GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum For

B. Tech. Information Technology

(Full Time)

2022

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

THADAGAM ROAD, COIMBATORE - 641 013

PHONE : 0422 - 2433355

E.mail: gctcoe@gct.ac.in

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind**.**

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

GOVERNMENT COLLEGE OF TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University)
Coimbatore - 641 013

DEPARTMENT OF INFORMATION TECHNOLOGY

VISION AND MISSION

VISION

Emerging as a Centre of Excellence in the field of Information Technology to produce skilled and intellectual professionals to meet societal needs.

MISSION

- To produce technologically competent and ethically responsible graduates through balanced and dynamic curriculum.

- To take up creative research in collaboration with Government, Industries and Professional Societies to make the nation as a knowledge-power.

- To produce successful graduates with personal and professional responsibilities and commitment to lifelong learning.

GOVERNMENT COLLEGE OF TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University)
Coimbatore - 641 013

DEPARTMENT OF INFORMATION TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

The Programme Educational Objectives of B.Tech. Information Technology programme are:

PEO1: Graduates will be in IT industries as leaders and experts in providing technically feasible and sociallyacceptable solutions to complex real life problems by virtue of their core competence and communication skills.

PEO2: Graduates will emerge as innovative researchers/developers by engaging in lifelong learning.

PEO3: Graduates will exhibit entrepreneurial skills and professional ethics to take up newventures.

GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

DEPARTMENT OF INFORMATION TECHNOLOGY

PROGRAMME OUTCOMES(POs)

Students of B.Tech. Information Technology Programme at the time of graduation will be able to:

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

2. Problem analysis: Identify, formulate, review 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 the public health and safety, and the 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 modeling 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 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.

GOVERNMENT COLLEGE OF TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University)
Coimbatore - 641 013

DEPARTMENT OF INFORMATION TECHNOLOGY

PROGRAMME SPECIFIC OUTCOMES(PSOs)

The Programme Specific Outcomes of B.Tech. Information Technology programme are:

PSO1: Apply programming principles and practices for the design and development of software solutions with varying degree of complexity.

PSO2: Identify and use the optimized resources to provide IT solutions to the future society.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE - 641013
B.Tech. INFORMATION TECHNOLOGY

FIRST SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
	22IMC1Z0	Induction Programme	MC	-	-	-	-	-	-	0
1	22IHS1Z1	தமிழர் மரபு Heritage of Tamils	HSMC	40	60	100	1	0	0	1
2	22IHS1Z2	Professional English	HSMC	40	60	100	2	1	0	3
3	22IBS1Z1	Linear Algebra and Calculus	BS	40	60	100	3	1	0	4
4	22IBS1Z2	Engineering Physics	BS	40	60	100	3	0	0	3
5	22IES101	Programming in C	ES	40	60	100	3	0	0	3
6	22IMC1Z1	Environmental Science and Engineering	MC	40	60	100	3	0	0	0
PRACTICAL										
7	22IHS1Z3	Cambridge English	HSMC	60	40	100	0	0	2	1
8	22IBS1Z3	Physics Laboratory	BS	60	40	100	0	0	3	1.5
9	22IES1Z2	Workshop Practice	ES	60	40	100	0	0	3	1.5
10	22IES103	Programming in C Laboratory	ES	60	40	100	0	0	3	1.5
TOTAL				**480**	**520**	**1000**	**15**	**2**	**11**	**19.5**

SECOND SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22IHS2Z4	தமிழரும்தொழில்நுட்பமும் Tamils and Technology	HSMC	40	60	100	1	0	0	1
2	22IHS2Z5	Values and Ethics	HSMC	40	60	100	3	0	0	3
3	22IBS204	Vector Spaces and Differential Equations with MATLAB	BS	40	60	100	3	1	0	4
4	22IBS205	Physics for Information Science	BS	40	60	100	3	0	0	3
5	22IBS206	Applied Chemistry	BS	40	60	100	3	0	0	3
6	22IES204	Basics of Electrical and Electronics Engineering	ES	40	60	100	3	0	0	3
		NCC Credit Course (Optional)					2	0	0	0
PRACTICAL										
7	22IBS2Z7	Chemistry Laboratory	BS	60	40	100	0	0	3	1.5
8	22IES2Z5	Engineering Graphics	ES	60	40	100	1	0	4	3
TOTAL				**360**	**440**	**800**	**17**	**1**	**7**	**21.5**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE - 641013

