sound Displays - Haptic Displays - Computing Architectures for VR - Gaming Desktop Architectures - Graphics Benchmarks - Distributed VR Architectures - Geometric Modeling - Kinematics Modeling - Physical Modeling - Behavior Modeling - Model Management.

UNIT- IV: VR PROGRAMMING   9

VR Programming – Scene Graphs and Toolkits - Java3d - The Vizard Toolkit - The Open haptics Toolkit - Unity 3d Game Engine.

UNIT- V: VR APPLICATIONS   9

Human Factors in VR - Methodology and Technology - User Performance Studies - Health and Safety Issues in Virtual Environments - Societal Implications of Virtual Reality -

Medical Applications of Virtual Reality - Virtual Reality in Education, Arts and Entertainment - Military Virtual Reality Applications.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the basic concepts of AR and VR.
- Understand the tools and technologies related to AR/VR.
- Know the working principle of AR/VR related Sensor devices.
- Design of various models using modelling techniques.
- Develop AR/VR applications in different domains.

TEXT BOOKS:

1. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", AddisonWesley, 2016. (Unit-1 & 2).
2. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", 3rd Edition, ISBN: 978-1-118-01480-6, 2024, Wiley-IEEE Press (Unit 3 - 5).

REFERENCES:

1. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018.
2. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2018.
3. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2	-
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2	-
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2	-
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2	-
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	-
Average	3.0	2.6	2.4	2.0	3.0	-	-	-	2.8	2.2	1.8	2.6	2.8	1.8	2.2	-

PIT405   GAME DEVELOPMENT   **L T P C**

                                                                             3 0 0 3

OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment.

UNIT- I: 3D GRAPHICS FOR GAME DESIGN   9

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT- II: GAME DESIGN PRINCIPLES   9

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT- III: GAME ENGINE DESIGN   9

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection.

UNIT- IV: OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS   9

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and multi-Player games.

UNIT- V: GAME DEVELOPMENT USING PYGAME   9

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.

                                                              TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the concepts of 2D and 3d Graphics
- Design game design documents.
- Implementation of gaming engines.

- Survey gaming environments and frameworks.
- Implement a simple game in Pygame.

TEXT BOOKS:

1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley,2013. (Unit 1)

2. Ernest Adams, Joris Dormans, "Game Mechanics: Advanced Game Design", New Riders, 2012. (Unit 2).

3. Jason Gregory, "Game Engine Architecture", 3rd Edition, CRC Press, 2018. (Unit 3 & 4).

4. Paul Craven, "Python Arcade games", Apress Publishers,2016. (Unit 5).

REFERENCES:

1. Wouter Van Toll, Arjan Egges, Jeroen D. Fokker, "Learning C# by Programming Games" Springer, 2019.

2. Morgan Sandler, "Visual Storytelling: How to speak to the Audience Without Saying a Word", Michael Wiese Productions, 2018.

3. Chris Solarski, "Interactive Stories and Video Game Art: A Storytelling Framework for Game Design", CRC Press, 2017.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2	-
2	1	2	2	1	2	-	-	-	-	-	-	-	2	2	1	-
3	1	1	1	2	1	-	-	-	-	-	-	-	2	2	2	-
4	3	3	1	3	3	-	-	-	-	-	-	-	2	2	3	-
5	3	3	2	1	3	-	-	-	-	-	-	-	2	2	3	-
Average	2.2	2.2	1.6	1.6	2.2	-	-	-	-	-	-	-	2	2	2.2	-

PIT406   DIGITAL MARKETING   L T P C

3 0 0 3

OBJECTIVES:

- To investigate and discuss the role and importance of digital marketing in today's quickly changing business environment.
- To be able to equip students with the ability to understand and subsequently create strategic and targeted campaigns using digital media tools.
- To investigate and discuss the role and importance of digital marketing in today's quickly changing business environment.
- To connect with digital platforms like Instagram, Youtube, Facebook, Twitter, and many others in order to accomplish corporate goals.
- To familiarize students with the concept of digital marketing and its current and future evolutions.

UNIT- I: INTRODUCTION TO ONLINE MARKET   9

Online Marketing- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Setup - Content Marketing.

UNIT- II: SEARCH ENGINE OPTIMISATION   9

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors - On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement.

UNIT- III: E- MAIL MARKETING   9

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation – Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness - Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns- Profiling and targeting using Online Tools.

UNIT- IV: SOCIAL MEDIA MARKETING   9

Social Media Marketing - Plans- Publishing Blogs-Microblogging- Engagement Marketing- Building Customer relationships – Location Marketing - Marketing plan.

UNIT- V: DIGITAL TRANSFORMATION   9

Online Branding-Digital Ecosystem - Market Influence Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- The Future of Marketing.

OUTCOMES:

At the end of this course, the students will be able to:

- To examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- To focus on how digital marketing can be utilized by organizations and how its effectiveness can be measured.
- To know the key elements of a digital marketing strategy.
- To study how the effectiveness of a digital marketing campaign can be measured
- To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

TEXT BOOKS:

1. Puneet Singh Bhatia, "Fundamentals of Digital Marketing", Pearson Education, 2023. (Unit I to V)
2. Damian Ryan, Calvin Jones, "Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation", Kogan Page Limited, 2008.
3. Vandana Ahuja, "Digital Marketing", Oxford University Press, 2015.
4. Philip Kotler, "Marketing 4.0: Moving from Traditional to Digital", Wiley; 1st edition, 2017.

REFERENCES:

1. Barker, Barker, Bormann and Neher, "Social Media Marketing: A Strategic Approach", 2E South-Western,Cengage Learning, 2017.
2. Pulizzi J, "Beginner's Guide to Digital Marketing", Mcgraw Hill Education.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	1	3	-	-	-	1	1	3	3	3	3	-	-
2	2	2	2	1	3	-	-	-	1	1	2	2	2	3	-	-
3	1	1	1	2	1	-	-	-	1	1	1	1	1	1	-	-
4	3	2	2	3	2	-	-	-	1	1	2	3	3	1	-	-
5	1	2	2	3	1	-	-	-	1	1	1	1	1	2	-	-
Average	2	2	2	2	2	-	-	-	1	1	1.8	2	2	2	-	-

VERTICAL V: COMPUTATIONAL INTELLIGENCE

PCS501   KNOWLEDGE ENGINEERING   **L T P C**
                                                                       3 0 0 3

OBJECTIVES:

- To understand the basics of Knowledge Engineering.
- To discuss methodologies and modeling for Agent Design and Development.
- To design and develop ontologies.
- To apply reasoning with ontologies and rules.
- To understand learning and rule learning.

UNIT- I: REASONING UNDER UNCERTAINTY   9

Introduction - Abductive reasoning - Probabilistic reasoning: Enumerative Probabilities - Subjective Bayesian view - Belief Functions - Baconian Probability - Fuzzy Probability - Uncertainty methods - Evidence-based reasoning - Intelligent Agent - Mixed-Initiative Reasoning - Knowledge Engineering

UNIT- II: METHODOLOGY AND MODELING   9

Conventional Design and Development - Development tools and Reusable Ontologies - Agent Design and Development using Learning Technology - Problem Solving through Analysis and Synthesis - Inquiry-driven Analysis and Synthesis - Evidence-based Assessment - Believability Assessment - Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT- III: ONTOLOGIES - DESIGN AND DEVELOPMENT   9

Concepts and Instances - Generalization Hierarchies - Object Features - Defining Features - Representation - Transitivity - Inheritance - Concepts as Feature Values - Ontology Matching. Design and Development Methodologies - Steps in Ontology Development - Domain Understanding and Concept Elicitation - Modelling-based Ontology Specification.

UNIT- IV: REASONIING WITH ONTOLOGIES AND RULES   9

Production System Architecture - Complex Ontology-based Concepts - Reduction and Synthesis rules and the Inference Engine - Evidence-based hypothesis analysis - Rule and Ontology Matching - Partially Learned Knowledge - Reasoning with Partially Learned Knowledge

UNIT- V: LEARNING AND RULE BASED LEARNING   9

Machine Learning - Concepts - Generalization and Specialization Rules - Types - Formal definition of Generalization. Modelling, Learning and Problem solving - Rule learning and Refinement - Overview - Rule Generation and Analysis - Hypothesis Learning.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the basics of Knowledge Engineering.
- Apply methodologies and modelling for Agent Design and Development.
- Understand Design and develop ontologies.
- Apply reasoning with ontologies and rules.
- Understand learning and rule learning.

TEXT BOOKS:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 - Chapter 1 / Unit 2 - Chapter 3, 4 / Unit 3 - Chapter 5, 6 / Unit 4 – Chapter 7, Unit 5 - Chapter 8, 9).

REFERENCES:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4. King, Knowledge Management and Organizational Learning, Springer, 2009.
5. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition, 2001.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	1	1	1	-	-	1	2	1	2	1	1	1	3
2	3	2	3	2	2	-	-	-	2	1	2	1	3	3	1	3
3	2	2	3	2	2	-	-	-	3	2	2	2	3	2	3	2
4	2	2	3	1	1	-	-	-	2	2	2	2	2	1	1	2
5	2	2	2	1	1	-	-	-	2	1	1	1	2	1	1	2
Average	2.4	1.8	2.4	1.4	1.4	1.0	-	-	2.0	1.6	1.6	1.6	2.2	1.6	1.4	2.4

PCS502   SOFT COMPUTING   **L T P C**

                                                                 3 0 0 3

OBJECTIVES:

- To understand the concepts of feed forward &feedback neural networks.
- To recognize the concept of fuzziness involved in various systems.
- To expose the ideas about genetic algorithm.
- To compare about FLC and NN toolbox.
- To design algorithm for optimization problem.

UNIT- I: INTRODUCTION OF SOFT COMPUTING   9

Introduction of soft computing - soft computing vs. hard computing - various types of soft computing techniques - applications of soft computing - Neuron-Nerve structure and synapse - Artificial Neuron and its model - activation functions - Neural network architecture - single layer and multilayer feed forward networks - McCullochPitts neuron model - perceptron model - MLP- back propagation learning methods.

UNIT- II: COUNTER PROPAGATION NETWORK AND   9
**   ASSOCIATIVE MEMORY**

Counter propagation network - architecture - functioning & characteristics of counter - Propagation network - Hopfield/Recurrent network - configuration - stability constraints - associative memory- characteristics - limitations and applications - Hopfield v/s Boltzman machine - Adaptive Resonance Theory - Architecture - classifications - Implementation and training - Associative Memory.

UNIT- III: FUZZY SYSTEMS   9

Different faces of imprecision - inexactness - Ambiguity - Undecidability - Fuzziness and certainty- Fuzzy sets and crisp sets - Intersections of Fuzzy sets - Union of Fuzzy sets - the complement of Fuzzy sets - Fuzzy reasoning - Linguistic variables - Fuzzy propositions - Fuzzy compositional rules of inference - Methods of decompositions and defuzzification

UNIT- IV: GENETIC ALGORITHM   9

Basic concept of Genetic algorithm and detail algorithmic steps - adjustment of free Parameters- Solution of typical control problems using genetic algorithm - Concept on some other search techniques like Tabu search and ant colony - search techniques for solving optimization problems.

GA application to optimization problems - Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB - Neural Network toolbox - Stability analysis of Neural Network interconnection systems - Implementation of fuzzy logic controller using MATLAB fuzzy logic toolbox - Stability analysis of fuzzy control systems.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Comprehend machine learning and soft computing techniques in solving real world applications.
- Design and develop ML techniques with assistance of MATLAB.
- Visualize and analyze behavioral pattern to develop evolutionary algorithm.
- Use MATLAB toolbox.
- Design Algorithm for classification Problems.

TEXT BOOKS:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley India, 2012.
2. Zimmermann H. J., "Fuzzy Set Theory and its Applications", Springer International Edition, 2013.

REFERENCES:

1. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
2. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms, and Applications", First Edition, Pearson Education, 1993.
3. W. T. Miller, R. S. Sutton, P. J. Webros, "Neural Networks for Control", MIT Press, 1996.
4. Herniter, Marc E., "Programming in MATLAB", Brooks/Cole-Thomson Learning, 2001.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	-	3	-	-	2	2	3	2	-	2	-	-	-
2	-	-	-	-	3	-	-	2	3	3	2	-	-	2	-	-
3	2	-	-	-	-	-	-	2	2	-	2	-	-	-	2	-
4	-	2	2	-	-	2	-	-	-	-	2	-	-	2	-	-
5	-	2	3	2	-	3	-	-	-	-	2	-	-	-	1	-
Average	2.0	2.0	2.5	2.0	3.0	2.5	-	2.0	2.3	3.0	2.0	-	2.0	2.0	1.5	-

PCS503   COGNITIVE SCIENCE   **L T P C**

                                                                     3 0 0 3

OBJECTIVES:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition.

UNIT- I: PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE   9

Philosophy: Mental-physical Relation - From Materialism to Mental Science - Logic and the Sciences of the Mind - Psychology: Place of Psychology within Cognitive Science - Science of Information Processing -Cognitive Neuroscience - Perception - Decision - Learning and Memory - Language Understanding and Processing.

UNIT- II: COMPUTATIONAL INTELLIGENCE   9

Machines and Cognition - Artificial Intelligence - Architectures of Cognition - Knowledge Based Systems - Logical Representation and Reasoning - Logical Decision Making - Learning - Language – Vision.

UNIT- III: PROBABILISTIC PROGRAMMING LANGUAGE   9

WebPPL Language - Syntax - Using Javascript Libraries - Manipulating probability types and distributions - Finding Inference - Exploring random computation - Coroutines: Functions that receive continuations –Enumeration.

UNIT- IV: INFERENCE MODELS OF COGNITION   9

Generative Models - Conditioning - Causal and statistical dependence - Conditional dependence - Data Analysis - Algorithms for Inference.

UNIT- V: LEARNING MODELS OF COGNITION   9

Learning as Conditional Inference - Learning with a Language of Thought - Hierarchical Models- Learning (Deep) Continuous Functions - Mixture Models.

                                                       TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the underlying theory behind cognition.
- Connect to the cognition elements computationally.
- Implement mathematical functions through WebPPL.

- Develop applications using cognitive inference model.
- Develop applications using cognitive learning model.

TEXT BOOKS:

1. Vijay V Raghavan, Venkat N. Gudivada, Venu Govindaraju, C.R. Rao, "Cognitive Computing: Theory and Applications (Handbook of Statistics 35)", Elsevier publications, 2016
2. Jose Luis Bermúdez, "Cognitive Science -An Introduction to the Science of the Mind", Cambridge University Press 2020

REFERENCES:

1. Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	3	2	2	-	-	-	1	1	2	2	1	2	2	3
2	2	2	1	1	2	-	-	-	3	2	3	1	2	3	2	2
3	1	3	1	3	3	-	-	-	1	3	1	3	3	1	2	1
4	2	1	1	2	3	-	-	-	1	2	3	1	3	3	1	2
5	1	2	3	2	2	-	-	-	1	2	2	2	2	2	1	1
Average	1.8	1.8	1.8	2.0	2.4	-	-	-	1.4	2.0	2.2	1.8	2.2	2.2	1.6	1.8

PCS504   OPTIMIZATION TECHNIQUES   **L T P C**

                                                                      3 0 0 3

OBJECTIVES:

- Formulate and solve linear programming problems (LPP)
- Evaluate Integer Programming Problems, Transportation and Assignment Problems.
- Obtain a solution to network problems using CPM and PERT techniques.
- Able to optimize the function subject to the constraints.
- Identify and solve problems under Markovian queuing models.

UNIT- I: LINEAR MODELS   9

Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to Solve LPP- Simplex Method- Two-Phase method.

UNIT- II: INTEGER PROGRAMMING AND TRANSPORTATION   9

**   PROBLEMS**

Integer programming: Branch and bound method- Transportation and Assignment problems- Traveling salesman problem.

UNIT- III: PROJECT SCHEDULING   9

Project network -Diagram representation - Floats - Critical path method (CPM) - PERT Cost considerations in PERT and CPM.

UNIT- IV: CLASSICAL OPTIMIZATION THEORY   9

Unconstrained problems - necessary and sufficient conditions - Newton-Raphson method, constrained problems - equality constraints - inequality constraints - Kuhn-Tucker conditions.

UNIT- V: QUEUING MODELS   9

Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels.

                                                              TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Formulate and solve linear programming problems (LPP).
- Evaluate Integer Programming Problems, Transportation and Assignment Problems.

- Obtain a solution to network problems using CPM and PERT techniques.

- Able to optimize the function subject to the constraints.

- Identify and solve problems under Markovian queuing models.

TEXT BOOKS:

1. Vikrant Sharma, Vinod Kumar Jain, Atul Kumar, "An Introduction to Optimization Techniques", CRC Press, 2021.

2. Sukanta Nayak, "Fundamentals of Optimization Techniques with Algorithms", Elsevier Science, 2020.

3. Hamdy A Taha, "Operations Research: An Introduction", Pearson, 10th Edition, 2019.

REFERENCES:

1. Peter Dunn, Gordon Smyth, "Generalized Linear Models With Examples in R", 2018.

2. Kenneth Baker, Dan Trietsch, "Principles of Sequencing and Scheduling", 2018.

3. Hiller F.S, Liberman G.J, "Introduction to Operations Research", 10th Edition McGraw Hill, 2017.

4. J. Chris White, Robert M. Sholtes, "The Dynamic Progress Method", 2016.

5. Mario Vanhoucke, "Project Management with Dynamic Scheduling", 2013.

6. Christian Artigues, Sophie Demassey, Emmanuel Neron, "Resource-Constrained Project Scheduling", 2013.

7. J. K. Sharma, "Operations Research Theory and Applications", Macmillan, 5th Edition, 2012.

8. ND Vohra, "Quantitative Techniques in Management", Tata McGraw Hill, 4th Edition, 2011.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	1	1	-	-	-	2	1	1	2	3	3	3	3
2	3	1	2	2	3	-	-	-	3	2	3	1	2	1	1	3
3	2	3	3	2	2	-	-	-	3	3	1	3	1	3	1	2
4	2	2	1	1	3	-	-	-	2	1	3	1	2	1	2	2
5	2	1	1	3	2	-	-	-	3	3	1	3	3	2	1	2
Average	2.4	2.0	1.8	1.8	2.2	-	-	-	2.6	2.0	1.8	2.0	2.2	2.0	1.6	2.4

PCS505   COMPUTER VISION   **L T P C**

                                                                         3 0 0 3

OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection.
- To become familiar with feature based alignment and motion estimation.
- To develop skills on 3D reconstruction.
- To understand image based rendering and recognition.

UNIT- I: INTRODUCTION TO IMAGE FORMATION AND PROCESSING   9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms- Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT- II: FEATURE DETECTION, MATCHING AND SEGMENTATION   9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods

UNIT- III: FEATURE-BASED ALIGNMENT & MOTION ESTIMATION   9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation- Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT- IV: 3D RECONSTRUCTION   9

Shape from X - Active range finding - Surface representations - Point-based representations, volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT- V: IMAGE-BASED RENDERING AND RECOGNITION   9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

                                                                         TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- To understand basic knowledge, theories and methods in image processing and computer vision.
- To implement basic and some advanced image processing techniques in OpenCV.
- To apply 2D a feature-based based image alignment, segmentation and motion estimations.
- To apply 3D image reconstruction techniques.
- To design and develop innovative image processing and computer vision applications

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Texts in Computer Science, Second Edition, 2022.
2. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, Second Edition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	1	1	-	-	-	2	1	3	2	2	1	1	-
2	3	3	3	2	2	-	1	-	2	1	2	2	3	1	2	-
3	3	3	2	2	2	-	-	-	1	1	2	2	3	2	2	-
4	2	3	3	2	2	-	-	-	3	1	2	3	2	2	3	-
5	2	3	3	2	3	2	-	-	2	1	2	3	2	2	3	-
Average	2.6	2.6	2.4	1.8	2.0	2.0	1.0	-	2.0	1.0	2.2	2.4	2.4	1.6	2.2	-

PCS506   COMPUTATIONAL LINGUSTICS   L T P C

3 0 0 3

OBJECTIVES:

- To understand the fundamental of Computational Lingustics
- To Develop Proficiency in Python for Language Processing
- To Explore Formal Language Theory and Linguistic Components
- To Utilize NLP Tools and Language Resources Effectively.
- To Apply Computational Techniques to Real-world Language Applications.

UNIT- I: INTRODUCTION AND TAMIL GRAMMAR   9

Introduction to Computational Linguistics-Ambiguity and uncertainty in language-Grammars and Parsing-Alphabets: Classification & Properties - Words: classification and components - Sentences: Structures and word ordering.

UNIT- II: PROGRAMMING IN PYTHON   9

Python introduction-Variables, numbers, strings, arrays, dictionaries, conditionals, iteration-The NLTK (Natural Language Toolkit).Object Oriented Tamil Computing - Tamil text processing using Open-Tamil python library.

UNIT- III: REGULAR EXPRESSIONS & COMPUTATIONAL LINGUISTICS   9

Chomsky hierarchy-Regular languages-and their limitations-Finite-state automata-Phonology - Phonology computing - lexicography - syntax - semantics - pragmatics, Languages for specific purpose & disconise computing.

UNIT- IV: COMPUTING TOOLS & RESOURCES   9

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Probabilistic language modeling and its applications-Markov models- N-grams

UNIT- V: COMPUTING APPLICATIONS   9

Machine Translation - Speech: Synthesis & Processing - Information: retrieval & Extraction - Question Answering - Text Summarization -Unsupervised Language Discovery.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- To understand the basics of computational linguistics and Tamil grammar.
- To write simple programs in Python for language processing
- To use regular expressions and formal models to study language structure.

- To work with language tools like POS taggers and sentence parsers.
- To apply language processing methods to real-world tasks like translation and speech processing.

TEXT BOOKS:

1. Bhargav Srinivasa Desikan, "Natural language processing and computational linguistics", Packt Publishing, first edition 2018.
2. The Oxford Handbook of Computational Linguistics, Edited by Ruslan Mitkov, Oxford University Press, 2022.

REFERENCES:

1. Valarmathi, "Translation - Theory and Application", International Institute of Tamil Studies, First Edition, 2001.
2. Chrisdas Prathima, "The Phonology and morphology of tamil", 2016.
3. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in
4. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2013.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	1	1	-	-	-	2	1	3	2	2	1	1	-
2	3	3	3	2	2	-	1	-	2	1	2	2	3	1	2	-
3	3	3	2	2	2	-	-	-	1	1	2	2	3	2	2	-
4	2	3	3	2	2	-	1	-	3	1	2	3	2	2	3	-
5	2	3	3	2	3	2	-	-	2	1	2	3	2	2	3	-
Average	2.6	2.6	2.4	1.8	2.0	2.0	1.0	-	2.0	1.0	2.2	2.4	2.4	1.6	2.2	-

VERTICAL VI: INDUSTRY 4.0

PCS601   **INTRODUCTION TO INDUSTRY 4.0**   **L T P C**

                                                  3 0 0 3

OBJECTIVES:

- To understand the smartness in Smart Factories, Smart cities, smart products and smart Services
- To understand the power of IOT and networks in a networked industrial System.
- To recognize the uses of data analytics and security
- To understand the power of Cloud computing in Industry 4.0
- To understand, discuss and define business strategies and plan toward the Fourth Industrial Revolution.

UNIT- I: **INTRODUCTION**   **9**

Introduction - The Various Industrial Revolutions -Defining Industry 4.0 -Main Characteristics of Industry 4.0 - The Value Chain - Industry 4.0 Design Principles - Building Blocks of Industry 4.0 - Smart Manufacturing -Digitalization and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0- Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

UNIT- II: **ROAD TO INDUSTRY 4.0**   **9**

Internet of Things (IoT) - Industrial Internet of Things (IIoT) - Internet of Services- Smart Manufacturing - Integrated Billing Solutions in the Internet of Things- Business Models for the Internet of Things -Network Dynamics: Population Models - Information Cascades - Network Effects - Network Dynamics: Structural Models - Cascading Behavior in Networks - The Small - World Phenomenon.

UNIT- III: **SYSTEM, TECHNOLOGIES FOR ENABLING INDUSTRY4.0**   **9**

Cyber physical Security in Industry 4.0 - Secure Manufacturing Information Architecture - Cyber Security --Robotic Automation and Collaborative Robots - Support System for Industry 4.0 - Mobile Computing - Smart Devices and Products- Smart Logistics - Smart Cities - Predictive Analytics.

UNIT- IV: **DATA, INFORMATION, KNOWLEDGE AND COLLABORATION**   **9**

Resource-based view of a firm - Data as a new resource for organizations- Harnessing and sharing knowledge in organizations- Cloud Computing Basics - Cloud-Based Design and Manufacturing - Defining Cloud-Based Design and Manufacturing (CBDM) - Software Defined Cloud Manufacturing -Cloud Computing and Industry 4.0

UNIT- V: BUSINESS ISSUES, APPLICATIONS, AND CASE STUDIES   9

Opportunities and Challenges -Industry 4.0 in Car Manufacturing - IOT Based Building Automation - Agricultural Automation.- IIoT case studies - Future of Works and Skills for Workers in the Industry 4.0 Era.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the smartness in Smart Factories, Smart cities, smart products and smart Services
- Understand the power of IOT and networks in a networked industrial System.
- Recognize the uses of data analytics and security
- Understand the power of Cloud computing in Industry 4.0
- Understand, discuss and define business strategies and plan toward the Fourth Industrial Revolution.

TEXT BOOKS:

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", APress; 1st ed. Edition (28 June 2016).
2. Alp Ustundag, EmreCevikcan, "Industry 4.0: Managing The Digital Transformation", Springer International Publishing AG; 1st ed. 2018.

REFERENCES:

1. Duato J, Yalamanchili S, and Lionel Ni, "Interconnection Networks: An Engineering Approach", Morgan Kaufmann Publishers, 2004.
2. Lane Thames, Dirk Schaefer, "Cybersecurity for Industry 4.0: Analysis for Design and Manufacturing", Springer; 1st ed. 2017 edition.
3. Acatech, Recommendations for implementing the strategic initiative INDUSTRIE 4.0. Final report of the Industry 4.0 Working Group, 2013.
4. Fayez Gebali, Haytham Elmiligi, Mohamed Wathed and El –Kharashi, "Networks-on chips: Theory and Practice", CRC Press, Taylor and Francis Group, 2009.
5. Industry 4.0 - Opportunities and Challenges of the Industrial Internet, PWC, 2015.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2	-	-	-	2	-	-	1	3	3	3	3
2	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	3
3	3	3	3	-	3	-	2	1	-	2	-	-	3	3	3	-
4	3	3	3	3	3	-	-	-	-	-	2	-	3	3	3	3
5	3	3	3	3	2	3	2	-	-	3	2	1	3	3	3	3
Average	3.0	3.0	3.0	3.0	2.5	3.0	2.0	1.0	2.0	2.5	2.0	1.0	3.0	3.0	3.0	3.0

PCS602   3D PRINTING AND DESIGN   **L T P C**

                                                                 3 0 0 3

OBJECTIVES:

- The course is designed to impart knowledge and skills related to 3D printing technologies.
- Selection of material and equipment and develop a product using this technique.
- To understand Industry 4.0 environment.
- To understand CAD and Additive manufacturing.
- To understand Additive Equipment.

UNIT- I: 3D PRINTING AND ADDITIVE MANUFACTURING   9

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.

UNIT- II: CAD AND ADDITIVE MANUFACTURING   9

CAD for Additive Manufacturing-CAD Data formats, Data translation, Data loss, STL format. Additive Manufacturing Techniques – Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.

UNIT- III: PROCESS   9

Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools.

UNIT- IV: MATERIALS   9

Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT- V: ADDITIVE MANUFACTURING EQUIPMENT   9

Process Equipment- Design and process Parameters - Governing Bonding Mechanism - Common faults and troubleshooting – Process Design- Post Processing: Requirement and Techniques- Product Quality.

                                                    TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate .stl file.

- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXT BOOKS:

1. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.2020
2. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

REFERENCES:

1. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
3. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
4. L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001.
5. Zhiqiang Fan and Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy", InTech, 2012.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2	-	-	-	2	-	-	1	3	3	3	3
2	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	3
3	3	3	3	-	3	-	2	1	-	2	-	-	3	3	3	-
4	3	3	3	3	3	-	-	-	-	-	2	-	3	3	3	3
5	3	3	3	3	2	3	2	-	-	3	2	1	3	3	3	3
Average	3.0	3.0	3.0	3.0	2.5	3.0	2.0	1.0	2.0	2.5	2.0	1.0	3.0	3.0	3.0	3.0

PCS603   INTERNET OF EVERYTHING   L T P C

3 0 0 3

OBJECTIVES:

- To understand Basic knowledge about IoT
- To Gain knowledge of hardware and fundamentals of Arduino.
- Evaluate and study suitable development protocols, technologies and tools.
- Evaluate methods of interface.
- Exposure to industrial applications.

UNIT- I: INTRODUCTION   9

Introduction to IoT concept, Objective, IoT History, Introduction to IoT communication, Why IoT, IoT Architecture, Telemetry Vs IoT, Objects in IOT, Identifier in the IOT, Technologies in IOT.

UNIT- II: INTRODUCTION IOT HARDWARE/DEVICES   9

Basics of Microcontroller, Microprocessor Vs Microcontroller, Types of Sensor, actuators and their application, Programming Fundamentals (C Programming), Introduction to Arduino microcontroller, hands on Arduino, Arduino board layout and LED Blinking temperature sensor application.

UNIT- III: RFID APPLICATIONS   9

Introduction, concepts and technology: RFID, transponder, RFID architecture, RFID applications i.e. logistics and supply chain, production, monitoring and maintenance, product safety, quality and information, access control and tracking and tracing of individuals, payment, loyalty, household etc. Hardware, Hardware issues, protocols: pure aloha, slotted aloha, frame slotted aloha, tree protocols, tree splitting algorithms, binary search algorithms, bitwise arbitration protocols. Main query tree protocols.

UNIT- IV: WIRELESS SENSOR NETWORKS   9

History and context, Node, connecting nodes, networking nodes, securing communication, standards and Fora. Networking and the Internet -IP Addressing, Protocols - MQTT, CoAP, REST Transferring data.

UNIT- V: MOBILITY AND SETTINGS   9

Introduction, localization, mobility management, localization and handover management, technology considerations, performance evaluation, simulation setup, performance results. Identification of IOT (data formats. IPV6, identifiers and locators, tag etc.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Apply the concepts of IOT.
- Identify the different technology.
- Analysis and evaluate protocols used in IOT.
- Design and develop smart city in IOT.
- Analysis and evaluate the data received through sensors in IOT.

TEXT BOOKS:

1. Hakima Chaouchi, "Internet of Things: connecting objects to the web", Wiley, 2013.
2. Arshdeep Bhaga and Vijay Madisetti, "Internet of Things (A Hands-on-Approach)", 2015.

REFERENCES:

1. Samuel Greengard, "The Internet of Things", MIT Press.
2. Herve chabanne, "RFID and the Internet of Things", Wiley.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	-	2	-	-	-	-	2	-	-	-	2	-	-	-
2	-	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
3	-	-	3	-	-	-	3	-	-	-	2	-	-	-	1	-
4	-	-	-	2	-	2	2	1	-	2	-	-	-	-	2	-
5	-	2	-	-	-	-	2	-	2	-	-	-	-	2	-	2
Average	2.0	1.6	3.0	2.0	2.0	2.0	2.3	1.0	2.0	2.0	2.0	-	2.0	2.0	1.5	2.0

PCS604   NEURAL NETWORKS   L T P C

                                                                        3 0 0 3

OBJECTIVES:

- To understand the basics in deep neural networks
- To understand the architecture, learning algorithms
- To learn various types of Artificial Neural Networks
- To understand the working of CNN and RNN.
- To learn practical implementation and training of Neural Network with case study.

UNIT- I: INTRODUCTION   9

Introduction- Basic concepts of Neural Network- Model of an Artificial Neuron- Characteristics of Neural Network- Learning Methods- Backpropagation Network Architecture Back Propagation Learning-Counter Propagation Network- Hopfield/Recurrent Network Adaptive Resonance Theory

UNIT- II: PERCEPTRON LEARNING RULE   9

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection.

UNIT- III: RADIAL BASIS NETWORKS   9

Radial basis networks: Radial basis networks: Radial basis network – training RBF networks - grossberg network: Basic non-linear model – two layer competitive network – Adaptive resonance theory: Overview of adaptive resonance-Layer 1-Layer 2 –Learning Law: L1-L2 and L2-L1-Hopfield network.

UNIT- IV: CONVOLUTION & RECURRENT NETWORKS   9

Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms. Recurrent Neural Networks: Bidirectional RNNs – Deep Recurrent Networks – Recursive Neural Networks.

UNIT- V: CASE STUDY   9

Pre-Training Steps – Training the Network – Post Training Analysis – Function Approximation – Probability Estimation – Pattern Recognition – Clustering – Prediction.

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the mathematical concepts of the performance surfaces and different methods for optimizations.

- Perform the training of neural networks using various learning rules.

- Understanding the concepts of forward and backward propagations.

- Understand the concepts, and representation of most common neural network models.

- Reason about the performance of neural networks and implement neural network models for particular applications.

TEXT BOOKS:

1. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, Orlando De Jesus, "Neural Network Design", 2nd Edition, ISBN-10: 0- 9717321-1-6, ISBN-13: 978-0-9717321-1-7

2. Simon Haykin, "Neural networks and Learning Machines", 3rd Edition, Prentice Hall, 2008.

REFERENCES:

1. Li Min Fu, "Neural Networks in Computer Intelligence", TMH 2003.

2. Christopher M. Bishop, "Neural Networks for Pattern Recognition", Springer, 2006.

3. Tariq Rashid, "Make Your Own Neural Network", 2016.

4. Simon S Haykin, " Neural Networks a Comprehensive Foundations", PHI Ed.

5. James A Freeman, David M Skapura, "Neural Networks", Pearson Ed., 2004.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	2	1	-	-	-	-	-	-	-	2	2	-	-	-
2	2	-	1	2	-	-	-	-	-	-	-	-	-	2	-	1
3	1	1	2	-	2	-	-	-	-	-	-	2	2	-	2	-
4	2	1	2	-	2	-	-	-	-	-	-	-	-	2	-	-
5	1	2	-	2	-	-	-	-	-	-	-	-	2	-	-	1
Average	1.6	1.3	1.8	1.7	2.0	-	-	-	-	-	-	2.0	2.0	2.0	2.0	1.0

PCS605   EXTENDED REALITY TECHNOLOGIES   **L T P C**

                                                                      3 0 0 3

OBJECTIVES:

- To impart the fundamental aspects and principles of Extended Reality technologies
- To understand the Human Computer Interaction for Extended Reality and 3D Modeling.
- To gain knowledge about AR/MR
- To study about VR modeling.
- To know the Applications involved in AR/VR.

UNIT- I: INTRODUCTION TO XR   9

Fundamentals of AR, VR and MR - Historical Evolution - Current Trends - Future trends in XR - Hardware XR systems - VR Headsets - AR display devices, glasses -MR Devices - Software and Development Tools - Unity Game Engine.

UNIT- II: HUMAN COMPUTER INTERACTION FOR XR AND 3D   9
                MODELING

Human - Computer Interaction for XR Systems – Perception – Navigation - Interaction Design (Voice, Gestures, Tracking. Fundamentals of 3D Modeling for XR - Geometric modeling Concepts - Software Tools for 3D Modelling - Asset Creation & Optimization.

UNIT- III: AUGUMENTED REALITY   9

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

UNIT- IV: VIRTUAL REALITY   9

Modeling - Geometric Modeling - Virtual Object Shape - Object Visual Appearance - Kinematics Modeling - Transformation Matrices - Object Position - Transformation Invariants -Object Hierarchies - Viewing the 3D World - Physical Modeling - Collision Detection - Surface Deformation - Force Computation - Force Smoothing and Mapping - Behavior Modeling - Model Management.

Human Factors in VR - Methodology and Terminology - VR Health and Safety Issues - VR and Society-Medical Applications of VR - Education, Arts and Entertainment - Military VR Applications - Emerging Applications of VR - VR Applications in Manufacturing - Applications of VR in Robotics - Information Visualization - VR in Business - VR in Entertainment - VR in Education.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the fundamental concepts, software development tools for Extended Reality
- Study Human Computer Interaction for XR and 3D Modeling technologies
- Use the concept of AR/MR Concepts in education and mobile.
- Study the modeling concept of VR.
- Compare and contrast the various applications of VR.

TEXT BOOKS:

1. The Extended Reality Blueprint: Demystifying the AR/VR, Production Process Annie Eaton, ISBN: 978-1-394-20769-5, March 2024
2. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018.
3. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016
4. Alan Craig, William Sherman and Jeffrey Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.

REFERENCES:

1. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
2. Burdea G. C. and P. Coffet, "Virtual Reality Technology", Second Edition. Wiley-IEEE Press, 2003/2006.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2	1
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2	1
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	2
Average	3.0	2.6	2.4	2.0	3.0	-	-	-	2.8	2.2	1.8	2.6	2.8	1.8	2.2	1.6

PCS606   ROBOTIC PROCESS AUTOMATION   **L T P C**

                                                             3 0 0 3

OBJECTIVES:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT- I: INTRODUCTION TO ROBOTIC PROCESS AUTOMATION   9

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT- II: AUTOMATION PROCESS ACTIVITIES   9

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events.

UNIT- III: APP INTEGRATION, RECORDING AND SCRAPING   9

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, scraping data from website and writing to CSV. Process Mining.

UNIT- IV: EXCEPTION HANDLING AND CODE MANAGEMENT   9

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT- V: DEPLOYMENT AND MAINTENANCE   9

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA.

                                                    TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Enunciate the key distinctions between RPA and existing automation techniques and platforms.
- Use UIPath to design control flows and work flows for the target process
- Implement recording, web scraping and process mining by automation
- Use UIPath Studio to detect, and handle exceptions in automation processes
- Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.

TEXT BOOKS:

1. Alok Mani Tripathi, "Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath", Packt Publishing, 2018.
2. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

REFERENCES:

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: A Primer", Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2. Richard Murdoch, "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant", Amazon Asia-Pacific Holdings Private Limited, 2018
3. A Gerardus Blokdyk, "Robotic Process Automation Rpa: A Complete Guide ", 2020.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	-	2	-	-	-	-	2	-	-	-	2	-	-	-
2	-	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
3	-	-	3	-	-	-	3	-	-	-	2	-	-	-	1	-
4	-	-	-	2	-	2	2	1	-	2	-	-	-	-	2	-
5	-	2	-	-	-	-	2	-	2	-	-	-	-	2	-	2
Average	2.0	1.6	3.0	2.0	2.0	2.0	2.3	1.0	2.0	2.0	2.0	-	2.0	2.0	1.5	2.0

OPEN ELECTIVES

OCE101   **AIR AND NOISE POLLUTION CONTROL**   **L T P C**

                        ENGINEERING   **3 0 0 3**

OBJECTIVES:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.
- To create awareness among the sources and effects of air pollution.
- To gain knowledge on air pollution control equipments.
- To develop a knowledge on air quality standards.
- To gain knowledge of characteristics of air pollution and noise pollution.

UNIT-I: INTRODUCTION   9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution –Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards - Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT-II: METEOROLOGY   9

Effects of Meteorology on Air pollution-Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns-Atmospheric Diffusion Theories-Dispersion models, plume rise.

UNIT-III: CONTROL OF PARTICULATE CONTAMINANTS   9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT IV   CONTROL OF GASEOUS CONTAMINANTS   9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT V   INDOOR AIR QUALITY MANAGEMENT   9   Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of Industries-Sources

and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management.
- Identify, formulate and solve air and noise pollution problems.
- Design stacks and particulate air pollution control devices to meet applicable standards.
- Select control equipment.
- Ensure quality, control and preventive measures.

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science & science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press Inc. 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

REFERENCES:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
3. Wayne T. Davis, "Air Pollution Engineering Manual", John Wiley & Sons Inc., 2000.
4. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited, 2007.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	-	-	1	1	2	-	1	2	1	-
2	-	-	2	3	-	-	3	2	2	-	-	3	-	-	-	1
3	1	2	3	-	-	2	2	3	-	2	-	-	3	-	-	-
4	-	2	-	3	-	-	-	-	2	2	-	2	-	2	1	-
5	1	1	2	3	-	1	3	3	1	1	2	3	2	-	2	-
Average	1.0	1.7	2.3	3.0	-	1.3	2.7	2.7	1.5	1.5	2.0	2.7	2.0	2.0	1.3	1.0

OCE102   **ENVIRONMENTAL IMPACT ASSESSMENT**   **L T P C**
                                                              3 0 0 3

OBJECTIVES:

- To develop a comprehensive understanding of sustainable development concepts, the EIA process, and stakeholders' roles.
- To acquire skills in EIA procedure, baseline monitoring, and impact assessment for land, water, air, noise, and energy.
- To evaluate policy and legal aspects, and formulate effective EMPs with mitigation strategies.
- Gain proficiency in environmental auditing and review of EIA reports for clearance.
- To analyze rehabilitation plans, and explore economic aspects, including valuation and ecological economics.

UNIT-I: INTRODUCTION   9

Basic concepts - Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Historical development – EIA in project cycle – EIA Notification and Legal Framework –Stakeholders and their Role in EIA.

UNIT-II: EIA METHODOLOGIES   9

LCA - EIA Procedure - Baseline monitoring - Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna – EIA Methods.

UNIT-III: ENVIRONMENTAL MANAGEMENT PLAN   9

Policy and Legal Aspects of EMP - Environmental Policies and Programmes in India - Environmental Laws and Legislations - Environmental Monitoring Plan - Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna.

UNIT-IV: ENVIRONMENTAL AUDITING   9

Introduction to Environmental Auditing (EnA) - General Audit Methodology - Elements of Audit Process - Waste Audits and Pollution Prevention Assessments - Auditing of EMS - – EIA Report Preparation – Review of EIA Reports - Environmental Clearance.

UNIT-V: ENVIRONMENTAL MITIGATIONS AND ECONOMICS   9

Rehabilitation and Resettlement Plan - National Rehabilitation and Resettlement Policy - Economics and the Environment - Environmental Valuation - Economics of Natural Resources - Ecological Economics.

OUTCOMES:

At the end of this course, the students will be able to:

- Understand sustainable development, articulate EIA processes, and analyze stakeholder roles.
- Proficient in EIA procedures, baseline monitoring, and impact assessment methodologies.
- Evaluate policies, formulate effective EMPs, and integrate mitigation strategies.
- Master environmental auditing, ensuring compliance and sustainability through critical reviews.
- Analyze rehabilitation plans, integrate economic principles for sustainable decision-making.

TEXT BOOKS:

1. Canter, R.L, "Environmental impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank,1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

REFERENCES:

1. Becker H. A., Frank Vanclay ,"The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	1.5	2.0	2.3	-	2.0	3.0	2.2	-	2.6	-	2.4	1.0	1.3	-	1.0

OCE103   **GREEN BUILDING DESIGN**   **L T P C**

                                                                         3 0 0 3

OBJECTIVES:

- To Understand and explain the goals and principles of green buildings, including certification programs.

- To analyze the objectives of sustainable development, with a focus on evaluating the impact of energy use and carbon emissions in buildings.

- To Compare traditional building techniques and assess their impact on sustainable building practices.

- To explore the use of solar energy in buildings, considering factors like comfort and location.