B.Tech. INFORMATION TECHNOLOGY

2022 REGULATIONS

THIRD SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22IBS308	Probability, Random Processes and Queuing Theory (Common to CSE & IT)	BS	40	60	100	3	1	0	4
2	22IES306	Computer Organization and Architecture	ES	40	60	100	3	0	0	3
3	22IES307	Digital Logic Design	ES	40	60	100	3	0	0	3
4	22IPC301	Data Structures and Algorithms	PC	40	60	100	3	0	0	3
THEORY WITH PRACTICAL COMPONENT										
5	22IPC302	Java Programming	PC	50	50	100	3	0	2	4
PRACTICAL										
6	22IES308	Engineering Exploration For Information Technology (Common to CSE & IT)	ES	100	-	100	0	0	3	1.5
7	22IES309	Digital Logic Design Laboratory	ES	60	40	100	0	0	2	1
8	22IPC303	Data Structures and Algorithms Laboratory	PC	60	40	100	0	0	3	1.5
TOTAL				**430**	**370**	**800**	**15**	**1**	**10**	**21**

FOURTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22IES410	Elements of Discrete Structures	ES	40	60	100	3	0	0	3
2	22IPC404	Embedded Systems Architecture	PC	40	60	100	3	0	0	3
3	22IPC405	Database Systems	PC	40	60	100	3	0	0	3
4	22IES411	Principles of Communication Engineering	ES	40	60	100	3	0	0	3
5	22IPC406	Design and Analysis of Algorithms (Common to CSE & IT)	PC	40	60	100	3	1	0	4
6	22IES412	Foundations of Data Science (Common to CSE & IT)	ES	40	60	100	3	0	0	3
PRACTICAL										
7	22IPC407	Database Systems Laboratory	PC	60	40	100	0	0	3	1.5
8	22IPC408	Embedded Systems Laboratory	PC	60	40	100	0	0	3	1.5

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE - 641013
B.Tech. INFORMATION TECHNOLOGY
2022 REGULATIONS

FIFTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22IPC509	Computer Networks *(Common to ECE, CSE and IT)*	PC	40	60	100	3	0	0	3
2	22IPC510	Theory of Computation *(Common to CSE and IT)*	PC	40	60	100	3	1	0	4
3	22IPC511	Artificial Intelligence *(Common to CSE and IT)*	PC	40	60	100	3	0	0	3
4	22IPC512	Operating Systems	PC	40	60	100	3	0	0	3
5	22IPC513	Advanced Programming using Python	PC	40	60	100	3	0	0	3
6	22IPE$XX	Professional Elective - I	PE	40	60	100	3	0	0	3
PRACTICAL										
7	22IPC514	Open Source Tools Laboratory	PC	60	40	100	0	0	3	1.5
8	22IPC515	Computer Networks Laboratory *(Common to ECE, CSE and IT)*	PC	60	40	100	0	0	3	1.5
9	22IPC516	Operating Systems Laboratory	PC	60	40	100	0	0	3	1.5
TOTAL				**420**	**480**	**900**	**18**	**1**	**9**	**23.5**

SIXTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22IPC617	Software Engineering	PC	40	60	100	3	0	0	3
2	22IPC618	Machine Learning *(Common to CSE and IT)*	PC	40	60	100	3	0	0	3
3	22IPC619	Big Data Analytics	PC	40	60	100	3	0	0	3
4	22IPC620	Web Essentials	PC	40	60	100	3	0	0	3
5	22IPE$XX	Professional Elective - II	PE	40	60	100	3	0	0	3
6	22#OE$XX	Open Elective - I/ Professional Elective VI	OE/PE	40	60	100	3	0	0	3
PRACTICAL										
7	22IPC621	Big Data Analytics Laboratory	PC	60	40	100	0	0	4	2
8	22IPC622	Web Essentials Laboratory	PC	60	40	100	0	0	3	1.5
9	22IES613	Design Thinking for Information Technology	ES	100	-	100	0	0	3	1.5
TOTAL				**460**	**440**	**900**	**18**	**0**	**10**	**23**

SEVENTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22IHS706	Industrial Management and Economics *(Common to EIE, CSE and IT)*	HSMC	40	60	100	3	0	0	3
2	22IPC723	Internet of Things	PC	40	60	100	3	0	0	3
3	22IPC724	Full Stack Web Development	PC	40	60	100	3	0	0	3
4	22IPE$XX	Professional Elective -III	PE	40	60	100	3	0	0	3
5	22#OE$XX	Open Elective – II/ Professional Elective VII	OE/PE	40	60	100	3	0	0	3
6	22IMC7Z2	Constitution of India (Common to all Branches)	MC	40	60	100	3	0	0	0
PRACTICAL										
7	22IPC725	Full Stack Web Development Laboratory	PC	60	40	100	0	0	3	1.5
8	22IEE701	Engineering Projects in Community Service	EEC	60	40	100	0	0	4	2
9	22IEE702	Internship*	EEC	100	--	100	--	--	--	4
TOTAL				**460**	**440**	**900**	**18**	**0**	**7**	**22.5**

EIGHTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22IPE$XX	Professional Elective –IV	PE	40	60	100	3	0	0	3
2	22IPE$XX	Professional Elective– V	PE	40	60	100	3	0	0	3
PRACTICAL										
3	22IEE803	Capstone Project	EEC	60	40	100	0	0	16	8
TOTAL				**140**	**160**	**300**	**6**	**0**	**16**	**14**

Note:

Internship of four consecutive weeks or two 2 consecutive weeks which are completed during the vacation of fourth (and/or) fifth (and/or) sixth semester shall be considered here.

TOTAL CREDITS: 167

SUMMARY OF CREDIT DISTRIBUTION

Sl. No	Course Category	Credits per Semester								Intern-ship	Total no of credits	Total Credits in %	Credits As per AICTE Model Curricula
		I	II	III	IV	V	VI	VII	VIII				
1	HS/ HSMC	5	4	--	--	--	--	3	--	--	12	7	16
2	BS	8.5	11.5	4	--	--	--	--	--	--	24	14	23
3	ES	6	6	8.5	9	--	1.5	--	--	--	31	19	29
4	PC	--	--	8.5	13	20.5	15.5	7.5	--	--	65	39	59
5	PE	--	--	--	--	3	3	3	6	--	15	9	12
6	OE	--	--	--	--	--	3	3	--	--	6	4	9
7	EEC	--	--	--	--	--	--	2	8	4	14	8	15
8	MC	0	--	--	--	0	--	0	--	--	0	0	--
TOTAL		**19.5**	**21.5**	**21**	**22**	**23.5**	**23**	**18.5**	**14**	**4**	**167**	**100**	**163***

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT(HS/HSMC)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22IHS1Z1	Heritage of Tamils (Common to all Branches)	HSMC	40	60	100	1	0	0	1
2	22IHS1Z2	Professional English (Common to all Branches)	HSMC	40	60	100	2	1	0	3
3	22IHS1Z3	Cambridge English (Common to all Branches)	HSMC	60	40	100	0	0	2	1
4	22IHS2Z4	Tamils and Technology (Common to all Branches)	HSMC	40	60	100	1	0	0	1
5	22IHS2Z5	Values and Ethics (Common to all Branches)	HSMC	40	60	100	3	0	0	3
6	22IHS706	Industrial Management and Economics *(Common toEIE, CSE and IT)*	HSMC	40	60	100	3	0	0	3
TOTAL				**260**	**340**	**600**	**10**	**2**	**2**	**12**

BASIC SCIENCE(BS)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22IBS1Z1	Linear Algebra and Calculus (Common to all Branches)	BS	40	60	100	3	1	0	4
2	22IBS1Z2	Engineering Physics (Common to all Branches)	BS	40	60	100	3	0	0	3
3	22IBS1Z3	Physics Laboratory (Common to all Branches)	BS	60	40	100	0	0	3	1.5
4	22IBS204	Vector Spaces and Differential Equations with MATLAB	BS	40	60	100	3	1	0	4
5	22IBS205	Physics for Information Science	BS	40	60	100	3	0	0	3
6	22IBS206	Applied Chemistry	BS	40	60	100	3	0	0	3
7	22IBS2Z7	Chemistry Laboratory (Common to all Branches)	BS	60	40	100	0	0	3	1.5
8	22IBS308	Probability, Random Processes and Queuing Theory (Common to CSE & IT)	BS	40	60	100	3	1	0	4
TOTAL				**360**	**440**	**800**	**18**	**3**	**6**	**24**

ENGINEERING SCIENCE(ES)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22IES101	Programming in C (Common to Civil, EEE,ECE,EIE,CSE,IT and IBT)	ES	40	60	100	3	0	0	3
2	22IES1Z2	Workshop Practice (Common to all Branches)	ES	60	40	100	0	0	3	1.5
3	22IES103	Programming in C Laboratory (Common to Civil, EEE,ECE,EIE,CSE,IT and IBT)	ES	60	40	100	0	0	3	1.5
4	22IES204	Basics of Electrical and Electronics Engineering	ES	40	60	100	3	0	0	3
5	22IES2Z5	Engineering Graphics (Common to all Branches)	ES	60	40	100	1	0	4	3
6	22IES306	Computer Organization and Architecture	ES	40	60	100	3	0	0	3
7	22IES307	Digital Logic Design	ES	40	60	100	3	0	0	3
8	22IES308	Engineering Exploration (Common to All Branches)	ES	60	40	100	0	0	3	1.5
9	22IES309	Digital Logic Design Laboratory	ES	60	40	100	0	0	2	1
10	22IES410	Elements of Discrete Structures	ES	40	60	100	3	0	0	3
11	22IES411	Principles of Communication Engineering	ES	40	60	100	3	0	0	3
12	22IES412	Foundations of Data Science (Common to CSE & IT)	ES	40	60	100	3	0	0	3
13	22IES613	Design Thinking for Information Technology	ES	100	-	100	0	0	3	1.5
TOTAL				**680**	**620**	**1300**	**22**	**0**	**15**	**31**

PROFESSIONAL CORE

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22IPC301	Data Structures and Algorithms	PC	40	60	100	3	0	0	3
2	22IPC302	Java Programming	PC	50	50	100	3	0	2	4
3	22IPC303	Data Structures and Algorithms Laboratory	PC	60	40	100	0	0	3	1.5
4	22IPC404	Embedded Systems	PC	40	60	100	3	0	0	3
5	22IPC405	Database Systems	PC	40	60	100	3	0	0	3
6	22IPC406	Design and Analysis of Algorithms (Common to CSE & IT)	PC	40	60	100	3	1	0	4
7	22IPC407	Database Systems Laboratory	PC	60	40	100	0	0	3	1.5
8	22IPC408	Embedded Systems Laboratory	PC	60	40	100	0	0	3	1.5
9	22IPC509	Computer Networks *(Common to ECE, CSE and IT)*	PC	40	60	100	3	0	0	3
10	22IPC510	Theory of Computation *(Common to CSE and IT)*	PC	40	60	100	3	1	0	4
11	22IPC511	Artificial Intelligence *(Common to CSE and IT)*	PC	40	60	100	3	0	0	3
12	22IPC512	Operating Systems	PC	40	60	100	3	0	0	3
13	22IPC513	Advanced Programming using Python	PC	40	60	100	3	0	0	3
14	22IPC514	Open Source Tools Laboratory	PC	60	40	100	0	0	3	1.5
15	22IPC515	Computer Networks Laboratory *(Common to ECE, CSE and IT)*	PC	60	40	100	0	0	3	1.5
16	22IPC516	Operating Systems Laboratory	PC	60	40	100	0	0	3	1.5
17	22IPC617	Software Engineering	PC	40	60	100	3	0	0	3
18	22IPC618	Machine Learning *(Common to CSE and IT)*	PC	40	60	100	3	0	0	3
19	22IPC619	Big Data Analytics	PC	40	60	100	3	0	0	3
20	22IPC620	Web Essentials	PC	40	60	100	3	0	0	3
21	22IPC621	Big Data Analytics Laboratory	PC	60	40	100	0	0	4	2
22	22IPC622	Web Essentials Laboratory	PC	60	40	100	0	0	3	1.5
23	22IPC723	Internet of Things	PC	40	60	100	3	0	0	3
24	22IPC724	Full Stack Web Development	PC	40	60	100	3	0	0	3
25	22IPC725	Full Stack Web Development Laboratory	PC	60	40	100	0	0	3	1.5
TOTAL				**1190**	**1310**	**2500**	**48**	**2**	**30**	**65**

PROFESSIONAL ELECTIVE(PE)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22IPE$XX	Professional Elective – I	PE	40	60	100	3	0	0	3
2	22IPE$XX	Professional Elective - II	PE	40	60	100	3	0	0	3
3	22IPE$XX	Professional Elective - III	PE	40	60	100	3	0	0	3
4	22IPE$XX	Professional Elective - IV	PE	40	60	100	3	0	0	3
5	22IPE$XX	Professional Elective - V	PE	40	60	100	3	0	0	3
6	22IPE$XX	Professional Elective - VI	PE	40	60	100	3	0	0	3
7	22IPE$XX	Professional Elective – VII	PE	40	60	100	3	0	0	3
TOTAL				**280**	**420**	**700**	**21**	**0**	**0**	**21**