- To explore green composites and sustainable approaches to water, waste, and sewage management in the built environment.

UNIT-I: INTRODUCTION   9

Definitions, Goals, Principles, Features, Requirements and Benefits - Evaluation of Green Buildings - Green Rating Systems - Codes and Certification Programs - Barriers to the Propagation of Green Buildings.

UNIT-II: SUSTAINABILITY AND ENERGY USE   9

Sustainability – Objectives of sustainable development – Sustainable principles - Energy use - carbon emissions – Sustainable building materials – LCA - Embodied Energy in Building Materials – Smart Materials - Transportation Energy for Building Materials - Maintenance Energy for Buildings.

UNIT-III: IMPLICATIONS OF BUILDING TECHNOLOGIES   9

Traditional Efficient Building techniques - Masonry Construction and Framed Construction - Alternative building concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT-IV: ENERGY SYSTEMS AND PASSIVE SOLAR DESIGN   9

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings – Thermal Comfort in Buildings – Building Physics – Daylighting strategies - Issues – Implications of Geographical Locations - Case studies

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand and apply principles of green buildings and evaluate them using certification programs.
- Grasp sustainable development goals and propose eco-friendly solutions for energy use in buildings.
- Compare traditional building techniques, analyze their impact, and suggest sustainable alternatives.
- Apply knowledge of solar energy for energy-efficient building design, considering comfort and location.
- Define and apply green composites, proposing sustainable approaches for water, waste, and sewage management.

TEXT BOOKS:

1. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
2. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
3. "Alternative Building Materials and Technologies" K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao.. New Age International, 2007.
4. "Green Building – Guidebook for sustainable Architecture", Dr. Michael Bauer, Peter mosle, Dr. Micheal Schwarz, Springer, 2007.

REFERENCES:

1. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010.
2. Jerry Yudelson, Green building Through Integrated Design, McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building by Marian Keeler, Bill Burke.Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.3	2.6	2.0	3.0	-	-	2.6	-	2.4	1.2	1.0	2.0	1.0

OAG101   ENVIRONMENT AND AGRICULTURAL ENGINEERING   L T P C
                                                        3 0 0 3

OBJECTIVES:

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To understand the ecological context of agriculture and its concerns.
- To study the context of climate change and emerging global issues.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT-I: INTRODUCTION   9

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation.

UNIT-II: ENVIRONMENTAL CONCERNS   9

Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Disaster management. Floods, earthquakes, cyclones and landslides. Social issues and the environment, unsustainable to sustainable development. The Environment Protections Act, The Air Act, The water Act, The Wildlife Protection.

UNIT-III: CLIMATE CHANGE AND ECOLOGICAL DIVERSITY   9

Global warming and changing environment – Ecosystem changes – Changing blue green-grey water cycles – Water scarcity and water shortages – Desertification-Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insects and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

UNIT-IV: AGRICULTURAL IMPACTS   9

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT-V: SUSTAINABLE AGRICULTURE 9

Sustainable agriculture-problems and its impact on agriculture, conservation agriculture strategies, HEIA, LELA and LE1SA and its techniques for sustainability, Integrated farming system components of IFS and its advantages, farming system and environment.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Know how the environment and agriculture are related and the changes in the environmental due to agriculture.
- Gather idea on about how the mechanization helps and impacts of soil erosion due to agricultural activities.
- Gain knowledge on the need for sustainable agriculture.
- Demonstrate how ecological balance is required for sustainability of agriculture.
- Know the ecological diversity in agriculture and different technologies used in farming activities.

TEXT BOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
3. B.K.Desai and Pujari, B.T., "Sustainable Agriculture: A vision for future", New India Publishing Agency, New Delhi, 2007.
4. Saroja Raman, "Agricultural Sustainability – Principles, Processes and Prospects", CRC Press, 2013.
5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020

REFERENCES:

1. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century: proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994.
3. Environment and agriculture: environmental problems affecting agriculture in theAsia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989.

4. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. "Ecosystem principles and sustainable agriculture", Scitech Publications, Chennai, 1999.

5. Bhoopander Giri, Ram Prasad, Qiang-Sheng Wu, Ajit Varma, Biofertilizers for Sustainable Agriculture and Environment, 2019.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	-	-	-	1	1	-	-	1	-	-	2	2	1	1
2	2	3	1	-	2	3	-	-	1	-	1	1	1	1	1	2
3	1	3	-	-	-	1	2	-	-	-	-	2	2	2	2	1
4	3	3	3	2	3	-	3	2	1	-	2	3	2	1	1	-
5	-	3	2	2	3	-	3	3	-	-	2	3	2	2	3	1
Average	2.0	2.8	2.0	2.0	2.6	1.7	2.3	2.5	2.0	1.0	1.7	2.3	1.8	1.6	1.6	1.3

OAG102   **ORGANIC FARMING FOR SUSTAINABLE**   **L T P C**
                AGRICULTURAL PRODUCTION   **3 0 0 3**

OBJECTIVES:

- To quantify the organic resources of integrated organic farming system (IOFS) components.
- To assess the total productivity of the system.
- To work out the economics of organic farming system.
- To gain knowledge on Organic Farming for Sustainable agriculture.
- To expose the students to the concept of Organic Farming.

UNIT-I: INTRODUCTION TO ORGANIC FARMING   9

Concept of organic farming, Significance of organic farming for Indian farmers, Terminologies used in organic farming, Objectives of organic farming, Characteristics of organic farming, often debated issues in organic farming, Area under OF and size of organic food market. Status of organic farming in India.

UNIT-II: SOIL HEALTH MANAGEMENT IN ORGANIC FARMING   9

Organic manures- Biofertilizers- Green manures- Crop rotation - Classification of Biofertilizers. Organic production requirements, Components. Nutrient requirements, Limiting nutrient losses, Farm Yard Manure (FYM), Enrichment of FYM.

UNIT-III: MICROBIAL INOCULATIONS IN ORGANIC FARMING   9

Importance, benefits, Methods of vermicomposting, Preparation and management of vermicompost unit. Recycling of organic residues, Classification of organic residues Biofertilizers, Importance, classification and benefits of biofertilizers (Azospirillum, Azotobacter, Rhizibium, PSB, VAM etc.,).

UNIT-IV: GOOD HARVESTING PRACTICES   9

Crop harvesting, signs of maturity in different field crops; physiological and crop Maturity- Methods of threshing crops, cleaning, drying and storage of field crops- Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India- Problems and prospects of rainfed agriculture in India.

UNIT-V: ORGANIC REGULATION AND CERTIFICATION PROCEDURE,   9

BRANDING, PACKAGING AND MARKETING OF ORGANIC PRODUCTS

Organic Certification-process-Requirements for Organic Certification Systems in India - Basic standards for Livestock Certification - NPOP - Marketing of Organic Produce - Integrated Farming System models for Sustainable Agriculture.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the concepts of Organic farming and sustainable agriculture.
- Gain knowledge on organic farming and Overview of Organic Farming in India.
- Understand Microbial Inoculations in Organic Farming.
- Design Sustainable agriculture.
- Understand Organic Regulation and Certification Procedure.

TEXT BOOKS:

1. Dr.S.Natarajan, Dr.P.Devasenapathy, Dr.R.Kalpana, Dr.C.Sudhalakshmi, Organic farming an overview, TNAU.
2. Dilip Nandwani Organic Farming for Sustainable Agriculture, 2016.
3. Jeyabalan Sangeetha, Kasem Soytong, Devarajan Thangadurai, Abdel Rahman Mohammad Al-Tawaha,Organic Farming for Sustainable Development, 2023.
4. Mohan Chand Rajbar,Organic Farming and Livestock Management in integrated farming: An Agro-entrepreneur manual to successful Integrated farm production, 2019.
5. Gopal Chandra De. 1980., Fundamentals of agronomy. Oxford and IBH Publishing

REFERENCES:

1. Agricultural and Processed Food Products Export Development Authority (APEDA). National Programme for organic production. http://apeda.gov.in/apedawebsite/organic/Organic_Products.html.
2. Singh, J.P. and N. Ravisankar, "Integrated Farming Systems for sustainable agricultural growth", 2015
3. Renu Soni, Ruchitra Gupta. 2022 Organic Farming: A Sustainable Agricultural Practice, Journal of Thematic Analysis.
4. Gour, M. (2016). Organic farming in India: Status, issues and prospects. SOPAAN.

5. Santhosh kumar M., Reddy G. C., & Sangwan, P. S. (2017). A Review on Organic Farming—Sustainable Agriculture Development. International Journal of Pure and Applied Bioscience.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
4	3	2	-	-	3	2	-	-	-	-	-	3	2	-	-	3
5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
Average	2.3	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	2.0	2.3	2.7	2.0	2.7

OAG103   **SUSTAINABLE DEVELOPMENT THROUGH**   **L T P C**

INDIAN KNOWLEDGE SYSTEM's (IKS)   **3 0 0 3**

OBJECTIVES:

- To understand the structure and methods of ancient Indian education, focusing on holistic development through indigenous learning systems like Gurukuls, Pathshalas, and ancient universities.

- To explore how ancient Indian architecture, as seen in landmarks like the Ajanta Caves, Konark Sun Temple, and Brihadishvara Temple, embodies principles of sustainability and energy efficiency.

- To study traditional Indian farming techniques such as organic farming, rainfed Agriculture, and agroforestry to promote biodiversity and environmental stewardship.

- To understand the holistic approach of Ayurveda, focusing on the Interconnection of physical, mental, and spiritual health through individualized treatments based on one's Prakriti (constitution).

- To explore the moral responsibility humans have toward nature, focusing on the interconnectedness of life, environmental ethics, and wildlife conservation.

UNIT-I: ANCIENT EDUCATION SYSTEM IN INDIA   9

Indigenous education systems (Home,Temples, Pathshalas, Tols, Chatuspadis and Gurukuls)-methods- multi design learning Shastra, Kala, Vidya- Prominent Universities Nalaandha and Takshashila - Vocational Training and Focus on Ethics and Values National Logic and Reasoning, Artistic Education, Astronomy and Mathematics.

UNIT-II: VASTU SHASTRA AND SUSTAINABLE ARCHITECTURE   9

Historical Architecture Models (Ajanta Caves (Aurangabad) Brihadishvara Temple (Tanjore)Qutb Minar (Delhi)Konark Sun Temple (Odisha)Shore Temple (Mahabalipuram)-Vastu Shastra and Ancient Indian Architecture- Natural Forces (wind, water, sunlight, earth) - Energy Efficiency and Sustainable Materials - Eco-Friendly Construction- Communal Space and Architectural Carvings-Human Well-Being-Modern Integration of Vastu.

UNIT-III: SUSTAINABLE AGRICULTURE AND WATER MANAGEMENT 9
IN INDIAN KNOWLEDGE SYSTEMS

Organic Farming and Rainfed Agriculture - Agroforestry and Biodiversity - Soil Science - Soil Erosion Prevention- Chemical free Farming and Environmental Stewardship-Water Management and Ancient Indian Techniques - Water Storage and Groundwater Recharge- Drought-Prone Areas and Reviving Traditional Practices-Human and Animal Powered Devices-Biodiversity Support and Ecosystem Preservation-Modern Water Scarcity Solutions and Cultural Heritage in Water Management.

UNIT-IV: AYURVEDA 9

Ayurveda and Holistic Health-Prakriti (Individual Constitution)- Personalized Health-Locally Sourced Remedies and Seasonal Foods- Sustainable Diet and Whole, Unprocessed Foods - Herbal Medicine and Natural Remedies - Yoga, Meditation, and Pranayama - Mental and Spiritual Well-Being- Resource Efficiency and Environmental Health- Non-Synthetic Healthcare and Home Remedies- Eco-Friendly Health Practices-Modern Healthcare Integration and Sustainable Wellness.

UNIT-V: SPIRITUAL ECOLOGY 9

Moral Responsibility and Interconnectedness of Life- Cosmic Order and Ethical Living-Environmental Ethics and Wildlife Conservation- Sustainable Resource Use-Traditional Indian Festivals and Agricultural Cycle- Sustainability Movements and Ethical Responsibility- Social Equity and Spiritual Well-Being- Intergenerational Sustainability-Cultural and Environmental Preservation.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Analyze the traditional learning methods, institutions, and disciplines such as Shastra, Kala, and Vidya.

- Understand natural forces and energy efficiency in ancient Indian architecture. Explore the modern integration of Vastu principles for human well-being.

- Understand traditional water management systems and their relevance to modern water conservation. Assess ancient Indian farming techniques and their ecological benefits.

- Understand the impact of Ayurvedic practices on environmental sustainability.

- Understand the relationship between traditional Indian festivals and ecological balance.

TEXT BOOKS:

1. Radha Kumud Mookerji, "Ancient Indian Education: Brahmanical and Buddhist", Motilal Banarsidass Publishing House, 2011.
2. S. V. Ganapati Sthapati, "Building architecture of Stha-patya Veda", Dakshinaa Pub. House, 2005.
3. R.S. Meena, "Sustainable Agriculture", Scientific Publishers (India) January 2019.
4. Vasant Lad, "The Complete Book of Ayurvedic Home Remedies", Little Brown Book Group, 2 November 2006.
5. Llewellyn Vaughan-Lee, "Spiritual Ecology: The Cry of the Earth", Golden Sufi Center, U.S,24 June 2013.

REFERENCES:

1. R. C. Majumdar, "The Concept of Education in Ancient India" by, MotilalBanarsidass. 2010.
2. Kalyan Kumar, "Trditional Water Management Systems in India", Aryan Books International, 2007
3. Dr María Rosa Mosquera-Losada, "Agroforestry for Sustainable Agriculture" Burleigh Dodds Science Publishing Limited, 2019.
4. Dr. Ashish S. Jain, Dr. Bhushan R. Rane, Sunil R. Bakliwa Integration of Ayurvedic Herbal Medicines into Modern Medicinal Practices, Nirali Prakashan, 2021.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
4	3	2	-	-	3	2	-	-	-	-	-	3	2	-	-	3
5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
Average	2.3	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	2.0	2.3	2.7	2.0	2.7

OCY101   **CYBER FORENSIC AND INVESTIGATION**   **L T P C**

                                                          3 0 0 3

OBJECTIVES:

- Principles of digital evidence handling and forensic investigation techniques.
- Proficiency in using forensic tools for imaging, data recovery, and analysis.
- Understanding legal and ethical considerations in cyber investigations.
- Incident response planning and execution for cyber incidents.
- Documentation and reporting of forensic findings for stakeholders and legal purposes.

UNIT-I: INTRODUCTION TO CYBER FORENSICS   9

Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services.

UNIT-II: COMPUTER FORENSICS EVIDENCE AND CAPTURE   9

Data Recovery – Evidence Collection and Data Seizure-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.

UNIT-III: COMPUTER FORENSIC ANALYSIS   9

Discover of Electronic Evidence- Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of the Military Tactics of Terrorist and Rogues – Tactics of Private Companies.

UNIT-IV: INVESTIGATION   9

Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime- Identity Theft and Identity Fraud – Organized Crime &Terrorism – Avenues Prosecution and Government Efforts – Applying the First Amendment to Computer Related Crime-The Fourth Amendment and other Legal Issues.

UNIT-V: COMPUTER FORENSIC INVESTIGATION CASES   9

Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues.

                                                          TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Demonstrate proficiency in using forensic tools and techniques for digital evidence analysis.

- Critically evaluate and interpret digital artifacts to reconstruct cyber incident timelines.
- Apply legal and ethical principles to ensure compliance in cyber forensic investigations.
- Formulate and implement incident response strategies to mitigate cyber threats effectively.
- Prepare clear and comprehensive forensic reports and presentations for stakeholders.

TEXT BOOKS:

1. Albert J. Marcella (2022). Cyber Forensics: Examining Emerging and Hybrid Technologies, 1st Edition, CRC Press.
2. Marjie T Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition, 2008. (CHAPTERS 3 – 13). (UNIT IV – V)
3. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005. (CHAPTERS 1 – 18). (UNIT I – IV).

REFERENCES:

1. Eoghan Casey (2019). Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, 4th Edition, Academic Press.
2. MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014.
3. Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover,2nd Edition, 2013.
4. Chad Steel, "Windows Forensics", Wiley, 1st Edition, 2006.
5. Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
2	-	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
3	3	-	2	-	-	3	-	-	-	-	-	-	-	-	3	-
4	2	-	2	-	-	-	-	-	-	-	-	-	-	2	-	-
5	3	-	-	2	-	2	-	-	-	-	-	-	-	-	2	-
Average	2.7	2.5	2.0	2.5	-	2.5	-	-	-	-	-	-	3.0	2.0	2.5	-

OCY102   SOCIAL MEDIA SECURITY   L T P C

3 0 0 3

OBJECTIVES:

- To Understand Social Media Platforms: Learn how popular social media platforms work.

- To Identify Security Risks: Recognize threats and vulnerabilities on social media.

- To Privacy and Data Protection: Protect personal information on social media.

- To Legal and Ethical Issues: Understand legal and ethical issues in social media.

- To Security Best Practices: Apply methods to secure social media accounts.

UNIT-I: INTRODUCTION TO SOCIAL MEDIA SECURITY   9

Social Media Platforms-Communication Impact-Cybersecurity Basics-Security Threats-UserAwareness-Breach Case Studies-Data Collection-Security Features- Future Trends.

UNIT-II: PRIVACY AND ACCOUNT SECURITY   9

Privacy Settings-Strong Passwords-Two-Factor Authentication (2FA)-Geotagging Risks Personal Information- Third-Party Apps-Account Takeover-Encryption Role-Safe Posting.

UNIT-III: THREATS AND ATTACKS   9

Social Engineering-Cybercriminal Tactics-Suspicious Activity-Malware Links- Hacking Cases-Suspicious Content-Security Tests-Insider Threats-Threat Intelligence.

UNIT-IV: LEGAL AND ETHICAL ISSUES   9

International Laws-Intellectual Property-Privacy Policies-Ethical Data Use-User Responsibilities-Legal Disputes- Freedom of Speech-Compliance Requirements-Regulation Future.

UNIT-V: ONLINE REPUTATION AND POLICIES   9

Reputation Strategies-Brand Impact-Crisis Management-Corporate Communication-Social Media Policies- Governance Role-Monitoring Tools- Employee Training-Cybersecurity Integration.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand Social Media Platforms.

- Identify Security Threats.

- Protect Privacy and Apply best practices to protect personal information on social media.

- Address Legal and Ethical Issues.
- Apply Security Measures and Use tools and techniques to secure social media.

TEXT BOOKS:

1. Kennesaw State University, Big Data Security and Privacy Group (2019), "Social Media Security: Threats, Countermeasures, and Best Practices", 1st Edition, Springer.

2. Nancy Flynn, "The Social Media Handbook: Rules, Policies, and Best Practices to Successfully Manage Your Organization's Social Media Presence, Posts, and Potential Legal Issues", 2013

3. Michael Cross, "Social Media Security: Leveraging Social Networking While Mitigating Risk", 2010.

REFERENCES:

1. Natasha L. Miller, "Social Media Risk and Governance: Preventing Fraud, Cybercrime, and Other Threats", 1st Edition, Wiley, 2022.

2. James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing", 2020.

3. Christopher Hadnagy and Michele Fincher, "Phishing Dark Waters: The Offensive and Defensive Sides of Malicious Emails", 2015.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	3	-	-	-	-	-	-	-	-	3	-	2	-
2	-	1	-	2	-	-	-	-	-	-	-	-	3	-	1	-
3	-	-	1	2	3	-	-	-	-	-	-	-	3	-	1	-
4	-	1	-	2	-	-	-	-	-	-	-	-	3	-	2	-
5	1	1	-	2	2	-	-	-	-	-	-	-	3	1	2	-
Average	1.0	1.3	1.0	2.2	2.5	-	-	-	-	-	-	-	3.0	1.0	1.6	-

OEE101   **RENEWABLE ENERGY SOURCES**   **L T P C**

                                                                   3 0 0 3

OBJECTIVES:

- To know the Indian and global energy scenario.
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT-I: ENERGY SCENARIO   9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status - Potential of various renewable energy sources - Global energy status - Per capita energy consumption - Future energy plans.

UNIT-II: SOLAR ENERGY   9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT-III: WIND ENERGY   9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics – Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT-IV: BIO-ENERGY   9

Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers – Cogeneration – Carbonization – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT-V: OCEAN AND GEOTHERMAL ENERGY   9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

                                                      TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Discuss the Indian and global energy scenario.
- Describe the various solar energy technologies and its applications.
- Explain the various wind energy technologies.
- Explore the various bio-energy technologies.
- Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, "Fundamentals and Applications of Renewable Energy", Indian Edition, McGraw Hill, First edition (10 December 2020), ISBN-10 :9390385636.

2. Kothari, "Renewable Energy Sources and Emerging Technologies", Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 8120344707.

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.

2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.

3. Sukhatme S. P, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.

4. Tiwari G. N, "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.

5. Twidell J. W & Weir A, "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
2	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
3	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
4	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
5	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
Average	3.0	3.0	2.0	-	-	1.0	-	-	-	-	-	-	3.0	-	-	-

OEE102   **ENERGY CONSERVATION AND MANAGEMENT**   **L T P C**

                                                                    3 0 0 3

OBJECTIVES:

- Acquire knowledge in the field of energy conservation and management.
- Study the various measures for energy conservation in electrical devices both static & rotating machineries.
- Analyze the energy efficiency in thermal utilities.
- Know the concept of compressed air system and improve the efficiency.
- Understand and analyze of Energy Economics.

UNIT-I: INTRODUCTION   9

Energy - Power – Past & Present scenario of World; National Energy consumption Data –Environmental aspects associated with energy utilization – Energy conservation and its importance - need for energy management – Energy accounting -Energy monitoring, targeting and reporting- Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers.

UNIT-II: ELECTRICAL SYSTEMS   9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors automatic power factor controllers - transformer losses - Electric motors: motor efficiency - factors affecting motor performance - energy saving opportunities with energy efficient motors – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination. Lighting System: Light source, choice of lighting, luminance requirements – ballast - energy efficient lighting controls - energy conservation avenues.

UNIT-III: THERMAL SYSTEMS   9

Introduction to fuels- Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss.

UNIT-IV: COMPRESSED AIR SYSTEM   9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – Diesel Generating System - methods adopted for effecting ENCON – economics of ENCON adoption in all the utilities.

UNIT-V: ECONOMICS   9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Acquire knowledge in the field of energy conservation and management process.
- Learn the various measures for energy conservation in electrical devices.
- Design the effective thermal utility system.
- Improve the efficiency in compressed air system.
- Suggest methodologies for Energy Economics.

TEXT BOOKS:

1. Mehmet Kanoglu, Yunus A. Cengel, "Energy Efficiency and Management for Engineers", 1st Edition, McGraw-Hill Education, 2020.
2. D Moncef Krati, "Energy Audit of Building Systems: An Engineering Approach", Second Edition, CRC Press, 2016.
3. Sonal Desai, "Handbook of Energy Audit", McGraw Hill Education (India) Private Limited, 2015.

REFERENCES:

1. Michael P. Deru, Jim Kelsey, "Procedures for Commercial Building Energy Audits", American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
2. Charles M. Gottschalk, "Industrial Energy Conservation", Wiley, 1996.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	-	1	-	3	-	-	-	2	-	-	1	-	-	-
2	-	-	2	-	1	-	-	-	2	-	-	1	1	2	-	-
3	-	1	-	3	-	2	-	-	-	-	-	-	1	-	-	-
4	3	-	-	-	-	3	-	2	-	-	2	-	1	-	-	-
5	-	2	-	3	2	-	1	2	-	-	-	2	2	-	-	-
Average	2.0	1.3	2.0	2.3	1.5	2.6	1.0	2.0	2.0	2.0	2.0	1.5	1.2	2.0	-	-

OEE103   **ELECTRIC AND HYBRID VEHICLES**   **L T P C**

3 0 0 3

OBJECTIVES:

- To know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures.
- To acquire the knowledge on modelling, sizing of batteries.
- To understand the working principle, construction and characteristics of various motors.
- To provide knowledge about various power converters and control.
- To understand the Hybrid and Electric vehicles.

UNIT-I: DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES   9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency-. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.

UNIT-II: ENERGY SOURCES   9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types- Half reactions of fuel cell. Ultra-capacitors. Battery Management System.

UNIT-III: MOTORS AND DRIVES   9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT-IV: POWER CONVERTERS AND CONTROLLERS   9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes.

UNIT-V: HYBRID AND ELECTRIC VEHICLES   9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles –

Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the operation and architecture of electric and hybrid vehicles.
- Identify various energy source options like battery and fuel cell.
- Select suitable electric motor for applications in hybrid and electric vehicles.
- Explain the role of power electronics in hybrid and electric vehicles
- Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

1. Iqbal Husain, "Electric and Hybrid Vehicles-Design Fundamentals", CRC Press, 2003.
2. Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 2005.

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained ", John Wiley & Sons, 2003
2. Lino Guzzella, "Vehicle Propulsion System", Springer Publications, 2005
3. Ron HodKinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication, 2005.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	2	3	2	-	-	-	-	1	1	2	-	2	-
2	3	3	3	2	3	2	-	-	-	-	-	1	-	1	-	1
3	3	3	3	2	3	2	3	-	-	-		2	2	-	-	1
4	3	3	3	2	3	2	-	-	-	-	1	1	-	-	-	-
5	3	3	3	2	3	2	2	-	-	-	1	1	1	-	-	-
Average	3.0	3.0	3.0	2.0	3.0	2.0	2.5	-	-	-	1.0	1.2	1.6	1.0	2.0	1.0

OEI101   **FUNDAMENTALS OF ROBOTICS**   **L T P C**

                                                                      3 0 0 3

OBJECTIVES:

- Understand the functions of robots and review the need and application of robots in different engineering fields.

- Exemplify the different types of robot drive systems as well as robot end effectors.

- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.

- Develop robotic programs for different tasks and analyze the kinematics motions of robot.

- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

UNIT-I: INTRODUCTION TO ROBOTICS   9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT-II: DRIVE SYSTEMS AND GRIPPERS   9

Pneumatic Drives-Hydraulic Drives-Electrical Drives- Fundamental features and Applications of A.C & D.C. Servo Motors, Stepper Motors, Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Selection and Design Considerations.

UNIT-III: SENSORS FOR ROBOT   9

Requirements of a sensor, Principles and Applications of the following types of sensors-Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors.

UNIT-IV: KINEMATICS AND PROGRAMMING   9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Programming Types-Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

RGV, AGV; Implementation of Robots in Industries -Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

REFERENCES:

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb.S.R., "Robotics Technology and Flexible Automation", Tata McGraw Hill Book Co. 1994.
3. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu K. S, Gonzalz R. C and Lee C. S. G, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Rajput R.K., "Robotics and Industrial Automation", S. Chand and Company, 2008.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	1	-	-	-	1	-	-	-	-	1	1	1	-
2	2	3	1	2	-	-	-	-	1	1	-	-	2	2	3	-
3	2	3	2	3	-	3	2	1	2	1	-	1	2	2	1	-
4	2	1	-	-	1	-	-	-	-	-	-	-	-	-	1	-
5	2	1	3	1	3	2	2	1	-	-	2	2	1	2	1	-
Average	2.2	1.8	1.8	1.8	2.0	2.5	2.0	1.0	1.5	1.0	2.0	1.5	1.5	1.8	1.4	-

OEI102   SENSORS FOR ENGINEERING APPLICATIONS   L T P C

3 0 0 3

OBJECTIVES:

- To know the various stimuli that are to be measured in real life instrumentation.
- To select the right process or phenomena of the sensor.
- To aware of the various sensors available for measurement and control applications.

UNIT-I: INTRODUCTION TO SENSORS   9

What is a sensor and what is a transducer? Electrical sensor – need for sensors in the modern world. Different fields of sensors based on the stimuli - various schematics for active and passive sensors. General characteristics and specifications of sensors - Implications of specifications uses of sensors - measurement of stimuli - block diagram of sensor system. Brief description of each block.

UNIT-II: TRANSDUCERS   9

Sensors for mechanical systems or mechanical sensors - Displacement - acceleration and force - flow of fluids - level indicators - pressure in fluids - stress in solids. Typical sensors - wire and film strain gauges, animometers, piezo electric and magnetostrictive accelerometers, potentiometric sensors, LVDT.

UNIT-III: TEMPERATURE SENSORS   9

Thermal sensors – temperature – temperature difference – heat quantity. Thermometers for different situation – thermocouples thermistors – color pyrometry. Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor- Radiation detectors: radiation intensity, particle counter – Gieger Muller courter (gas based), Hallide radiation detectors.

UNIT-IV: MAGNETIC SENSORS   9

Introduction- magnetic field, magnetic flux density – magneto resistors, Hall sensors, super conduction squids. Acoustic or sonic sensors: Intensity of sound, frequency of sound in various media, various forms of microphones, piezo electric sensors.

UNIT-V: ELECTRICAL SENSORS   9

Introduction- conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. High frequency sensors like microwave frequency sensors, wavelength measuring sensors. MEMs and MEM based sensors.

OUTCOMES:

At the end of this course, the students will be able to:

- Appreciate the operation of various measuring and control instruments which they encounter in their respective fields.
- Visualize the sensors and the measuring systems when they have to work in areas of interdisciplinary nature.
- Think of sensors and sensors systems when for a new situation they encounter in their career.
- Identify and select the right process or phenomena on which the sensor should depend on.
- Know various stimuli that are to be measured in real life instrumentation.

TEXT BOOKS:

1. Doebelin, "Measurement Systems: Application and Design", McGraw Hill Kogakusha Ltd.
2. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim "Microsensors, MEMS and Smart Devices", New York: Wiley, 2001.
3. Henry Bolte, "Sensors – A Comprehensive Sensors", John Wiley.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	1	1	1	3	1	2	1	1	2	-	2	-
2	2	-	2	2	-	-	1	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	1	1	-	-	-	-	1	1	2		-
4	3	3	3	3	1	-	-	3	1	2	-	-	-	-	-	-
5	2	1	2	1	1	1	1	2	1	1	1	1	2	2	2	-
Average	2.4	2.0	2.3	2.0	1.0	1.0	1.0	2.7	1.0	1.7	1.0	1.0	1.7	2.0	2.0	-

OEC101   **INTRODUCTION TO 5G COMMUNICATION NETWORKS**   **L T P C**

                                                       3 0 0 3

OBJECTIVES:

- To understand the evolution of wireless networks.
- To learn the various features of 5G.
- To get acquainted with the fundamentals of EPC.
- To study the processes associated with 5G architecture.
- To explore the spectrum sharing and spectrum trading.
- To assess the security features in 5G networks.

UNIT-I: **EVOLUTION OF WIRELESS NETWORKS**   **9**

Networks evolution: 1G, 2G, 3G, 4G, Evolution of radio access networks, Need for 5G. 4G versus 5G, Next Generation Core (NG-Core), visualized Evolved Packet Core (vEPC).

UNIT-II: **5G CONCEPTS AND CHALLENGES**   **9**

Fundamentals of 5G technologies, Overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT-III: **NETWORK ARCHITECTURE AND THE PROCESSES**   **9**

5G architecture and core, Network slicing, Multi access edge computing (MEC) Visualization of 5G components, End-to-end system architecture, Service continuity, Relation to EPC, and Edge computing.

UNIT-IV: **PROTOCOLS AND SPECTRUM MANAGEMENT**   **9**

5G protocols: 5G NAS, NGAP, GTP-U, IP Sec and GRE, Mobility management, Command and control, Spectrum sharing and Spectrum trading, Cognitive radio based on 5G.

UNIT-V: **SECURITY IN 5G NETWORKS**   **9**

Security features in 5G networks, Network domain security, User domain security, Flow based QoS framework, Mitigating the threats in 5G.

                                              TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Emphasize the basic theory of evolution of communication techniques.
- Apply the concepts of 4G communication.
- Assess the need for 5G communication Techniques.
- Comprehend architecture and protocols for 5G communication.

- Understand the principles of dynamic spectrum management.
- Analyze the security aspects in 5G networks.

TEXT BOOKS:

1. Stephen Rommer, "5G Core networks: Powering Digitalization", Academic Press, 2019.
2. Saro Velrajan, "An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases", First Edition, 2020.

REFERENCES:

1. Jyrki. T.J. Penttinen, "5G Simplified: ABCs of Advanced Mobile Communications", Copyrighted Material.
2. Wan Lee Anthony, "5G system Design: An end to end Perspective", Springer Publications,2019.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	-	2	-	-	-	-	-	3	2	2	-	-
2	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
3	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
4	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
5	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
6	3	2	3	2	-	2	-	-	-	-	-	2	2	2	-	-
Average	3.0	2.8	2.8	2.0	-	2.0	-	-	-	-	-	2.2	2.0	2.0	-	-

OEC102   **INTRODUCTION TO INDUSTRIAL IoT**   **L T P C**
                                                           3 0 0 3

OBJECTIVES:

- To understand basic industrial processes and its reference architecture
- To perceive the knowledge of networks and programming of IIOT.
- To study the role of sensors, actuators and communication protocols used for interfacing.
- To introduce and familiarize the industry 4.0
- To master security in IIOT
- To study application of IIOT in various fields.

UNIT-I: INTRODUCTION TO INDUSTRIAL IoT AND ITS ARCHITECTURE   9

IIoT Introduction, Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain – Implementation View point – Architectural Topology – Three Tier Topology – Data Management.

UNIT-II: NETWORKING AND PROGRAMMING OF IIoT   9

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication. Industrial IoT-Layers: IIoT Communication, IIoT Networking. Industrial IoT: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop.

UNIT-III: SENSOR AND INTERFACING   9

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, and M2M.

UNIT-IV: COMPUTATION IN IIoT AND SECURITY   9

SDN in IIoT, Data Center Networks, Industrial IoT: Security and Fog Computing- Cloud Computing in IIoT, Industrial IoT Application Domains: Factories and Assembly Line, Food Industry.

UNIT-V: IIoT APPLICATIONS   9

Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security: AR and VR safety applications, Facility Management. Industrial IoT-

Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Interpret basic industrial processes and its reference architecture
- Comprehend to the modern networking technologies and programming of IIOT.
- Illustrate the sensors, actuators and communication protocols used for interfacing.
- Analyze the concepts and gain insights into Industry 4.0
- Handle real time security issues in IIOT.
- Realize the importance of IIoT applications in real time.
- Create numerous IOT applications with the physical world of humans and real life problem solving.

TEXT BOOKS:

1. S. Misra, C. Roy, and A. Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0". CRC Press.2020
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2017
3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawart, "Industrial Internet of Things: Cybermanufacturing Systems", Springer, 2017.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

REFERENCES:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
2. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key, applications and Protocols", Wiley, 2012.
4. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	1	-	-	-	-	-	-	-	-	3	1	2	-	-
2	1	-	1	-	-	-	-	-	-	-	-	2	2	2	-	-
3	2	3	3	3	-	-	-	-	-	-	-	2	2	3	-	-
4	1	-	2	-	-	-	-	-	-	-	-	2	2	2	-	-
5	2	1	3	2	-	-	-	-	-	-	-	2	3	2	-	-
6	2	3	3	2	-	-	-	-	-	-	-	2	3	2	-	-
Average	1.5	2.3	2.2	2.3	-	-	-	-	-	-	-	2.2	2.2	2.2	-	-

OEC103   ARDUINO PROGRAMMING AND ITS APPLICATIONS   L T P C

3 0 0 3

OBJECTIVES:

- To understand the evolution of IoT boards.

- To program Arduino to control lights, motors and other devices.

- To learn Arduino's architecture, including inputs and connectors for add-on devices.

- To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.

- To explore various options in programming Arduino boards.

- To test, debug, and deploy the Arduino to solve real world problems.

UNIT-I: INTRODUCTION TO SENSORS   9

Transducers, Classification, Roles of sensors in IoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators.

UNIT-II: ARDUINO GPIOs and APIs   9

Hardware requirement for Arduino, connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, APIs / Packages- Quark SOC processor.

UNIT-III: ARDUINO INTERFACES   9

Sensor with Arduino- Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal - Reading various sensor data on serial monitor and LCD Display.

UNIT-IV: PROGRAMMING IN ARDUINO IoT DEVICE   9

Preparing the development environment (Arduino IDE), Exploring the Arduino language syntax, Coding, compiling, and uploading to the microcontroller, Working with Arduino Communication Modules: Bluetooth Modules, Wi-Fi Modules and I2C and SPI.

UNIT-V: PROGRAMMING ESP 8266 MODULE   9

ESP8266 Wi-Fi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor, Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via Thing Speak.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the basics of sensors, its functioning
- Execute basic and advanced assembly language programs.
- Learn the ways to interface I/O devices with processor for task sharing.
- Evoke the basics of co-processor and its ways to handle float values by its instruction set
- Recognize the functionality of micro controller, latest version processors and its applications.
- Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyse the results.

TEXT BOOKS:

1. Simon Monk, "Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi", 2nd Edition, McGraw-Hill Education, 2017.
2. Donald Norris, "The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black", 1 st edition, McGraw Hill Education, 2015.

REFERENCES:

1. Marco Schwartz, "Home Automation with Arduino", 3rd edition, Open Home Automation 2014.
2. Schwartz, Marco, "Internet of things with arduino cookbook", 1st edition, Packt Publishing Ltd, 2016.
3. Kooijman Matthijs, "Building Wireless Sensor Networks Using Arduino", 1st edition, Packt Publishing Ltd, 2015.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	-	-	-	-	-	-	-	3	2	2	-	-
2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
3	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
5	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
6	3	2	3	2	-	-	-	-	-	-	-	2	2	2	-	-
Average	3.0	2.8	2.8	2.0	-	-	-	-	-	-	-	2.2	2.0	2.0	-	-

OMD101   **INTRODUCTION TO FOOD PROCESSING**   **L T P C**

                                                                    3 0 0 3

OBJECTIVES:

- To learn about the shelf life of food products.

- To gain knowledge on the storage of food products.

- To know about the thermal and non-thermal processing methods of food.

- To design different types of Dryers and methods to prevent food wastage.

- To understand the Food Hygiene methods and its importance.

UNIT-I: FOOD PROCESSING AND ITS IMPORTANCE   9

Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT-II: METHODS OF FOOD HANDLING AND STORAGE   9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods. Retort pouch packing, Aseptic packaging.

UNIT-III: THERMAL METHODS AND NON-THERMAL METHODS   9

Newer methods of thermal processing- batch and continuous - In container sterilization canning - application of infra-red microwaves - ohmic heating - control of water activity - preservation by concentration and dehydration - osmotic methods. Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

UNIT-IV: DRYING PROCESS FOR TYPICAL FOODS & FOOD WASTES   9
                    IN VARIOUS PROCESSES

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages. Waste disposal-solid and liquid waste, rodent and insect control, use of pesticides, ETP, selecting and installing necessary equipment.

Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Aware of the different methods applied to preserving foods.
- Explain the food handling and storage processes.
- Analyze the thermal and non-thermal processing methods.
- Explore the drying process of foods.
- Understand Food Hazards, Adulteration, and Safety in handling and procurement & Microbial considerations and sanitation.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund, "Physical Principles of Food Preservation", Rutledge, 2003.
2. VanGarde S. J and Woodburn M, "Food Preservation and Safety Principles and Practice", Surbhi Publications, 2001.
3. Sivasankar B, "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005

REFERENCES:

1. Shafiur M Rahman, "Handbook of Food Preservation", Second Edition, CRC Press, 2007
2. Zeuthen Peter, Bogh-Sorensen Leif, "Food Preservation Techniques", Wood Head Publishing, Cambridge, England, 2005.
3. Ranganna S, "Handbook of Canning and Aseptic Packaging", Tata McGraw-Hill, 2000.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	3	-	1	1	-	-	-	-	-	-	1	-	-
2	2	3	1	2	-	-	-	2	-	-	-	2	-	1	-	-
3	3	2	1	2	-	1	1	-	-	-	-	2	-	1	-	-
4	3	2	1	2	-	1	1	-	-	-	-	2	-	1	-	-
5	3	1	2	-	-	1	1	-	-	-	-	2	-	1	-	-
Average	2.6	2.0	1.3	2.3	-	1.0	1.0	2.0	-	-	-	2.0	-	1.0	-	-

OMD102   INTRODUCTION TO BIOMEDICAL INSTUMENTATION   L T P C
                                                                      3 0 0 3

OBJECTIVES:

- To explore the characteristics of electrode configuration.
- To study the characteristics of Bio signals.
- To explain the necessity of bio amplifiers in biomedical signal processing.
- To analyze the different techniques used for measurement of non-electrical bio-parameters.
- To understand the biochemical measurement techniques and sensors.

UNIT-I: ELECTRODE CONFIGURATIONS   9

Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non- polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT-II: BIOSIGNAL CHARACTERISTICS   9

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT-III: BIOAMPLIFIERS   9

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

UNIT-IV: MEASUREMENT OF BIO SIGNALS   9

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements.

UNIT-V: BIOCHEMICAL MEASUREMENTS   9

Biochemical sensors - pH, pO_2 and pCO_2, Ion selective Field Effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

OUTCOMES:

At the end of this course, the students will be able to:

- Illustrate the origin of various biological signals and their characteristics.
- Apply knowledge of bio signal characteristics.
- Gain knowledge on various amplifiers involved in monitoring bio signals.
- Identify appropriate instruments and methods for each physiological parameter.
- Examine the biochemical measurement techniques.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", second edition, Academic Press,2005.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-	-
4	3	2	1	1	-	-	-	-	-	-	1	-	2	1	-	-
5	3	2	1	1	-	-	-	-	-	-	1	-	2	1	-	-
Average	3.0	2.0	1.0	1.0	-	-	-	-	-	-	1.0	-	2.0	1.0	-	-

OME101   REFRIGERATION AND AIR CONDITIONING   L T P C

                                                                    3 0 0 3

OBJECTIVES:

- To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
- To study the Vapour absorption and air refrigeration systems.
- To learn the psychrometric properties and processes.
- To study the air conditioning systems and load estimation.

UNIT-I: INTRODUCTION   9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT-II: VAPOUR COMPRESSION REFRIGERATION SYSTEM   9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT-III: OTHER REFRIGERATION SYSTEMS   9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic Vortex and Pulse tube refrigeration systems.

UNIT-IV: PSYCHROMETRIC PROPERTIES AND PROCESSES   9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT-V: AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION   9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications,

Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the basic concepts of Refrigeration.
- Explain the Vapor compression Refrigeration systems and to solve problems.
- Discuss the various types of Refrigeration systems.
- Calculate the Psychrometric properties and its use in psychrometric processes.
- Explain the concepts of Air conditioning and to solve problems.

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010
2. R.S. Khurmi, "Textbook of Refrigeration and Air-Conditioning (M.E.)", 10 February 2019.

REFERENCES:

1. ASHRAE Hand book, Fundamentals, 2010.
2. Jones W. P, "Air conditioning engineering", 5th edition, Elsevier Butterworth Heinemann, 2007.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
2	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
3	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
4	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
5	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
Average	2.0	1.0	1.0	1.0	-	-	2.0	-	1.0	-	-	1.0	2.0	2.0	-	-

OME102   ADVANCED MANUFACTURING PROCESSES   **L T P C**

3 0 0 3

OBJECTIVES:

- To describe the concepts of various metal casting processes.
- To demonstrate the concepts of various metal joining processes.
- To describe unconventional machining processes.
- To demonstrate thermal and electrical based processes.
- To describe the chemical and electrochemical-based process parameters, their influence on performance, and their application.