VERTICALS

Vertical I **Data Science**	**Vertical II** **Full Stack Development**	**Vertical III –*** **Cloud Computing and Data Centre Technologies** **(Minor)**	**Vertical IV** **Cyber Security and Data Privacy**	**Vertical V** **Artificial Intelligence and Machine Learning**
22IPE$01 - Exploratory Data Analysis *(Common to CSE and IT)*	22IPE$08 -Cloud Computing	22IPE$08 -Cloud Computing	22IPE$22 -Ethical Hacking *(Common to CSE and IT)*	22IPE$29- Knowledge Engineering
22IPE$02- Recommender Systems*(Common to CSE and IT)*	22IPE$09-App Development *(Common to CSE and IT)*	22IPE$16 - Virtualization Techniques	22IPE$23-Digital and Mobile Forensics *(Common to CSE and IT)*	22IPE$30-Soft Computing *(Common to CSE and IT)*
22IPE$03 - Deep Learning *(Common to CSE and IT)*	22IPE$10-Cloud Services Management	22IPE$10 - Cloud Services Management	22IPE$24-Social Network Security *(Common to CSE and IT)*	22IPE$03 - Deep Learning *(Common to CSE and IT)*
22IPE$04- Text and Speech Analysis	22IPE$11- UI & UX Design *(Common to CSE and IT)*	22IPE$17 - Data Warehousing	22IPE$25-Modern Cryptography *(Common to CSE and IT)*	22IPE$04- Text and Speech Analysis
22IPE$05-Business Analytics	22IPE$12-Software Testing and Automation	22IPE$18 -Storage Technologies	22IPE$26- Engineering Secure software systems *(Common to CSE and IT)*	22IPE$31- Optimization Techniques
22IPE$06- Image and video analytics	22IPE$13-Web Application Security *(Common to CSE and IT)*	22IPE$19-Software Defined Networks	22IPE$27-Crypto currency and Blockchain Technologies *(Common to CSE and IT)*	22IPE$32- Game Theory *(Common to CSE and IT)*
22IPE$07- Computer Vision *(Common to CSE and IT)*	22IPE$14 - Dev-ops *(Common to CSE and IT)*	22IPE$20-Stream Processing	22IPE$28-Network Security	22IPE$33 - Cognitive Science *(Common to CSE and IT)*
-	22IPE$15 -Principles of Programming Languages*(Common to CSE and IT)*	22IPE$21-Security and Privacy in Cloud *(Common to CSE and IT)*	22IPE$21- Security and Privacy in Cloud *(Common to CSE and IT)*	22IPE$34 - Ethics And AI *(Common to CSE and IT)*

*** - Minor Degree**

PROFESSIONAL ELECTIVES
VERTICAL I-DATA SCIENCE

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22IPE$01	Exploratory Data Analysis	PE	40	60	100	3	0	0	3
2.	22IPE$02	Recommender Systems	PE	40	60	100	3	0	0	3
3.	22IPE$03	Deep Learning	PE	40	60	100	3	0	0	3
4.	22IPE$04	Text and Speech Analysis	PE	40	60	100	3	0	0	3
5.	22IPE$05	Business Analytics	PE	40	60	100	3	0	0	3
6.	22IPE$06	Image and video analytics	PE	40	60	100	3	0	0	3
7.	22IPE$07	Computer Vision	PE	40	60	100	3	0	0	3

VERTICAL II -FULL STACK DEVELOPMENT

Sl. No	Course Code	ourse Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22IPE$08	Cloud Computing	PE	40	60	100	3	0	0	3
2.	22IPE$09	App Development	PE	40	60	100	3	0	0	3
3.	22IPE$10	Cloud Services Management	PE	40	60	100	3	0	0	3
4.	22IPE$11	UI &UX Design	PE	40	60	100	3	0	0	3
5.	22IPE$12	Software Testing and Automation	PE	40	60	100	3	0	0	3
6.	22IPE$13	Web Application Security	PE	40	60	100	3	0	0	3
7.	22IPE$14	Dev-ops	PE	40	60	100	3	0	0	3
8.	22IPE$15	Principles of Programming Languages	PE	40	60	100	3	0	0	3