UNIT-I: METAL CASTING   9

Casting terminology, pattern material, allowance; Pattern types: Single piece, split, gated; Core prints, moulding sand properties, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - Stir casting; Defects in Sand casting.

UNIT-II: JOINING PROCESSES   9

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding. brazing, soldering and adhesive bonding; Weld defects: types, causes and cure.

UNIT-III: MECHANICAL ENERGY BASED PROCESSES   9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining - (AJM, WJM, AWJM and USM) - Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT-IV: THERMAL AND ELECTRICAL ENERGY BASED PROCESSES   9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipment - Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits- Tool Wear –Dielectric – Flushing – Applications. Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Working Principles – Equipment –Types – Beam control techniques – Applications.

UNIT-V: CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED   9
PROCESSES

Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant – techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- Equipment -Surface Roughness and MRR Electrical circuit -Process Parameters ECG and ECH – Applications.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the various metal casting processes.
- Understand the various metal joining techniques.
- Describe the unconventional machining processes and the mechanical processes.
- Understand the thermal and electrical-based processes.
- Understand the chemical and electrochemical-based process parameters, their influence on performance, and their application.

TEXT BOOKS:

1. Serope Kalpakjian, Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education, Eighth Edition, 2020.
2. P.N. Rao, "Manufacturing Technology: Foundry, Forming and Welding – Volume 1", Tata McGraw-Hill Publishing Limited, 2019.

REFERENCES:

1. P.C. Sharma, "A text book of Production Technology (Manufacturing Processes)", S. Chand and Company, 8th Edition 2014.
2. S. Gowri, P. Hariharan and A. Suresh Babu, "Manufacturing Technology 1", Pearson Education, 2020.

E- RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107219
2. https://archive.nptel.ac.in/courses/112/105/112105212

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
2	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
3	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
4	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
5	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
Average	2.0	-	1.0	-	1.0	-	1.0	-	1.0	1.0	-	1.0	1.0	1.0	-	-

OME103 **MATERIAL TESTING AND CHARACTERIZATION** **L T P C**

3 0 0 3

OBJECTIVES:

- To describe the phase structure of metals/alloys.
- To demonstrate the heat treatment process employed for various materials.
- To describe the classification of ferrous and nonferrous alloys.
- To describe the Practical exposure towards microstructure of Engineering Materials.
- To demonstrate the Mechanical testing tools for engineering materials.

UNIT-I: BINARY PHASE DIAGRAM **9**

Solid solutions: Substitutional and interstitial – Compound – Phase diagram: Classification - Phase reactions with an example: Isomorphous, eutectic, eutectoid, peritectic and peritectoid, Iron – Iron carbide diagram.

UNIT-II: HEAT TREATMENT PROCESSES **9**

Full, stress relief, recrystallization and spherodizing annealing – normalizing, hardening and tempering of steel –phase transformation - Isothermal transformation (TTT) diagram for Eutectoid Steel – cooling curves - CCR –Hardenability - Jominy end quench test – Austempering - martempering. Case hardening - carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening.

UNIT-III: FERROUS ALLOYS **9**

Classification, properties, microstructure, processing and applications of low, medium & high carbon steel & FG, SG, White, Malleable cast iron – effect of alloying elements on steel (Cr, Mo, V, Ti, Ni & W) - stainless steel and tool steels - HSLA steel & Maraging steels – Die steel, Wear of Metals - BIS Specification.

UNIT-IV: NON-FERROUS ALLOYS **9**

Properties, Composition, Applications: Copper and its alloys - Brass, Bronze and Cupronickel – Aluminium and its alloys – Duralumin- Bearing alloys. Nickel and Titanium base alloys – Metals for low and high temperature applications- BIS Specification.

UNIT-V: MECHANICAL TESTING **9**

Mechanical properties - stress - strain curve for ferrous and non-ferrous alloys - Mechanism of plastic deformation, slip and twinning – Fracture: types – Griffith theory - Material testing: Tensile, compression and shear loads –Hardness tests: Brinell, Rockwell

and Vickers - Impact test: Izod and Charpy - Fatigue and creep tests - fracture toughness tests - Characterization techniques: Optical, SEM, XRD.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Recall the phase reactions of various metals and alloys.
- Have great exposure in the heat treatment processes and know their purpose in engineering applications.
- Have knowledge in the classification, properties and applications of various ferrous alloys.
- Understand the classification and application of various nonferrous alloy materials.
- Identify the various mechanical properties for the ferrous and nonferrous alloys using modern testing facilities.

TEXT BOOKS:

1. Jindal U. C, "Material science and Metallurgy", Pearson New Delhi, 2015.
2. Selvakumar N, "Engineering Metallurgy and Nanotechnology", Scitech Publications (India) Pvt. Ltd., 2018.

REFERENCES:

1. Raghavan.V, "Materials Science and Engineering", Prentice-Hall, 6th Edition, 2015.
2. William D. Callister and David G. Rethwisch, "Material Science and Engineering: An Introduction", John Wiley, 10th Edition, 2018.

E- RESOURCES:

1. https://nptel.ac.in/courses/112108150.
2. https://www.digimat.in/nptel/courses/video/113107078/L01.html

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
2	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
3	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
4	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
5	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
Average	3.0	1.0	3.0	1.0	-	-	-	-	-	-	-	1.0	1.0	1.0	-	-

OME104   **HAZARDOUS WASTE MANAGEMENT**   **L T P C**

                                                                    3 0 0 3

OBJECTIVES:

- To understand the type, nature of hazardous wastes.
- T o study the hazardous wastes management.
- To study the biomedical waste management.
- To study the radioactive waste management.
- To study the E-Waste Management.

UNIT-I: INTRODUCTION   9

Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste -Physical and biological routes of transport of hazardous substances.

UNIT-II: HAZARDOUS WASTES MANAGEMENT   9

Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment technologies - Physical, chemical and thermal treatment of hazardous waste – Solidification- Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste landfills - Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques.

UNIT-III: BIOMEDICAL WASTE MANAGEMENT   9

Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources– Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection – Disposal-Infection control Practices.

UNIT-IV: RADIOACTIVE WASTE MANAGEMENT   9

Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes - Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB.

UNIT-V: E-WASTE MANAGEMENT   9

Regulatory aspects of E-I Waste management, Waste characteristics- Generation–-Collection - Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e- waste management.

                                                        TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Gain the knowledge of the type, nature hazardous wastes.
- Plan minimization of hazardous wastes.
- Handle the bio medical Waste.
- Handle the radioactive waste.
- Handle the E- Waste Management.

TEXT BOOKS:

1. Charles A. Wentz, "Hazardous waste management", Second edition 1995, McGraw Hill International.
2. Michael D. La Gerga, PhilipL Buckingham, Jeffrey C. Evans, "Hazardous waste management", Second edition 2010.Waveland Press.

REFERENCES:

1. William C. Blackman Jr., "Basic Hazardous waste management", Third Edition, 2001, Lewis Publishers
2. "Integrated solid waste management", George Techobanoglous, Hilary Theisen & Sammuel A. Vigil.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
2	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
3	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
4	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
5	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
Average	2.0	1.0	1.0	-	-	-	3.0	-	1.0	-	-	1.0	1.0	2.0	-	-

OME105   **AUTOMOTIVE ENGINEERING**   **L T P C**

                                                    3 0 0 3

OBJECTIVES:

- The intention and purpose of this course is to study the basics of electronics, emission controls and its Importance in automobiles.

- To study the Ignition and Injection system in Automobiles

- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.

- To study the various blocks of mechatronics control units used for control of fuel, ignition and exhaust systems.

- To learn about different types of chassis and mechatronics safety systems in automobile.

UNIT-I: INTRODUCTION   9

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT-II: IGNITION AND INJECTION SYSTEMS   9

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT-III: SENSOR AND ACTUATORS IN AUTOMOTIVES   9

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT-IV: ENGINE CONTROL SYSTEMS   9

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT-V: CHASSIS AND SAFETY SYSTEMS   9

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of air bag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Know the importance of emission standards in automobiles.
- Understand the electronic fuel injection and ignition components and their function.
- Choose and use sensors and equipment for measuring mechanical quantities temperature and appropriate actuators.
- Diagnose electronic engine control systems problems with appropriate diagnostic tools.
- Analyze the chassis and vehicle safety system.

TEXT BOOKS:

1. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2017.
2. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 7th edition, 2019.

REFERENCES:

1. Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication, 4th edition, 2000.
2. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
2	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
3	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
4	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
5	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
Average	3.0	2.0	1.0	1.0	1.0	-	-	-	-	-	1.0	1.0	1.0	2.0	-	-

OCH101   **NANOMATERIALS AND APPLICATIONS**   **L T P C**

3 0 0 3

OBJECTIVES:

- To make the students familiar with the properties and applications of nanomaterials.
- To acquaint the student with the synthesis of nanomaterials by different methods.
- To provide knowledge on the different characterisation techniques employed to characterise the nanomaterials.
- To inculcate the students on the knowledge of nanocomposites, biodegradable polymer-based nanocomposites, and clay polymer nanocomposites.
- To enlighten the needs and utilization of nanomaterials in various fields such as energy, water treatment process, agriculture, electronics, medicine, engineering and Information technology.

UNIT-I: PROPERTIES OF NANOMATERIALS   9

Definition – importance of nano structured materials - size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials. Surface area - band gap energy and its applications. Photochemistry and electrochemistry of nanomaterials –ionic properties of nanomaterials- Nanocatalysis. Green Materials – biomaterials, biopolymers and bioplastics.

UNIT-II: SYNTHESIS OF NANOMATERIALS   9

Bottom-up and top-down approach to obtain nanomaterials. Chemical methods: co-precipitation methods, sol-gel technique, photochemical synthesis. Physical methods: high energy ball milling, PVD methods, gas phase condensation and magnetron sputtering.

UNIT-III: STRUCTURAL CHARACTERISTICS   9

Introduction, principles, instrumentation and applications of powder X-ray diffraction, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, nanoindentation, small angle X-ray and neutron scattering and BET analysis method.

UNIT-IV: NANOCOMPOSITES   9

Introduction, the importance of nanocomposites, binary and ternary nanocomposites. Synthesis, properties and applications of metal-metal oxide and metal oxide-metal oxide

nanocomposites, biodegradable polymer-based nanocomposites, thermoplastic nanocomposites, nylon-6 nanocomposites, clay polymer nanocomposites.

UNIT-V: APPLICATIONS OF NANOMATERIALS   9

Introduction, applications of nanomaterials in renewable energy generation, drug delivery, cosmetics, tissue engineering, bioinformatics, nanomedicine, molecular motors, bioelectronics & spintronics, textiles, cosmetics, agriculture & food technology, high integrated circuits, information technology, defence and aerospace. Practice of nanoparticles for environmental remediation and water treatment.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Evaluate and understand the different types of nanomaterials and their properties.
- Understand the proper methods for synthesizing nanomaterials.
- Recommend the characterization techniques for various nanomaterials.
- Illustrate the functioning and properties of nanocomposites and their interference.
- Develop a more profound knowledge on the applications of nanomaterials in various fields.

TEXT BOOKS:

1. C. N. R. Rao, Achim Muller, Anthony K. Cheetham, "The Chemistry of Nanomaterials: Synthesis, Properties and Applications", 2nd Edition Wiley-VCH, Germany, 2006.

2. Geoffrey A. Ozin, Andre C. Arsenault, Ludovico Cademartiri, Chad A. Mirkin, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2nd Edition, United Kingdom, 2008.

3. Azamal Husen, Khwaja Salahuddin Siddiqi, "Advances in Smart Nanomaterials and their Applications (Micro and Nano Technologies)", 1st Edition, Elsevier, Netherlands, 2023.

REFERENCES:

1. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis, United Kingdom, 2012.

2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, London, 2004.

3. N. Kumar, "Concise concepts of nanoscience and nanomaterials", Scientific publishers, New Delhi, 2019.

4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, Hyderabad, 2018.

5. Korada, Viswanatha Sharma, Hamid, Nor Hisham, Engineering Applications of Nanotechnology: From Energy to Drug Delivery, Springer, United States, 2017.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	2	-	-	-	-	-	-	-	-	1	-	-	-	-
3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
4	2	1	1	1	-	1	-	1	-	-	-	1	-	-	-	-
5	2	1	1	1	1	1	-	1	-	-	-	1	-	-	-	-
Average	2.0	1.0	1.3	1.0	1.0	1.0	-	1.0	-	-	-	1.0	-	-	-	-

OPH101 **ADVANCED FUNCTIONAL MATERIALS** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the sensors and actuators.
- To facilitate the knowledge about photoactive functional soft materials.
- To enrich the idea of Functional magnetic materials.
- To explore bio mimics, bionics and biomineralization.
- To enhance the fundamental knowledge about Energy Functional materials and molecular Electronics.

UNIT-I: FUNCTIONAL MATERIALS FOR SENSORS AND ACTUATORS 9

Introduction of sensors - differences between transducers, Sensors and Actuators-Conducting polymers sensor materials- Conducting polymer FET sensor - Chemi resistive sensor. Introduction of actuators and its working principle - Electrochromic and Electroactive Polymer actuators: Wet and Dry Electroactive polymer actuators (EAP).

UNIT-II: PHOTOACTIVE FUNCTIONAL SOFT MATERIALS 9

Introduction - soft materials-photo thermal effect-photo isomerisation-photo switches - opto fluidics. micro soft robotics-light driven micro pumps and micro mixers – Photo acutuation. Photo tunable photonic crystals-photo patterning and alignment. Optical control in a chiral photo magnet.

UNIT-III: FUNCTIONAL MAGNETIC MATERIALS 9

Magneto caloric effect-magnetic cooling and heating-Magneto caloric materials for heat pumping applications. Soft magnetic wires for sensor applications-Magnetic bistability and domain wall propagation. slow magnetic relaxation-magnetic molecular materials - single molecule magnets-single ion magnets - single chain magnets - molecular spin qubits.

UNIT-IV: ENERGY MATERIALS AND MOLECULAR ELECTRONICS 9

Electro chemical capacitor - super capacitors for energy storage - single junction solar cell-Tandem solar cell - Dye sensitized solar cells – Quantum dot solar cell - Organic solar cells – Semiconductor nanostructures. Superconductors for energy storage systems and transportation. Organic electronics- Organic LED – spintronics - dilute magnetic semiconductors.

UNIT-V: BIO-INSPIRED MATERIALS 9

Bio-inspired materials, Classification, Biomimics, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics' - Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization-En route to Nanotechnology; Biometals – bioceramics- bio synthetic polymers.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Gain knowledge on the basics of conducting polymer sensors, actuators and FET sensors.
- Have adequate knowledge on the soft materials, and micro soft robotics.
- Have knowledge on the concepts Magneto caloric effect, magnetic cooling and heating.
- Understand the basics of Bio-inspired materials and Bio-inspired Information Technologies
- Get knowledge on electro chemical capacitor and spintronics.

TEXT BOOKS:

1. Hasse Fredriksson, KTH Stockholm, Sweden and Ulla Åkerlind University of Stockholm, Sweden, "Physics of Functional Materials", John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, 2008.
2. S Banerjee, A.K. Tyagi, "Functional Materials- Preparation, Processing and Applications", Elsevier, 2011.
3. Chander Prakash, Sunpreet Singh, J. Paulo Davim, "Functional and Smart Materials", CRC Press, 2020.
4. Arcady Zhukov, "Novel Functional Magnetic Materials- Fundamentals and Applications", Springer International Publishing, 2016.
5. Insup Noh, "Biomimetic Medical Materials- From Nanotechnology to 3D Bioprinting", Springer Singapore, 2018.

REFERENCES:

1. Quan Li, "Photoactive Functional Soft Materials Preparation, Properties, and Applications", Wiley-VCH, 2019.
2. Hee-Gweon Woo, Hong Li, "Advanced Functional Materials", Springer, 2011.

3. Rupitsch, Johann S, "Piezoelectric Sensors and Actuators", Springer-Verlag Berlin Heidelberg, 2018.

4. G. Arthanareeswaran, Pei Sean Goh, S. A. Gokula Krishnan, "Functional Polymers and Nanomaterials for Emerging Membrane Applications", CRC Press, 2023.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	-	-	1	1	-	-	-	-	1	-	-	-	-
2	3	2	2	1	2	1	1	-	-	-		1	-	-	-	-
3	3	2	1	1	2	1	1	-	-	-	-	1	-	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
5	3	2	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Average	3.0	1.8	1.6	1.0	1.5	1.0	1.0	-	-	-	-	1.0	-	-	-	-

MINOR DEGREE COURSES

VERTICAL 1: FINTECH AND BLOCKCHAIN

BAM101 **FINANCIAL MANAGEMENT** **L T P C**

3 0 0 3

OBJECTIVES:

- To acquire the knowledge of the decision areas in finance.
- To learn the various sources of Finance.
- To describe about capital budgeting and cost of capital.
- To discuss on how to construct a robust capital structure and dividend policy.
- To develop an understanding of tools on Working Capital Management.

UNIT-I: **INTRODUCTION TO FINANCIAL MANGEMENT** **9**

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of Money-Risk and return concepts.

UNIT-II: **SOURCES OF FINANCE** **9**

Long term sources of Finance-Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits etc.

UNIT-III: **INVESTMENT DECISIONS** **9**

Investment Decisions: Capital budgeting – Need and Importance –Techniques of Capital Budgeting - Payback - ARR – NPV – IRR – Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock - Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT-IV: **FINANCING AND DIVIDEND DECISION** **9**

Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy.

UNIT-V: **WORKING CAPITAL DECISION** **9**

Working Capital Management: Working Capital Management - concepts - importance - Determinants of Working capital - Working capital operating cycle. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

OUTCOMES:

At the end of this course, the students will be able to:

- Have an understanding on Time value of money and role of a finance manager.
- Analyze the various avenues available to generate long term funds for investments through capital markets and other sources.
- Apply various techniques for Investment decisions.
- Choose the right approach for financing and dividend decisions to solve business issues.
- Analyze the requirement and management of working capital.

REFERENCES:

1. M.Y. Khan and P.K. Jain, "Financial Management, text, problems and cases", Tata McGraw Hill, 8th edition 2017.
2. I.M. Pandey, "Financial Management", Vikas Publishing House Pvt. Ltd., 11th edition, 2018.
3. Prasanna Chandra, "Financial Management – Theory and Practice", 9th edition, Tata McGraw Hill, 2017.
4. Rajiv Srivastava and Anil Misra, "Financial Management", Oxford University Press, 2011.
5. ParasuramanN. R, "Financial Management: a step-by-step approach", 2nd edition, Cengage Learning India Pvt. Ltd., 2019.

BAM102   **FUNDAMENTALS OF INVESTMENT**   **L T P C**

                                                               3 0 0 3

OBJECTIVES:

- To describe the investment environment and understand the factors influencing investment decisions.
- To explain the methods of valuing bonds and equities.
- To examine various approaches used in the valuation of securities.
- To understand the principles of portfolio construction and the role of diversification in creating efficient portfolios.
- To discuss the mechanisms of investor protection in India, including regulatory frameworks and investor rights.

UNIT-I: THE INVESTMENT ENVIRONMENT   9

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT-II: FIXED INCOME SECURITIES   9

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating. Yield Measures: Current Yield, Yield to Maturity (YTM), Yield to Call (YTC) Money Market Instruments (Treasury Bills, Certificates of Deposit, Commercial Paper). Credit Rating Agencies in India (CRISIL, ICRA, CARE, India Ratings).

UNIT-III: APPROACHES TO EQUITY ANALYSIS   9

Introduction to Fundamental Analysis, Technical, Analyze macroeconomic indicators: GDP, interest rates, inflation, etc. Sector and industry analysis (Porter's Five Forces). Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT-IV: PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES   9

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT-V: INVESTOR PROTECTION   9

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism. Concept of Fair Disclosure and Transparency. Sustainable Investing and ESG.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand basic investment concepts and their significance, and analyze various investment avenues including stocks, bonds, mutual funds, real estate, commodities, and financial derivatives.

- Evaluate risk and return profiles of different investment options using appropriate tools and techniques, and interpret market trends and economic indicators to make informed investment decisions.

- Apply principles of portfolio construction and management to optimize investment returns.

- Develop a long-term investment strategy aligned with financial goals and risk appetite.

- Explain the regulatory framework for investor protection in India and the principles of sustainable and ethical investing.

REFERENCES:

1. Pinto J. E, Henry E, Robinson T. R & Stowe J. D, "Equity Asset Valuation", (4th ed.), Wiley India, 2023.
2. Chandra P, "Fundamentals of Investment", (Revised ed.) McGraw-Hill Education, 2022.
3. Mishkin, F. S., & Eakins, S. G. Financial Markets and Institutions (9th ed., Indian adaptation by Aparna Pujari 2021.
4. Sundaresan, S. Fixed Income Securities (4th ed.). McGraw-Hill Education 2021.
5. Graham, B., & Dodd, D. Security Analysis (7th ed.). McGraw-Hill Education 2020.

BAM103   BANKING, FINANCIAL SERVICES AND INSURANCE   L T P C

3 0 0 3

OBJECTIVES:

- To understand the Banking system in India.
- To grasp how banks, raise their sources and how they deploy it.
- To understand the development in banking technology.
- To understand the financial services in India.
- To understand the insurance Industry in India.

UNIT-I: INTRODUCTION TO INDIAN BANKING SYSTEM   9

Overview of Banking system–Structure– Functions–Banking system in India –Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT-II: MANAGING BANK FUNDS / PRODUCTS   9

Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market.

UNIT-III: DEVELOPMENT IN BANKING TECHNOLOGY   9

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT-IV: FINANCIAL SERVICES   9

Introduction – Need for Financial Services – Financial Services Market in India – NBFC –– Leasing and Hire Purchase –– mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking.

UNIT-V: INSURANCE   9

Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Identify and describe the roles and interrelationship of institutions in the banking, financial services, and insurance sectors.
- Understand key functions such as deposits, loans, credit creation, and payment systems in both commercial and central banking.
- Analyze various products such as savings accounts, fixed deposits, mutual funds, credit cards, and insurance policies.
- Demonstrate an understanding of the regulatory environment, including acts, guidelines, and the roles of RBI, SEBI, IRDAI, etc.
- Assess the impact of digital banking, and e-insurance services on customer experience and operational efficiency.

REFERENCES:

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010.
3. Peter S. Rose and Sylvia C and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017.
4. M. Y. Khan, "Indian Financial System", McGraw Hill Education, 2019 10th Edition.
5. L. M. Bhole & Jitendra Mahakud, "Financial Markets and Institutions", McGraw Hill Education, 2021 6th Edition.

CSM101   **INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS   L T P C**

3 0 0 3

OBJECTIVES:

- To understand Blockchain's fundamental components, and examine decentralization using blockchain.
- To explain how cryptocurrency works, from when a transaction is created to when it is considered part of the Blockchain.
- To explain the components of Ethereum and Programming Languages for Ethereum.
- To study the basics of Hyperledger and Web3.
- To know about alternative Blockchains and Blockchain projects in different domains.

UNIT-I: INTRODUCTION TO BLOCKCHAIN   9

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

UNIT-II: INTRODUCTION TO CRYPTOCURRENCY   9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

UNIT-III: ETHEREUM   9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

UNIT-IV: WEB3 AND HYPERLEDGER   9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT-V: ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS   9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the technology components of Blockchain and how it works behind the scenes.

- Understand Bitcoin and its limitations by comparing with other alternative coins.

- Devise solution using the Ethereum model.

- Understand and use Hyperledger and its development framework.

- Track alternative Blockchains and emerging trends in Blockchain.

TEXT BOOK:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.

2. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly, 2014.

3. Roger Wattenhofer, "The Science of the Blockchain", CreateSpace Independent Publishing, 2016.

4. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.

5. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	1	-	-	3	-	-	1	-	-	3	-	-	-
2	-	3	3	-	-	-	-	3	3	-	-	-	-	3	-	-
3	-	-	3	1	-	-	-	-	3	1	-	-	-	-	3	-
4	3	-	-	-	-	-	3	-	-	-	-	-	1	1	-	-
5	-	-	-	-	3	-	-	-	-	-	3	-	2	3	1	3
Average	3.0	3.0	3.0	1.0	3.0	-	3.0	3.0	3.0	1.0	3.0	-	2.0	2.3	2.0	3.0

BAM104   FINTECH PERSONAL FINANCE AND PAYMENTS   L T P C

3 0 0 3

OBJECTIVES:

- To introduce the foundational concepts of Financial Technology (FinTech) and its applications in personal finance, inclusive finance, and digital financial services.

- To familiarize students with digital payment systems and cryptocurrencies, including their underlying technologies, security concerns, and legal frameworks.

- To provide insights into InsurTech innovations, focusing on the integration of AI, ML, and IoT in risk management, underwriting, and fraud detection in insurance.

- To enable understanding of peer-to-peer lending models and crowdfunding ecosystems, with a focus on digital infrastructure and financing solutions for SMEs and MSMEs.

- To develop awareness of global and domestic FinTech regulations, and the emergence of RegTech as a tool for ensuring regulatory compliance and fraud monitoring using AI.

UNIT-I: INTRODUCTION TO FINTECH AND DIGITAL FINANCE   9

Overview of FinTech: Definition, scope, applications. History of Financial Innovation and Digitization. Alternative Finance: Crowdfunding – Types (Charity, Equity), platforms. Introduction to Initial Coin Offering (ICO). Role of FinTech in personal finance and inclusive finance.

UNIT-II: DIGITAL PAYMENTS AND CRYPTOCURRENCIES   9

Introduction to Cryptocurrencies: Bitcoin and Applications. Types of Cryptocurrencies and Digital Wallets. Basics of Blockchain Technology. National Payment Systems: Real-Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Unified Payments Interface (UPI). Digital Payments: Smart Cards, Mobile Payments, Payment Gateways, Virtual Currencies. Legal, Security, Privacy, and Ethical Issues in Digital Transactions.

UNIT-III: INSURTECH AND DIGITAL INSURANCE INNOVATIONS   9

Introduction to InsurTech. Role of (Artificial Intelligence (AI), Machine Language (ML), and Internet of Things (IoT) in insurance services. Risk Modelling, Fraud Detection. Innovations in Claims Processing and Underwriting. Impact on traditional insurance business models.

UNIT-IV: P2P LENDING AND FINANCIAL INCLUSION   9

Peer-to-Peer (P2P) and Marketplace Lending. Architecture and Technology Platforms. Crowdfunding Unicorns and Business Models. Financing for SME/MSME – Opportunities, Challenges, and FinTech Solutions.

UNIT-V: FINTECH REGULATIONS AND REGTECH   9

Global and Indian FinTech Regulations. Legal and Regulatory Risks. RegTech: Definition, Evolution. RegTech Ecosystem – Institutions, Startups, Regulators. Role of AI in Compliance and Fraud Monitoring.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the fundamentals of cryptocurrencies, digital wallets, blockchain and payment systems such as UPI, RTGS, and IMPS, along with related security and regulatory aspects.

- Describe the evolution of digital finance and analyze alternative finance models like crowdfunding and Initial Coin Offerings (ICO).

- Evaluate the role of AI, ML, and IoT in InsurTech applications such as underwriting, claims processing, risk modeling, and fraud detection.

- Analyze P2P lending and crowdfunding platforms, infrastructure, and innovations for SME/MSME financing.

- Interpret FinTech regulations and assess the role of RegTech and AI in ensuring compliance and detecting fraud.

REFERENCES:

1. Swanson, Seth, "Fintech for Beginners: Understanding and Utilizing the Power of Technology", Create Space Independent Publishing Platform 2016.
2. Tanda, Alessandra & Schena, Cristiana-Maria, "FinTech, BigTech and Banks: Digitalisation and Its Impact on Banking Business Models". Springer 2019.
3. Diedrich, Henning "Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations", Wildfire Publishing 2016.
4. William, Jacob, "Fin Tech: The Beginner's Guide to Financial Technology", Create Space Independent Publishing Platform 2016.
5. Indian Institute of Banking and Finance (IIBF) Digital Banking. Taxmann Publications 2016.

BAM105   INTRODUCTION TO FINTECH   **L T P C**

                                                                3 0 0 3

OBJECTIVES:

- To learn about history, importance and evolution of Fintech.
- To acquire the knowledge of Fintech in payment industry.
- To acquire the knowledge of Fintech in insurance industry.
- To learn the Fintech developments around the world.
- To know about the future of Fintech.

UNIT-I: INTRODUCTION   9

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT-II: PAYMENT INDUSTRY   9

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT-III: INSURANCE INDUSTRY   9

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On- Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT-IV: FINTECH AROUND THE GLOBE   9

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT-V: FUTURE OF FINTECH   9

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand and describe the historical phases of FinTech.
- Recognize how FinTech is revolutionizing payments, lending, wealth tech, insurance, and emerging sectors across different regions.
- Understand the nuances of fintech in wealth management industry.
- Compare major FinTech hubs and understand strategic collaborations between traditional financial institutions and tech firms.
- Understand the future of fintech.

REFERENCES:

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
5. Sanjay Phadke, Fintech Future: The Digital DNA of Finance Paperback, Sage Publications, 2020.

VERTICAL 2: ENTREPRENEURSHIP

BAM201 FOUNDATIONS OF ENTREPRENERUSHIP   **L T P C**

                                          3 0 0 3

OBJECTIVES:

- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
- To empower the learners to run a Technology driven business efficiently and effectively.
- To cultivate entrepreneurial skills, increase awareness of entrepreneurship, and foster a culture of innovation and job creation.

UNIT-I: INTRODUCTION TO ENTREPRENEURSHIP   **9**

Entrepreneurship- Definition, Need, Scope -Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Barriers to Entrepreneurship– Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT-II: BUSINESS OWNERSHIP & ENVRIONMENT   **9**

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological- Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration.

UNIT-III: FUNDAMENTALS OF TECHNOPRENEURSHIP   **9**

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts-Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends- Managing Techno Stress – Eustress and Distress – Coping Strategies of Techno Stress.

UNIT-IV: APPLICATIONS OF TECHNOPRENEURSHIP   **9**

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies.

Effective Business Management Strategies for Franchising - Sub-Contracting- Leasing-Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Learn the basics of Entrepreneurship.
- Understand the business ownership patterns and environment.
- Understand the Job opportunites in Industries relating to Technopreneurship.
- Learn about applications of technopreneurship and successful technopreneurs.
- Acquaint with the recent and emerging trends in entrepreneurship.

REFERENCES:

1. S.S. Khanka, "Entrepreneurial Development" S. Chand & Co. Ltd. Ram Nagar New Delhi, 2021.

2. Donal F Kuratko, "Entrepreneurship: Theory, Process, Practice", 11th Edition, Cengage Learning, 2019.

3. Daniel Mankani, "Technopreneurship: The successful Entrepreneur in the new Economy", Prentice Hall, 2003.

4. Edward Elgar, Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub 2007.

5. Lang J, "TheHigh-TechEntrepreneur'sHandbook", Ft.com 2002.

BAM202   TEAM BUILDING AND LEADERSHIP MANAGEMENT   L T P C
FOR BUSINESS   3 0 0 3

OBJECTIVES:

- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively.
- To emphasize the importance of ethics and values in leadership practices.

UNIT-I: INTRODUCTION TO MANAGING TEAMS   9

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancingteamworkwithinagroup-TeamCoaching-TeamDecisionMaking-VirtualTeams-Self Directed Work Teams (SDWTs) -Multicultural Teams.

UNIT-II: MANAGING AND DEVELOPING EFFECTIVE TEAMS   9

Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High- Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT-III: INTRODUCTION TO LEADERSHIP   9

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation – Effective Communication in Leadership - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT-IV: LEADERSHIP IN ORGANISATIONS   9

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership – Change Management - Role of Ethics and Values in Organisational Leadership.

UNIT-V: LEADERSHIP EFFECTIVENESS   9

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership – Motivation and Employee Engagement - Managerial

Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Learn the basics of managing teams for business.

- Understand developing effective teams for business management.

- Understand the fundamentals of leadership for running a business.

- Learn about the importance of leadership for business development.

- Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

1. "Leadership and Team Building" by Uday Kumar Haldar, First Edition, Oxford University Press, New Delhi 2010.

2. "The Five Dysfunctions of a Team: A Leadership Fable" by Patrick Lencioni, 20th Anniversary Edition, Jossey-Bass 2002.

3. Hughes, R.L, Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. 2019.

4. Katzenback J. R, SmithD. K, The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, 2015.

5. Haldar, U.K., Leadership and Team Building, Oxford University Press, 2010.

BAM203   CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP   L T P C

3 0 0 3

OBJECTIVES:

- To develop the creativity skills among the learners.
- To impart the knowledge of creative intelligence essential for entrepreneurs.
- To impart the knowledge of Innovation in Industries.
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

UNIT-I: CREATIVITY   9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology - Creative Personality and Motivation - Creativity Training.

UNIT-II: CREATIVE INTELLIGENCE   9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT-III: INNOVATION   9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation- Inbound and Outbound Ideation-Product Innovation and Process- Technological, Organizational Innovation – Indicators Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system.

UNIT-IV: INNOVATION AND ENTREPRENEURSHIP   9

Innovation and Entrepreneurship: Entrepreneurial Mindset, Motivations and Behaviours-Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product - Market fit.

UNIT-V: INNOVATIVE BUSINESS MODELS   9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business

Models –Innovative Business Models: Elements, Designing Innovative Business Models-Responsible Innovation and Creativity.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Learn the basics of creativity for developing Entrepreneurship
- Understand the importance of creative intelligence for business growth
- Understand the advances through Innovation in Industries
- Learn about applications of innovation in building successful ventures
- Acquaint with developing innovative business models to run the business efficiently and effectively.

REFERENCES:

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand & Sons, 2021.
2. Innovation Management, C.S.G. Krishnama charyulu, R. Lalitha, Himalaya Publishing House, 2nd edition, 2017.
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4. A. Dale Timpe, Creativity, Jaico Publishing House, 2003. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
5. Tidd, J., & Bessant, J. Managing innovation: Integrating technological, market and organizational change. UK: Wiley 2020.

BAM204   PRINCIPLES OF MARKETING MANAGEMENT   L T P C
**   FOR BUSINESS   3 0 0 3**

OBJECTIVES:

- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs

- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.

- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

- To consider the various decision areas within marketing and the tools and methods used by marketing managers for making decisions.

- To appreciate how a marketing perspective is important in your own personal and professional development.

UNIT-I: INTRODUCTION TO MARKETING MANAGEMENT   9

Introduction-Market and Marketing – Concepts – Functions of Marketing - Importance of Marketing Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT-II: MARKETING ENVIRONMENT   9

Introduction-Environmental Scanning- Analysing the Organisation's Micro Environment andMacro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT-III: PRODUCT AND PRICING MANAGEMENT   9

Product-Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT-IV: PROMOTION AND DISTRIBTUION MANAGEMENT   9

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) – Introduction to Advertising and Sales Promotion –Basics of Public Relations and

Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.

UNIT-V: CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

Introduction - Relationship Marketing vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing, E-Marketing or Online Marketing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Have the awareness of marketing management process.
- Understand the marketing environment.
- Acquaint about product and pricing strategies.
- Have the knowledge of promotion and distribution in marketing management.
- Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House,2016.
2. Marketing Management, Philip Kotler and Kevin Lane Keller, PHI 15th Ed, 2015.
3. Marketing Management-An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.
4. Marketing Management Global Perspective, Indian Context, V. S. Ramaswamy & S. Namakumari, Macmillan Publishers India, 5th edition, 2015.
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.

BAM205   **HUMAN RESOURCE MANAGEMENT FOR**   **L T P C**
                         ENTREPRENEURS   **3 0 0 3**

OBJECTIVES:

- To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
- To create an awareness of the roles, functions and functioning of human resource department.
- To understand the methods and techniques followed by Human Resource Management practitioners.
- To understand the training and compensation practices in Industry.
- To create an awareness on controlling measures followed HR practitioners.

UNIT-I: INTRODUCTION TO HRM   9

Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting – HR Audit - Challenges in HRM.

UNIT-II: HUMAN RESOURCE PLANNING   9

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends.

UNIT-III: RECRUITMENT AND SELECTION   9

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources –e Recruitment - Selection Process- Selection techniques -E-Selection- Interview Types- Employee Engagement.

UNIT-IV: TRAINING AND EMPLOYEE DEVELOPMENT   9

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices.

UNIT-V: CONTROLLING HUMAN RESOURCES   9

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods- Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment – Union - Management Relationship - Recent Trends.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the Evolution of HRM and Challenges faced by HR Managers
- Learn about the HR Planning Methods and practices.
- Acquaint about the Recruitment and Selection Techniques followed in Industries.
- Know about the methods of Training and Employee Development.
- Comprehend the techniques of controlling human resources in organisations.

REFERENCES:

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e, Pearson, 2015.
2. David A Decenzo, StephenP. Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
3. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
4. R. Wayne Mondy, Human Resource Management, Pearson, 2015.
5. Luis R. Gomez-Mejia, David B. Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012.

BAM206   **FINANCING NEW BUSINESS VENTURES**   **L T P C**

                                                                                  3 0 0 3

OBJECTIVES:

- To introduce the fundamentals of financing entrepreneurial ventures.
- To understand the structure and avenues for debt and equity financing.
- To explore government initiatives and institutional frameworks for start-ups.
- To equip students with practical knowledge of fundraising processes for new ventures.
- To develop competencies in evaluating financing strategies for new businesses.

UNIT-I: ESSENTIALS OF NEW BUSINESS VENTURE   9

Setting up new Business Ventures – Need - Scope - Startup Ecosystem in India-Franchising - Location Strategy, Registration Process - Legal Requirements- State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT-II: INTRODUCTION TO VENTURE FINANCING   9

Venture Finance–Definition–Historic Background– Importance – Funding New Ventures-Need–Scope– Types – Cost of Project-Means of Financing -Estimation of Working Capital-Requirement of funds– Mix of Debt and Equity - Challenges and Opportunities.

UNIT-III: SOURCES OF DEBT FINANCING   9

Fund for Capital Assets - Term Loans - Leasing and Hire Purchase - Money Market instruments – Bonds, Debentures, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT-IV: SOURCES OF EQUITY FINANCING   9

Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding-Venture Capital- Venture Valuation- meaning and Basic Mechanics of Valuation.

UNIT-V: METHODS OF FUND RAISING FOR NEW VENTURES   9

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods- Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment – Union - Management Relationship - Recent Trends.

                                                                  TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Learn the basics of starting a new business venture.

- Identify various venture financing opportunities

- Understand the sources of debt financing.

- Understand the sources of equity financing.

- Acquaint and Formulate strategies for effective fundraising in real-world scenarios.

REFERENCES:

1. Chandra, P. Projects: Planning, analysis, financing, implementation, and review (8th ed.). McGraw Hill Education, 2017.

2. Ramsinghani, M., The business of venture capital: The art of raising a fund, structuring investments, portfolio management, and exits (3rd ed.). Wiley. 2021.

3. Prasanna Chandra, Projects planning, Analysis, Selection, Financing, Implementation and Review, McGraw Hilld Education India Pvt Ltd, New Delhi, 2019.

4. Byers, Thomas. Technology Ventures: From Idea to Enterprise. McGraw – Hill Higher Education, 2014.

5. Steven Rogers, Entrepreneurial Finance: Finance and Business Strategies for the Serious Entrepreneur 3e, Tata Mc Graw Hill, 2014.

VERTICAL 3: PUBLIC ADMINISTRATION

BAM301   PRINCIPLES OF PUBLIC ADMINISTRATION   L T P C
**   3 0 0 3**

OBJECTIVES:

- To understand the nature, scope and essentials of Public Administration administrative theories and concepts to make sense of administrative practices.
- To evaluate the changing paradigms of Public Administration.
- To understand the synthesizing knowledge of public administration from public perspective.
- To study and explore the approaches of administrative process.
- To cover the principles, practices and the impact of public administration on society.

UNIT-I: INTRODUCTION TO PUBLIC ADMINISTRATION   9

Meaning- Nature and Scope of Public Administration, Evolution of Public Administration, Public Administration and Private Administration, Public Administration –Arts, Science or both, Public Administration - relations to other social sciences, Importance of Public Administration.

UNIT-II: EMERGING TRENDS IN PUBLIC ADMINISTRATION   9

New Public Administration–Formulating the structure, New Public Management, Globalization and Public Administration, Paradigm Shift from Government to Governance.

UNIT-III: ADMINISTRATIVE ORGANIZATIONS   9

Forms of Administrative Organizations –Departments, Public Corporations, Public sector undertakings, Independent Regulatory Commissions, Line and Staff Agencies, Administrative Tribunal.

UNIT-IV: APPROACHES AND THEORIES OF PUBLIC ADMINISTRATION   9

Classical Approach, Administrative Approach, Scientific Management Approach, Bureaucratic Approach, Human Relations Approach, Ecological Approach.

UNIT-V: PRINCIPLES AND PRACTICES OF PUBLIC ADMINISTRATION   9

Chief Executive - Meaning, Types, Functions & Qualities of Chief Executive, Supervision, Communication - meaning, types of communication & its importance in Public Administration, Centralization & Decentralization, Public Relation, Meaning, Methods &

Significance, Decision making - Types, Techniques and Processes, Leadership - Styles –Approaches.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand public administration theory and concepts from multiple perspectives.
- Appreciate the nature, scope and dynamics of Public Administration.
- Acquaint with India's development experience and changing role of administration practices.
- Grasp the administrative theories, concepts and principles to make sense of administration in the developing era.
- Demonstrate the integrative knowledge, skills and ethics necessary for responsible Administrative, management and leadership positions.

REFERENCES:

1. Lakshmi Kanth, Public Administration by McGraw Hill,2018
2. Rosenbloom David, Public Administration: Understanding Management, Politics, and Law in the Public Sector, McGraw Hill, 2018.
3. Avasthi and Maheswari: Public Administration in India, Agra: Lakshmi Narain Agarwal, 2013.
4. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
5. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.

BAM302   **CONSTITUTION OF INDIA**   **L T P C**
                                             3 0 0 3

OBJECTIVES:

- To know about the basic structure of Indian Constitution, Fundamental Rights(FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
- To know about the functioning of three wings of the government i.e., executive, legislative and judiciary.
- To know the State Executive s Union territories.
- To know about the Local Administration from Corporation to Village Level.
- To learn the pattern of Election systems and concept of E-Governance.

UNIT-I: **INTRODUCTION**   **9**

Meaning of the Constitution Law and Constitutionalism - Constituent Assembly. Government of India Act of 1935 and Indian Independence Act of 1947 – Enforcement of COI and its Salient Features – Why Tamilnadu's "Sengol" in Parliament (1947 & 2023)- Samvidhan Divas - The Preamble. The Constitutional amendments in India - National Emergency, President Rule, Financial Emergency - Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II: **THE CENTRE: EXECUTIVE, LEGISLATIVE AND JUDICIARY**   **9**

Meaning of Indian Flag & Ashoka Chakra. Indian Parliament – RS - LS – Power & Functions. Honourable "The President" & "The Vice President", "The Prime Minister" - Power &Functions - Comparison of Indian President with the United States - Central Ministry of Council. The Independence of the Supreme Court - Appointment of Supreme & High Courts Judges (Collegium) - Judicial Review, Judicial Activism, and PIL -, The Lokpal & Lok Ayuktas 2013 – NRC & CAA (Illegal Migrants) - Abrogation of Article 370 in J & K – Need of Uniform Civil Code.