VERTICAL III -CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES

Sl. No	Course Code	ourse Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22IPE$08	Cloud Computing	PE	40	60	100	3	0	0	3
2.	22IPE$16	Virtualization Techniques	PE	40	60	100	3	0	0	3
3.	22IPE$10	Cloud Services Management	PE	40	60	100	3	0	0	3
4.	22IPE$17	Datawarehousing	PE	40	60	100	3	0	0	3
5.	22IPE$18	Storage technologies	PE	40	60	100	3	0	0	3
6.	22IPE$19	Software Defined Networks	PE	40	60	100	3	0	0	3
7.	22IPE$20	Stream Processing	PE	40	60	100	3	0	0	3
8.	22IPE$21	Security and Privacy in Cloud	PE	40	60	100	3	0	0	3

VERTICAL IV -CYBER SECURITY AND DATA PRIVACY

Sl. No	Course Code	ourse Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22IPE$22	Ethical Hacking	PE	40	60	100	3	0	0	3
2.	22IPE$23	Digital and Mobile Forensics	PE	40	60	100	3	0	0	3
3.	22IPE$24	Social Network Security	PE	40	60	100	3	0	0	3
4.	22IPE$25	Modern Cryptography	PE	40	60	100	3	0	0	3
5.	22IPE$26	Engineering Secure Software systems	PE	40	60	100	3	0	0	3
6.	22IPE$27	Cryptocurrency and Blockchain Technologies	PE	40	60	100	3	0	0	3
7.	22IPE$28	Network Security	PE	40	60	100	3	0	0	3
8.	22IPE$21	Security and Privacy in Cloud	PE	40	60	100	3	0	0	3

VERTICAL V -ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Sl. No	Course Code	ourse Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22IPE$29	Knowledge Engineering	PE	40	60	100	3	0	0	3
2.	22IPE$30	Soft Computing	PE	40	60	100	3	0	0	3
3.	22IPE$03	Deep Learning	PE	40	60	100	3	0	0	3
4.	22IPE$04	Text and Speech Analysis	PE	40	60	100	3	0	0	3
5.	22IPE$31	Optimization Techniques	PE	40	60	100	3	0	0	3
6.	22IPE$32	Game Theory	PE	40	60	100	3	0	0	3
7.	22IPE$33	Cognitive Science	PE	40	60	100	3	0	0	3
8.	22IPE$34	Ethics and AI	PE	40	60	100	3	0	0	3

OPEN ELECTIVE (OE)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22COE$01	Disaster management and mitigation	OE	40	60	100	3	0	0	3
2	22COE$02	Water sanitation and health	OE	40	60	100	3	0	0	3
3	22MOE$03	Nanotechnology and surface engineering	OE	40	60	100	3	0	0	3
4	22MOE$04	Industrial safety management	OE	40	60	100	3	0	0	3
5	22EOE$05	Renewable power generation systems	OE	40	60	100	3	0	0	3
6	22EOE$06	Smart grid technology	OE	40	60	100	3	0	0	3
7	22LOE$07	Cmos vlsi design	OE	40	60	100	3	0	0	3
8	22LOE$08	Mobile communication	OE	40	60	100	3	0	0	3
9	22POE$09	Rapid prototyping	OE	40	60	100	3	0	0	3
10	22POE$10	Managerial economics	OE	40	60	100	3	0	0	3
11	22NOE$11	Measurement and control	OE	40	60	100	3	0	0	3
12	22NOE$12	Industrial automation	OE	40	60	100	3	0	0	3
13	22SOE$13	Programming in java	OE	40	60	100	3	0	0	3
14	22SOE$14	Network essential	OE	40	60	100	3	0	0	3
15	22I0E$15	Video creation and editing	OE	40	60	100	3	0	0	3
16	22IOE$16	Digital marketing	OE	40	60	100	3	0	0	3
17	22BOE$17	Principles of food technology	OE	40	60	100	3	0	0	3
18	22BOE$18	Biology for engineers	OE	40	60	100	3	0	0	3
TOTAL				**720**	**1080**	**1800**	**54**	**0**	**0**	**54**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22IEE701	Engineering Projects in Community Service	EEC	60	40	100	0	0	4	2
2	22IEE702	Internship*	EEC	100	--	100	-	-	-	4
3	22IEE803	Capstone Project	EEC	60	40	100	0	0	16	8
TOTAL				**220**	**80**	**300**	**0**	**0**	**22**	**15**