UNIT-III: **THE STATE GOVERNMENT, UNION TERRITORIES STATE**   **9**
                      LEGISLATURE

Madras Presidency to Tamil Nadu – Tamil Nadu Emblem. State Executives – His Excellency "The Governor" Power & Functions, Chief Minister – Power & Functions, State Cabinet, Members of Legislative Assembly Role. Union Territories – Power & Functions. Federal System, Centre-State Relations. High Court & Subordinate Courts- Lok Adalat 1982 Vs Arbitration Tribunal.

UNIT-IV: LOCAL ADMINISTRATION   9

Corporation – Mayor, Chairman District Administration Head - Role and Importance, Role of Elected Representative – Pachayati Raj: Functions PRI – Grama Sabha. Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy.

UNIT-V: ELECTION SYSTEMS AND E-GOVERNANCE   9

Election Commission: Role of Chief Election Commissioner - State Election Commission – One India One Election. National Good Governance Day - Governance and role of Engineers in E-Governance, Need for reformed engineering serving at the Centre and State, E- Courts, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Identify and explore the basic features and modalities about Indian constitution.
- Differentiate and relate the functioning of 3 wings of India.
- Understand the state level executives and state courts
- Identify the role of Mayor and elected representatives of Municipalities
- Know the role of Election Commission apply knowledge and E-governance.

REFERENCES:

1. BR. Ambedkar, Rupa Publications. The Constitution of India. Rupa Publications. 2024.
2. Singh, M. P. (Ed.). EBC's V. N. Shukla's Constitution of India (14th ed., reprint 2024). Eastern Book Company.
3. Bakshi, P. M The Constitution of India (19th ed.). Universal Law Publishing (LexisNexis) 2023.
4. Babu, D. D. Introduction to the Constitution of India (27th ed.). Lexis Nexis 2024.
5. Sharma, B. K. Introduction to the Constitution of India (11th ed.). PHI Learning 2024.

BAM303   **PUBLIC PERSONNEL ADMINISTRATION**   **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the fundamental principles, scope, and evolution of Public Personnel Administration.
- To analyze different types of personnel systems and their relevance in democratic governance.
- To examine the processes of recruitment, training and promotion within the public sector.
- To gain insights into the structure and functioning of All India Services and State Public Service Commissions.
- To evaluate employer-employee relations, wage systems and benefits in the context of public sector employment.

UNIT-I: INTRODUCTION TO PERSONNEL ADMINISTRATION   9

Meaning, Scope and Importance of Personnel Administration - Evolution of Public Personnel Administration-Personnel Administration vs. Human Resource Management – Challenges in Personnel Administration – Types of Personnel Systems Bureaucratic, Democratic and Representative systems- Emerging Trends in Personnel Administration.

UNIT-II: PERSONNEL SYSTEMS AND ADMINISTRATIVE ETHICS   9

Generalist Vs Specialist – Comparative Analysis of Personnel Systems – Role of Civil Servants in Policy Implementation - Relationship between Civil Servants and Political Executives - Mechanisms for Promoting Administrative Accountability-Civil Servant's Relationship with Political Executive – Ethics and Integrity in Administration - Mechanisms for Promoting Administrative Accountability.

UNIT-III: RECRUITMENT, TRAINING AND PROMOTION   9

Recruitment: Direct Recruitment and Recruitment from Within – Methods of Manpower Planning- Training: Objectives and Need –Types of Training: Induction, In-service, Orientation, Refresher - Performance Appraisal and Merit-based Promotion – Promotion.

UNIT-IV: PUBLIC SERVICE FRAMEWORK IN INDIA   9

All India Services – Structure and Cadre Management – Rules and Regulations Governing Service Conditions – Code of Conduct and Disciplinary Actions –State Public Service Commissions: Functions and Autonomy - UPSC and Its Constitutional Mandate - Reservation Policy in Services - Gender Sensitization and Inclusivity in Services.

Employer Employee Relations – Wage Theories and Compensation Models – Principles of Pay Fixation-Salary Structures in Indian Civil Services –Salary Structures in Indian Civil Services –Social Security Benefits and Retirement Schemes - Wage and Salary Administration – Allowances and Benefits.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Demonstrate a comprehensive understanding of the nature, scope, and importance of public personnel administration
- Distinguish between bureaucratic, democratic, and representative personnel systems in public administration.
- Apply knowledge of recruitment, training and promotion practices to real-world administrative scenarios.
- Critically analyze the structure and functioning of the All India Services and State Public Service Commissions.
- Evaluate wage and salary administration, allowances and employee relations within the framework of public sector employment.

REFERENCES:

1. Public Personnel Administration, 6th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2015.
2. Personnel Management in Government, 7th Ed, by R. Wayne Boss 2016.
3. Human Resource Management in Public Service, 5th Ed, by Richard C. Kearney, Jerrell D. Coggburn 2015.
4. Public Administration: An Introduction, 12th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2019.
5. Public Personnel Management, 4th Ed, by Donald E. Klingner, John Nalbandian 2018.

BAM304   **ADMINISTRATIVE THEORIES**   **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce students to the evolution of administrative thought
- To study the contributions of key administrative thinkers
- To develop an understanding of leadership, governance, and management principles
- To relate classical theories to contemporary administrative practices
- To enhance analytical and critical thinking skills.

UNIT-I: INTRODUCTION TO PUBLIC ADMINISTRATION   9

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration. Public Administration - Introduction, Principles of Organization and Management, Public Policy and Governance, Administrative Structure in India, Ethics and Accountability in Public Administration, Technology and Public Administration, Contemporary Issues in Public Administration.

UNIT-II: THEORIES OF ORGANIZATION   9

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory. Introduction to Organizations, Neo-Classical Theories, Modern Theories, Contemporary Approaches, Organization Design and Structure, Leadership and Motivation in Organizations, Applications to Modern Industry and Technology.

UNIT-III: ORGANIZATIONAL BEHAVIOUR AND DESIGN   9

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design. Organizational Behaviour - Introduction, Individual Behaviour in Organizations, Group Behaviour and Team Dynamics, Leadership and Power, Conflict and Negotiation, Organizational Culture and Climate, Organizational Change and Development, Contemporary Issues in OB.

UNIT-IV: MOTIVATION AND LEADERSHIP   9

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making Motivation - Definition and Importance, Content Theories, Process Theories. Leadership - Meaning, Roles, and Importance of Leadership, Leadership Theories. Decision Making - Nature

and Types of Decisions, Decision-Making Process: Steps and Models. Contemporary Perspectives, Applications and Case Studies.

UNIT-V: ADMINISTRATIVE THINKERS   **9**

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard. Peter Drucker Introduction to Administrative Thought, Kautilya (Chanakya) - Arthashastra: Concepts of Governance and Statecraft. Woodrow Wilson - The Study of Administration as a discipline. Chester I. Barnard - The Functions of the Executive, Concept of Formal and Informal Organizations, Peter F. Drucker - Management by Objectives (MBO), Comparing Key Contributions: Classical vs Modern Perspectives. Administrative Principles in Startups, Tech Companies, and Government Projects.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand foundational ideas of administration.
- Analyze different administrative and management theories.
- Apply classical principles to modern contexts.
- Evaluate the role of leadership and ethics in administration.
- Develop problem-solving skills using administrative models.

REFERENCES:

1. R. K. Sapru – Administrative Theories & Management Thought, 3rd Edition, 2013
2. "Public Administration Theories & Principles" (Vidya R., Rajaram), Kindle 2024 Edition.
3. Fernando Lunenburg & Allen Irby – included in Development of Administrative Theory, SAGE Publications 2022
4. Global Encyclopedia of Public Administration, Public Policy, and Governance. Springer Publications, 2nd Edition, 2020.
5. Administrative Theories: Approaches, Concepts and Thinkers in Public Administration, Rakesh Hooja, Ramesh K Arora 2007.

BAM305　　　**INDIAN ADMINISTRATIVE SYSTEM**　　　**L T P C**

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OBJECTIVES:

- To understand the historical evolution and constitutional framework of Indian administration.
- To analyze the role and functioning of key constitutional authorities and administrative institutions.
- To explore the structure, functions, and challenges of local governance and grassroots administration.
- To examine the impact of coalition politics and the role of ethics in administrative integrity
- To evaluate the mechanisms for corruption control, including Ombudsman, Lokpal & Lok Ayukta.

UNIT-I:　　INTRODUCTION TO INDIAN ADMINISTRATION　　　9

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India, Separation of powers and checks & balances in governance.

UNIT-II:　　LOCAL GOVERNMENT AND ADMINISTRATION　　　9

Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government, Role of Smart Cities & Urban Local Bodies in governance.

UNIT-III:　　CONSTITUTIONAL AMENDMENTS　　　9

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992, Implementation challenges and success stories of decentralized governance, Case studies on local governance reforms.

UNIT-IV:　　POLITICS AND ETHICS　　　9

Coalition politics in India, Integrity and Vigilance in Indian Administration, Role of transparency and accountability in governance (RTI Act, Citizen Charters), Ethical dilemmas in civil services and administrative ethics.

Corruption–Ombudsman, Lokpal & Lok Ayuktha, Recent anti-corruption measures (Whistle blower Protection Act, Black Money laws), Digital governance and technology-driven transparency in administration.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Gain a comprehensive understanding of India's administrative system, governance structure, and reforms.
- Critically assess the functioning of constitutional authorities and their influence on policymaking
- Develop the ability to analyze local governance models and propose solutions for administrative challenges.
- Demonstrate awareness of political dynamics, ethics, and accountability in governance.
- Be equipped to evaluate anti-corruption measures and suggest improvements for transparent administration.

REFERENCES:

1. S.R. Maheswari : Indian Administration - Orient Black Swan, Sixth edition, 2001
2. In dian Public Administration: Institutions and Issues by Rajni Arora & Ramesh K. Goyal - New Age International Publishers, Fourth edition, 2022
3. Indian Administration - Evolution and Practice by Bidyut Chakrabarty – SAGE Publications India Pvt, Ltd. First edition,2019
4. Khera. S.S : Administration in India – Asia Publishing House, Bombay, First edition,1964
5. Ramesh K. Arora : Indian Public Administration - New Age International Publishers, Fourth edition, 2022.

BAM306   **PUBLIC POLICY ADMINISTRATION**   **L T P C**
                                                              3 0 0 3

OBJECTIVES:

- To provide students with a comprehensive understanding of the meaning, nature, scope, and significance of public policy.
- To equip students with knowledge of various approaches to policy analysis and familiarize them with key models such as Dror's Optimal Model.
- To enable students to understand the stages of the policy-making process, including formulation, implementation, and evaluation.
- To analyze the role of institutions, bureaucracy, interest groups, and political parties in the public policy process.
- To introduce students to significant public policies in India, such as the New Economic Policy, Population Policy, Agricultural Policy, and Information Technology Policy.

UNIT-I: INTRODUCTION TO PUBLIC POLICY   9

Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration – Importance and relevance of public policy in modern society.

UNIT-II: POLICY APPROACHES   9

Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model- Comparison of different approaches.

UNIT-III: POLICY FRAMEWORK   9

Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation – Feedback mechanism and Policy change.

UNIT-IV: ROLE OF POLITICS IN POLICY FRAMEWORK   9

Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties – Role of Judiciary.

UNIT-V: TECHNOLOGY IN POLICY FRAMEWORK   9

Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy – Digital India Initiative.

                                                        TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Know the importance of public policy and its interdisciplinary connections, especially with political science and public administration.
- Assess different approaches and models used in policy analysis, including institutional, incremental, systems approaches, and Dror's Optimal Model.
- Understand the stages involved in the policy-making process, from formulation through to evaluation.
- Analyze the institutional framework and the roles played by bureaucracy, political parties, and interest groups in policy-making.
- Evaluate the key public policies in India, understanding their context, objectives, and impacts.

REFERENCES:

1. Anderson, J. E., Moyer, J., & Chichirau, G. Public Policymaking: An Introduction (9th ed.). New Delhi, India: Cengage India 2023.
2. Bardach, E., & Patashnik, E. M. A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving (7th ed.). Washington, DC: CQ Press 2023.
3. Cairney, P. Understanding Public Policy: Theories and Issues (2nd ed.). London: Bloomsbury Academic 2024.
4. Kraft, M. E., & Furlong, S. R. (Public Policy: Politics, Analysis, and Alternatives (8th ed.). Thousand Oaks, CA: CQ Press 2023.
5. Smith, K. B., & Larimer, C. W. The Public Policy Theory Primer (3rd ed.). New York, NY: Routledge 2017.

VERTICAL 4: BUSINESS DATA ANALYTICS

BAM401   STATISTICS FOR MANAGEMENT   **L T P C**
                                                                3 0 0 3

OBJECTIVES:

- To apply statistical methods to analyze engineering and management problems.

- To use descriptive statistics and probability theory to summarize, interpret, and present engineering and business data effectively.

- To employ inferential statistical tools such as hypothesis testing, confidence intervals, and regression analysis to solve real-world management and engineering problems.

- To utilize statistical software/tools to perform data analysis and interpret output for strategic planning, quality control, and operational efficiency.

- To develop problem-solving skills by applying statistical reasoning to project management, production processes, and optimization in engineering enterprises.

UNIT-I: INTRODUCTION   9

Concepts of Experiment, Event, Sample Space, Basic definitions and addition and multiplication rules for probability, Baye's theorem and random variables, Importance of Statistics in Business and Engineering, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT-II: SAMPLING DISTRIBUTION AND ESTIMATION   9

Introduction to Sampling, Population vs. Sample, Concept of a Sampling Distribution, Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters. Confidence Interval for the Mean (Known and Unknown Population Variance).

UNIT-III: TESTING OF HYPOTHESIS - PARAMETRIC TESTS   9

Introduction to Hypothesis Testing - Definition and Importance of Hypothesis Testing in Engineering and Business, Basic Concepts: Null Hypothesis (H_0), Alternative Hypothesis (H_1), Type I and Type II Errors, Significance Level (α) and Power of a Test, p-Value: Concept and Interpretation. Parametric Tests for Mean (t-test), Parametric Tests for Proportions (Z-test), Analysis of Variance (ANOVA).

UNIT-IV: TESTING OF HYPOTHESIS - NON-PARAMETRIC TESTS   9

Introduction to Non-Parametric Tests, Differences Between Parametric and Non-Parametric Tests, Sign Test (Concept of the Sign Test for One-Sample Data), Mann-

Whitney U Test (Wilcoxon Rank-Sum Test), Wilcoxon Signed-Rank Test (Testing Differences for Paired Data), Kruskal- Wallis H Test (Testing for Differences Between More Than Two Independent Groups), Chi- Square Test for Goodness of Fit (Goodness of Fit Test, Test for Independence, Analyzing Relationships Between Categorical Variables), Friedman Test (Non-Parametric Test for Comparing More Than Two Related Groups).

UNIT-V: CORRELATION AND REGRESSION   9

Introduction to Correlation and Regression, Correlation Analysis - Pearson's Correlation Coefficient (r), Spearman's Rank Correlation. Simple Linear Regression - Introduction to Regression Analysis, Simple Linear Model, Multiple Linear Regression, Applications of Correlation and Regression in Engineering - Quality Control and Six Sigma, Reliability Engineering, Optimization Problems.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Facilitate objective solutions in business decision making.

- Understand and solve business problems.

- Apply statistical techniques to data sets, and correctly interpret the results.

- Develop skill-set that is in demand in both the research and business environments.

- Apply the statistical techniques in a work setting.

REFERENCES:

1. Richard I. Levin, David S. Rubin, Masood H Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.

2. Fundamentals of Mathematical Statistics, by S.C. Gupta and V.K. Kapoor Revised Edition 2020.

3. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.

4. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.

5. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.

BAM402   DATA MINING FOR BUSINESS INTELLIGENCE   L T P C

                                                                  3 0 0 3

OBJECTIVES:

- To familiarize students with the fundamental principles and scope of datamining and business intelligence.
- To develop an understanding of data preparation and data quality issues in business analytics.
- To explain key datamining techniques such as classification, clustering, and association rule mining from a business view point.
- To expose students to the practical applications of datamining in various business functions.
- To sensitize students to the ethical, strategic and managerial implications of using datamining for decision-making.

UNIT-I: INTRODUCTION TO DATAMINING AND BUSINESS   9
**   INTELLIGENCE**

Data Mining – Definition – Purpose – Role in Business Intelligence – Scope – Importance in Managerial Decision-Making – Difference between Data Mining and Business Analytics – Knowledge Discovery in Databases (KDD) – CRISP – DM Methodology – Phases of Data Mining Process – Applications in Business – Benefits and Limitations – Organizational Challenges in Data Mining Implementation.

UNIT-II: DATA PREPARATION AND DATA UNDERSTANDING   9

Types and Sources of Business Data – Structured and Unstructured Data–Importance of Data Quality – Data Cleaning and Handling Missing Values – Data Normalization and Transformation – Exploratory Data Analysis (EDA) – Descriptive Statistics – Frequency Distributions–Data Visualization Techniques–Graphs and Charts–Use of Dashboards for Business Insights – Role of EDA in Business Decision-Making.

UNIT-III: CORE DATA MINING TECHNIQUES   9

Overview of Data Mining Techniques – Classification – Concept and Applications – Decision Trees – Logistic Regression – Business Use Cases – Clustering – Concept and Business Use –Customer Segmentation – Behavioral Grouping – Association Rule Mining – Market Basket Analysis– Support, Confidence and Lift – Interpretation of Rules – Use in Retail and Marketing–Non- Technical Overview of Techniques.

UNIT-IV: FUNCTIONAL APPLICATIONS OF DATA MINING   9
**   IN BUSINESS**

Applications in Marketing–Customer Profiling–Targeted Campaigns– Churn Prediction–Applications in Finance – Risk Assessment – Credit Scoring – Fraud Detection – Applications in HR – Employee Attrition – Workforce Analytics – Applications in Operations–Demand Forecasting – Inventory Optimization – Vendor Analysis – Real-Life Business Use Cases – Managerial Interpretation of Results.

UNIT-V: MANAGERIAL PERSPECTIVES, ETHICS AND   9
**   EMERGING TRENDS**

Managerial Role in Business Intelligence – Framing Business Problems – Interpretation of Data Mining Results – Reporting and Communication of Insights – Ethical Issues – Data Privacy – Consent – Algorithmic Bias – Transparency – Recent Trends – Self–Service BI–Real- Time Analytics – Augmented Intelligence – Role of Managers in Promoting Data-Driven Culture–Challenges and Future Opportunities.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Explain the core concepts and process models used in data mining and business intelligence.
- Recognize the importance of data quality, organization and visualization in deriving insights.
- Interpret the basic logic of classification, clustering, and association rules with practical business examples
- Apply conceptual knowledge of datamining techniques to functional business problems.
- Evaluate the role of ethics, managerial insight and business context in the implementation of data-driven strategies.

REFERENCES:

1. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Analytics: Concepts, Techniques, and Applications with XL Miner, 3rd Edition, 2016, Wiley.
2. U Dinesh Kumar, Business Analytics: The Science of Data – Driven Decision Making, 2nd Edition,2020, Wiley India Pvt. Ltd.

3. V. Rameshand K.N. Prasad, Data Mining and Data Warehousing, 2nd Edition,2020, Wiley India Pvt. Ltd.

4. V.P Jain, Data Mining Techniques for Marketing, Sales, and Customer Relationship Management,1st Edition,2016, BPB Publications.

5. Anil Maheshwari, Data Analytics Made Accessible, 2nd Edition, 2017, Amazon Digital Services LLC.

BAM403   HUMAN RESOURCE ANALYTICS   **L T P C**

                                                                          3 0 0 3

OBJECTIVES:

- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.

- To know the different types of HR metrics and understand their respective impact and application.

- To understand the impact and use of HR metrics and their connection with HR analytics.

- To understand common work force issues and resolving the musing people analytics.

- The learners will be conversant about HR metrics and ready to apply at work settings.

UNIT-I: INTRODUCTION TO HR ANALYTICS   9

HR analytics - People Analytics: Definition- context - stages of maturity - Human Capital in the Value Chain: impact on business. HR Analytics vs HR Metrics – HR metrics and KPIs.

UNIT-II: HR ANALYTICS I: RECRUITMENT   9

Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire- Recruitment to HR cost - Recruitment analysis.

UNIT-III: HR ANALYTICS II: TRAINING AND DEVELOPMENT   9

Training & Development Metrics: Percentage of employee trained- Internally and externally trained - Training hours and cost per employee - ROI -Optimising the ROI of HR Programs - Training and Development analysis.

UNIT-IV: HR ANALYTICS III: EMPLOYEE ENGAGEMENT AND   9
                   CAREER PROGRESSION

Employee Engagement Metrics: Talent Retention - Retention index - Voluntary and involuntary turnover- Turnover by department, grades, performance, and service tenure - Internal hired index - Engagement Survey Analysis. Career Progression Metrics: Promotion index - Rotation index - Career path index - Level wise succession readiness index.

UNIT-V: HR ANALYTICS IV: WORK FORCE DIVERSITY AND   9
DEVELOPMENT

Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling- Churn over index - Workforce diversity index - Gender mix - Differently abled index- Revenue per employee – Operating cost per employee - PBT per employee - HR cost per employee- HR budget variance - Compensation to HR cost.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Be conversant about HR metrics and ready to apply at work settings.
- Resolve HR issues using people analytics.
- Gain knowledge about analytics of training and development.
- Know about the analytics of employee engagement and career progression
- Competent in the analytics of work force diversity and development.

REFERENCES:

1. Ferrar, J., & Green, D. Excellence in People Analytics: How to Use Data to Create Value and Drive Business Success (2nd ed.). Kogan Page. 2021.
2. Soundararajan, R., & Singh, K. Winning on HR Analytics: Leveraging Data for Competitive Advantage. SAGE Publications Pvt. Ltd. 2022.
3. Edwards, M. R., Minbaeva, D., Levenson, A., &Huselid, M. A. (Eds.). Workforce Analytics: A Global Perspective. Routledge. 2023.
4. Jang, D., Edwards, M., & Edwards, K. Using R in HR Analytics. Kogan Page 2023.
5. Lochab, A., Duhan, P., &Dangi, H.K. HR Analytics: Concepts and Applications. S. Chand Publishing. 2025.

BAM404   MARKETING AND SOCIAL MEDIA WEB ANALYTICS   L T P C

3 0 0 3

OBJECTIVES:

- To showcase today's opportunities to leverage the power of marketing on the web and social media through web analytics.
- Understand the role of social media web analytics within the digital marketing landscape.
- Identify, define, and interpret commonly used web metrics and KPIs.
- Understand analytical methods to transform social media data into marketing insights.
- Understand the process of search engine optimization and the search behaviors of customers.

UNIT-I: MARKETING ANALYTICS   9

Introduction to Marketing Analytics - Marketing Budget and Marketing Performance Measure, Marketing Metrics and Its Applications - Financial Implications of Various Marketing Strategies- Geographical Mapping, Data Exploration, Market Basket Analysis.

UNIT-II: COMMUNITY BUILDING AND MANAGEMENT   9

The History and Evolution of Social Media, Understanding the Science of Social Media, Goals for Using Social Media, Social Media Audience and Influencers, Keys to Community Building, Promoting Social Media Pages, Linking Social Media Accounts, The Viral Impact of Social Media, and Social Media as a Business.

UNIT-III: SOCIAL MEDIA POLICIES AND MEASUREMENTS   9

Social Media Policies-Etiquette, Privacy- Ethical Problems Posed by Emerging Social Media Technologies - The Basics of Tracking Social Media. - Social Media Analytics- Insights Gained from Social Media- Customized Campaign Performance Reports - Observations of Social Media Use.

UNIT-IV: WEB ANALYTICS   9

Web Analytics—Present and Future—Data Collection—Importance and Options, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of A Successful Web Analytics Strategy, Web Analytics Fundamentals, Concepts, Proposals & Reports, Web Data Analysis.

UNIT-V: SEARCH ANALYTICS   9

Search Engine Optimization (SEO), User Engagement, User-Generated Content, Web Traffic Analysis, Navigation, Usability, Eye Tracking, Online Security and Ethics, Content Management System, Data Visualization. RSS Feeds, Mobile Platforms, Understanding Search Behaviors.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand Marketing in Social Media, Web, and Social Media Analytics and their Potential Impact.
- Enhance their social media marketing skills.
- Develop a mass communication strategy and guide marketing campaigns.
- Understand the fundamentals and concepts of web analytics.
- Learn to use the resulting insights effectively to support website design decisions, campaign optimisation, search analytics, etc.

REFERENCES:

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013.
2. Christian Fuchs, Social Media: A Critical Introduction, Sage Publications Ltd, 2014.
3. Bittu Kumar, Social Networking, V & S Publishers, 2013.
4. Avinash Kaushik, Web Analytics - An Hour A Day, Wiley Publishing, 2007.
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and Cafepress 2004.

BAM405   OPERATION AND SUPPLY CHAIN ANALYTICS   L T P C

3 0 0 3

OBJECTIVES:

- To introduce students to the foundational concepts of analytics and their strategic role in transforming supply chains using descriptive, predictive, and prescriptive methods.

- To equip learners with quantitative tools for warehousing decisions, including mathematical programming and heuristic methods for facility layout and space optimization.

- To develop an in-depth understanding of inventory management techniques, emphasizing risk analysis, aggregation models, and multi-echelon planning.

- To provide analytical skills to model and solve complex transportation and distribution network problems using graph theory, flow models, and routing algorithms.

- To enable application of Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, and TOPSIS in supply chain decision scenarios.

UNIT-I: INTRODUCTION   9

Introduction to analytics – descriptive, predictive, and prescriptive analytics, Data-driven supply chains, Road map for data-driven supply chains. Transforming supply chains, Barriers to implementation of supply chain strategies.

UNIT-II: WAREHOUSING DECISIONS   9

Mathematical programming models - P-median methods - Guided LP approach - Balmer–Wolfe method, Greedy drop heuristics, Dynamic location models, Space determination and layout methods.

UNIT-III: INVENTORY MANAGEMENT   9

Inventory aggregation models - Dynamic lot sizing methods, Multi-echelon inventory models, Aggregate inventory system and limit, Risk analysis in the supply chain - Measuring transit risks, Supply risks, Delivering risks, and risk pooling strategies.

UNIT-IV: TRANSPORTATION NETWORK MODELS   9

The notion of graphs, Minimal spanning trees, Shortest path algorithms, Maximal flow problems, Multistage transhipments, and transportation problems, Set covering and set partitioning problems, Traveling salesman algorithms, and deficit function approach, Scheduling Algorithms.

UNIT-V: MCDM MODELS   9

Multi-Criteria Decision-Making (MCDM) Techniques, Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the Analytical Network Process (ANP), TOPSIS-Application in SCM.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand and explain the concepts of descriptive, predictive, and prescriptive analytics and their role in enhancing data-driven supply chain decision-making.

- Apply mathematical programming and heuristic methods such as P-median, Guided LP, and Greedy Drop techniques to make effective warehousing and location decisions.

- Analyze and manage inventory using aggregation models, multi-echelon systems, and risk pooling strategies to improve supply chain resilience and efficiency.

- Solve transportation network problems using graph-based algorithms like shortest path, maximal flow, and traveling salesman models to optimize logistics performance.

- Evaluate complex supply chain scenarios using Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, TOPSIS, and fuzzy logic for better strategic decision- Making.

REFERENCES:

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.

2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.

3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.

4. Muthu   Mathirajan,   Chandrasekharan   Rajendran,   Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management, I.K. International Publishing House Pvt. Ltd., 2016.

5. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

BAM406   **FINANCIAL ANALYTICS**   **L T P C**

                                                    3 0 0 3

OBJECTIVES:

- To introduce fundamental financial concepts and decision-making techniques relevant to corporate finance.

- To familiarize students with the basics of financial markets and time-series analysis techniques for estimating risk and return.

- To provide insights into portfolio theory and option pricing models used for investment analysis.

- To expose students to basic technical indicators and simulation strategies for analyzing stock market behavior.

- To enable students to understand and apply basic credit risk models using statistical and machine learning techniques.

UNIT-I: **FOUNDATIONS OF CORPORATE FINANCIAL ANALYSIS**   **9**

Introduction to financial analytics. Basic financial models – Time value of money, cash flow analysis, cost of capital. Project appraisal methods – Payback period, NPV, IRR. Capital budgeting and financial break-even analysis.

UNIT-II: **FINANCIAL MARKET DATA AND TIME-SERIES ANALYSIS**   **9**

Introduction to financial market instruments – Stocks and Bonds. Basics of risk and return. Overview of financial data and Time-Series characteristics. Introduction to Value at Risk (VaR). Basics of Auto Regressive Moving Average (ARMA), Autoregressive Conditional Heteroscedasticity (ARCH), and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models for volatility forecasting.

UNIT-III: **PORTFOLIO THEORY AND DERIVATIVES**   **9**

Portfolio diversification and risk-return trade-off. Capital Asset Pricing Model (CAPM). Sharpe ratio. Option pricing basics – Binomial model, Black-Scholes model. Implied volatility and option strategies.

UNIT-IV: **TECHNICAL ANALYSIS AND TRADING SIMULATIONS**   **9**

Overview of technical indicators – Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), Rate of Change (ROC), Moving Averages, Candlestick patterns. Simulation of basic trading strategies. Introduction to algorithmic trading concepts. Prediction of stock prices using chart patterns.

Introduction to credit risk. Data pre-processing for credit modelling. Logistic regression, decision trees, and model evaluation techniques. Application of analytics in credit scoring and loan approvals, and evaluating credit risk model.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Apply core financial concepts to evaluate corporate investment decisions using tools like NPV and IRR.
- Analyze risk and return using financial time-series models and interpret key market indicators.
- Construct and assess investment portfolios and derivative strategies using theoretical models.
- Use basic technical analysis indicators and simulate simple trading strategies.
- Develop and evaluate credit risk models using statistical methods like logistic regression and decision trees.

REFERENCES:

1. Mark J. Bennett, Dirk L. Hugen, "Financial Analytics with R: Building a Laptop Laboratory for Data Science", Cambridge University Press, 1st Edition, 2016.
2. Pavel Ryzhov, "Haskell Financial Data Modeling and Predictive Analytics", Packt Publishing, 1st Edition, 2013.
3. Edward E. Williams, John A. Dobelman, "Quantitative Financial Analytics: The Path to Investment Profits", World Scientific Publishing, 1st Edition, 2017.
4. Yuxing Yan, "Python for Finance – Second Edition: Apply Powerful Finance Models and Quantitative Analysis with Python", Packt Publishing, 2nd Edition, 2017.
5. James Ma Weiming, "Mastering Python for Finance – Second Edition: Implement Advanced State-of-the-Art Financial Statistical Applications Using Python", Packt Publishing, 2nd Edition, 2019.

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

AGM501   **SUSTAINABLE INFRASTRUCTURE DEVELOPMENT**   **L T P C**

3 0 0 3

OBJECTIVES:

- To impart knowledge about sustainable Infrastructure development goals.
- To practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
- To understand how infrastructure projects are conceptualised and planned and the project lifecycle phases.
- To learn concepts related to infrastructure economics and finance, including various project feasibility models.
- To understand and assess the use of various risk management processes and practices in the context of infrastructure projects.

UNIT-I: SUSTAINABLE DEVELOPMENT GOALS   9

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT-II: SUSTAINABLE INFRASTRUCTURE PLANNING   9

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

**UNIT-III: SUSTAINABLE CONSTRUCTION PRACTICES AND   9
                    TECHNIQUES**

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT-IV: SUSTAINABLE CONSTRUCTION MATERIALS   9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies.

**UNIT-V: SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE   9
                    PROJECTS**

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and

Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the environment sustainability goals at global and Indian scenario.
- Understand risks in development of projects and suggest mitigation measures.
- Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
- Explain Life Cycle Analysis and life cycle cost of construction materials.
- Explain the new technologies for maintenance of infrastructure projects.

TEXT BOOKS:

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4th Edition, Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell, UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques, (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine.

REFERENCES:

1. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press.
2. Munier N, "Introduction to Sustainability", Springer 2005.
3. Sharma, "Sustainable Smart Cities in India: Challenges and Future Perspectives", SPRINGER, 2022.
4. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009.
5. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	1	1	-	2	3	1	1	-	2	1	1	2	1	-
2	3	1	3	2	1	2	2	-	1	1	1	2	2	2	2	-
3	2	2	3	1	1	1	1	-	-	-	1	1	1	3	1	-
4	3	1	3	2	2	1	3	1	1	1	1	2	2	2	2	-
5	3	1	2	2	2	2	3	1	-	1	1	2	2	3	2	-
Average	2.6	1.3	2.4	1.6	1.5	1.6	2.4	1.0	1.0	1.0	1.2	1.6	1.6	2.4	1.6	-

AGM502   **SUSTAINABLE AGRICULTURE AND**   **L T P C**
             ENVIRONMENTAL MANAGEMENT   **3**
                    0 0 3

OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems.
- To introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.
- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

**UNIT-I: AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE   9
             AGRICULTURE CONCEPTS**

Ecosystem definition - Biotic *Vs.* abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems.

UNIT-II: SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT   9

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control.

UNIT-III: WATER MANAGEMENT   9

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use.

UNIT-IV: ENERGY AND WASTE MANAGEMENT   9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high

value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture.

UNIT-V: EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS   9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production **-** Goals and components of a community food system - Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture.
- Discuss the sustainable ways in managing soil health, nutrients, pests and diseases.
- Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources.
- Develop energy and waste management plans for promoting sustainable agriculture in non- sustainable farming areas.
- Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem.

TEXT BOOKS:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020.
2. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
3. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
4. Saroja Raman, "Agricultural Sustainability – Principles, Processes and Prospects", CRC Press, 2013.
5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

REFERENCES:

1. Agricultural Economics and Agribusiness, Cramer, Jensen, and Southgate, John Wiley.
2. Agricultural Economics, Drummond and Goodwin, Prentice Hall.

3. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.

4. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020.

5. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	-	-	-	-	-	2	-	2	-	-	2	2	-	-
2	-	2	-	2	2	2	-	-	-	-	-	-	3	2	-	-
3	-	-	-	2		2	-	-	-	-	-	-	3	2	3	-
4	3	2	-	-	2	-	-	2	2	2	2	-	3	2	3	-
5	-	2	3	2	-	-	1	-	-	-	-	1	-	2	-	-
Average	3.0	2.0	3.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0	1.0	2.7	2.0	3.0	-

AGM503   **SUSTAINABLE BIO MATERIALS**   **L T P C**

                                                                    3 0 0 3

OBJECTIVES:

- To Impart knowledge of biomaterials and their properties.
- To learn about Fundamentals aspects of Biopolymers and their applications.
- To learn about bioceramics and biopolymers.
- To introduce the students about metals as biomaterials and their usage as implants.
- To make the students understand the significance of bionanomaterials and its applications.

UNIT-I: INTRODUCTION TO BIOMATERIALS   9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants- textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues- performance of implants-tissue response to implants- Impact and Future of Biomaterials.

UNIT-II: BIO POLYMERS   9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques– Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers – Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives - Synthetic polymeric membranes and their biological applications.

UNIT-III: BIO CERAMICS AND BIOCOMPOSITES   9

General properties- Bio ceramics -Silicate glass - Alumina (Al_2O_3) -Zirconia (ZrO_2)- Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Compsite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants- Tissue engineering scaffolds.

UNIT-IV: METALS AS BIOMATERIALS   9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals.

UNIT-V: NANOBIOMATERIALS   9

Steel construction, Types of steel used for construction, Methods of utilizing steel construction, Advantages and Applications of steel in construction.

Advanced Materials: Adhesives in construction industry-Acrylics, Bridge bearings, Industrial waste materials in concrete Rapid wall panels, Moisture Barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Gain familiarity with Biomaterials and they will understand their importance.
- Get an overview of different biopolymers and their properties.
- Gain knowledge on some of the important Bioceramics and Biocomposite materials.
- Gain knowledge on metals as biomaterials.
- Gain knowledge on the importance of nanobiomaterials in biomedical applications.

TEXT BOOKS:

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani "Introduction to Biomaterials Basic Theory with Engineering Applications" Cambridge University Press, 2014.
2. Donglu shi "Introduction to Biomaterials" Tsinghua University press, 2006.
3. Joon Park, R.S. Lakes "Biomaterials an Introduction" third edition, Springer 2007.
4. M.Jaffe, W. Hammond, P. Tolias and T. Arinzeh "Characterization of Biomaterials" Wood head publishing, 2013.
5. Buddy D. Ratner and Allan S. Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.

REFERENCES:

1. Vasif Hasirci, Nesrin Hasirci "Fundamentals of Biomaterials" Springer, 2018.
2. Leopoido Javier Rios Gonzalez. "Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process" Apple academic press, 2021.

3. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad "Functional Bionanomaterials" springer, 2020.

4. Sujata.V. Bhat Biomaterials; Narosa Publishing house, 2002.

5. VasifHasirci, NesrinHasirci "Fundamentals of Biomaterials" Springer, 2018.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	2	2	1	-	-	-	-	-	-	-	-	-	-
2	2	2	2	1	2	1	-	-	-	-	-	-	-	-	-	-
3	2	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-
4	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-
5	2	2	1	-	2	1	-	-	-	-	-	-	-	-	-	-
Average	2.2	1.8	1.8	1.5	1.7	1.0	-	-	-	-	-	-	-	-	-	-

AGM504   MATERIALS FOR ENERGY AND SUSTAINABILITY   L T P C

                                                                      3 0 0 3

OBJECTIVES:

- To familiarize the students about the challenges and demands of energy sustainability.
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell.
- To enable students to appreciate novel materials and their usage in photovoltaic application.
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT-I: SUSTAINABLE ENERGY SOURCES   9

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy.

UNIT-II: ELECTROCHEMICAL DEVICES   9

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).

UNIT-III: FUEL CELLS   9

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion

conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT-IV: PHOTOVOLTAICS   9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine).

UNIT-V: SUPERCAPACITORS   9

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) -   Two - Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Acquire knowledge about energy sustainability and principles of different electrochemical devices and working of fuel cells and their application.
- Gain knowledge on different types of supercapacitors and the performance of various materials.

- Comprehend and learn concepts related to building automation hardware and software and their application in smart buildings.
- Examine and apply lighting control, air conditioning and related applications in the context of smart buildings.
- Assess and apply other critical smart building applications and appreciate the role of data analytics in the control of building systems.

TEXT BOOKS:

1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.

2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.

3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.

4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.

5. Materials for Supercapacitor applications; B. Viswanathan. M.Aulice Scibioh.

REFERENCES:

1. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.

2. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.

3. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.

4. Raphael, B. (2022). Construction and Building Automation: From Concepts to Implementation. Routledge.

5. Sinopoli, J. M. (2009). Smart buildings systems for architects, owners and builders. Butterworth-Heinemann.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-
2	1	-	-	-	-	-	-	-	1	-	-	2	-	3	1	-
3	-	-	-	3	-	1	2	-	-	-	-	-	-	2	-	2
4	-	-	-	-	-	-	-	1	-	-	3	-	1	-	2	-
5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	1.5	-	-	3.0	-	1.0	2.0	2.0	1.5	-	3.0	2.0	1.5	2.5	1.5	2.0

AGM505   **GREEN TECHNOLOGY**   **L T P C**

3 0 0 3

OBJECTIVES:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To understand the principles of green chemistry and eco friendly methodologies.
- To create awareness on Cleaner development mechanisms.
- To develop concepts on various energy efficient systems and green buildings.
- To provide green engineering solutions to energy demand, reduced energy.

UNIT-I: PRINCIPLES OF GREEN CHEMISTRY   9

Introduction to green chemistry and technology. Twelve principles of green chemistry, Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

UNIT-II: POLLUTION TYPES   9

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT-III: GREEN REAGENTS AND GREEN SYNTHESIS   9

Cleaner development technologies Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling. Oxidation technology for waste water treatment- Cavitation, Fenton chemistry, photo catalysis and hybrid processes.

UNIT-IV: DESIGNING GREEN PROCESSES   9

Energy efficient systems and processes Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green production systems.

UNIT-V: GREEN NANOTECHNOLOGY   9

Green Buildings Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Ecofriendly and cost effective materials,

Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the principles of green engineering and technology.
- Learn about pollution using hazardous chemicals and solvents.
- Modify processes and products to make them green and safe.
- Design processes and products using green technology.
- Understand advanced technology in green synthesis.

TEXT BOOKS:

1. Soli J. Arceivala, "GREEN TECHNOLOGIES", McGraw Hill Education,2017.
2. Khan B.H, Non conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
3. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.
4. Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi 2009.
5. Paul L. Bishop, Pollution prevention–Fundamentals and Practices, McGraw-Hill-international 2000.

REFERENCES:

1. Ritu Dogra, "Renewable Energy and Green Technology", Brillion Publishing, 2023.
2. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications,2008.
3. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017.
4. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997.
5. Sambit Kumar Mishra, Zdzislaw Polkowski, Samarjeet Borah, Ritesh Dash, "AI in Manufacturing and Green Technology: Methods and Applications" CRC Press, 2021.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.3	1.6	2.0	3.0	-	-	2.6	-	2.4	1.2	1.0	2.0	1.0

AGM506   **ENVIRONMENTAL QUALITY MONITORING**   **L T P C**

AND ANALYSIS   **3 0 0 3**

OBJECTIVES:

- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.
- To know the analytical and instrumental methods to measure various IEQ parameters.
- To familiarize the regulations, standards and guidelines of IEQ.
- To learn the fundamentals of computational fluid dynamics (CFD).

UNIT-I: ENVIRONMENTAL MONITORING AND STANDARDS   9

Introduction to indoor environmental quality – Parameters: Thermal Comfort - thermal balance of human body – instrumentation and measurement - impact of thermal comfort on human productivity and health.

UNIT-II: MONITORING OF ENVIRONMENTAL PARAMETERS   9

Current Environmental Issues- Global Environmental monitoring programme- International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT-III: ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING   9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis.

UNIT-IV: ENVIRONMENTAL MONITORING PROGRAMME (EMP) &   9

RISK ASSESSMENT

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification- exposure assessment- dose-response assessment; risk characterization.

Fundamentals of mass transport – definition of intraphase and inter-phase chemical flux; interphase mass transport, diffusion coefficient and convection mass transfer coefficients. Chemical Exchange between air-water Overall transport model and scenarios.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to know:

- The basic concepts of environmental standards and monitoring.
- The ambient air quality and water quality standards.
- The various instrumental methods and their principles for environmental monitoring.
- The significance of environmental standards in monitoring quality and sustainability of the environment.
- The various ways of raising environmental awareness among the people.

TEXT BOOKS:

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc.
3. Pengler, J.D.; McCarthy, J.F.; Same, J.M., Indoor Air Quality Handbook. McGraw Hill, 2000.
4. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
5. Daoliang Li, Shuangyin Liu, "Water Quality Monitoring and Management" Elsevier, 2018.

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1. Nazaroff, W.W., and Alvarez-Cohen, L., Environmental Engineering Science. Wiley sons, Newyork, 2001.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3. Maroni, M.; Seifert, B.; Lindvall, T., Indoor Air Quality: A Comprehensive Reference Book. Elsevier Science Ltd, 1996.

4. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

5. Nicolas Mazzeo, "Air Quality Monitoring, Assessment and Management", IntechOpen.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	1.5	2.0	2.3	-	2.0	3.0	2.2	-	2.6	-	2.4	1.0	1.3	-	1.0