MANDATORY COURSES (MC)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22IMC1Z0	Induction Programme	MC	-	-	-	-	-	-	0
2	22IMC1Z1	Environmental Science and Engineering (Common to all Branches)	MC	40	60	100	3	0	0	0
3	22IMC7Z2	Constitution of India (Common to all Branches)	MC	40	60	100	3	0	0	0
TOTAL				**80**	**120**	**200**	**6**	**0**	**0**	**0**

VALUE ADDED COURSES

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1		SWAYAM/NPTEL Courses	EEC							
2		Online Courses from Coursera	EEC							
3		Research Publication	EEC							
4		Infosys Spring Board Courses	EEC							
5		Naan Mudhalvan Courses	EEC							

GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore–641013.

INFORMATION TECHNOLOGY

22IMC1Z0	INDUCTION PROGRAMME	SEMESTER I

Details of the Programme:

Day 0: College Admission

Day1: Orientation Programme

Day2 Onwards : Induction Programme

Activities:
Physical activity,
Playground Events,
Yoga Practices,
Literary,
Proficiency modules,
Team Building,
Lectures by Eminent people,
Familiarization to department,
Branch oriented information,
Motivational speakers,
Talent exposure,
Quiz completion,
Visit to local areas….etc.

22IHS1Z1	தமிழர் மரபு Heritage of Tamils *(Common to all Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

UNIT – I	LANGUAGE AND LITERATURE	3 Periods
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 Periods**
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role ofTemples in Social and Economic Life of Tamils.		
UNIT – III	**FOLK AND MARTIAL ARTS**	**3 Periods**
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
UNIT – IV	**THINAI CONCEPT OF TAMILS**	**3 Periods**
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature- Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
UNIT – V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3 Periods**
Contribution of 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 Tamil Books.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

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)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)(Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22IHS1Z1	**தமிழர் மரபு Heritage of Tamils** *(Common to all Branches)*	**SEMESTER I**

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

அலகு I	மொழி மற்றும் இலக்கியம்	3 Periods

இந்திய மொழிக் குடும்பங்கள்- திராவிட மொழிகள்- தமிழ் ஒரு செம்மொழி- தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை-சங்க இலக்கியத்தில் பகிர்தல் அறம்-திருக்குறளில் மேலாண்மைக் கருத்துக்கள்-தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்தசமயங்களின் தாக்கம்-பக்தி இலக்கியம், ஆழ்வார்கள்மற்றும்நாயன்மார்கள்-சிற்றிலக்கியங்கள்-தமிழில்நவீன இலக்கியத்தின் வளர்ச்சி-தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II	மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை–சிற்பக் கலை	3 Periods

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்-பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர சிலை – இசைக் கருவிகள் – மிருதங்கம் , பறை, வீணை, யாழ் , நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3 Periods

தெருக்கூத்து, கரகாட்டம்-வில்லுப்பாட்டு-கணியான் கூத்து-ஒயிலாட்டம்-தோல்பாவைக் கூத்து-சிலம்பாட்டம் –வளரி-புலியாட்டம் -தமிழர்களின் விளையாட்டுகள்.

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3 Periods

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு –சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் –சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3 Periods

இந்திய விடுதலைபோரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

TEXT BOOK:

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)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)(Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22IHS1Z2	PROFESSIONAL ENGLISH *(Common to all Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	2	1	0	3

Course Objectives	1. To engage learners in meaningful language activities to improve their LSRW skills 2. To enhance learners' awareness of general rules of writing for specific audiences 3. To help learners understand the purpose, audience, contexts of different types of writing 4. To develop analytical thinking skills for problem solving in communicative contexts 5. To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT – I	**FUNDAMENTALS OF COMMUNICATION**	**9 Periods**

Listening –Listening to Personal Introduction and Filling a form
Speaking - Self Introduction; Introducing someone in a formal context
Reading -Reading Biographies/ Autobiographies and E-mails relevant to technical contexts.
Writing - Writing Biographies/ Autobiographies; Drafting Professional E-mails.
Grammar - Present Tense (Simple Present, Present Progressive, Present Perfect, Present Perfect Continuous); Parts of Speech
Vocabulary - Word Formation with Prefixes; Antonyms; Portmanteau Words

UNIT – II	**SUMMATION AND PROBLEM SOLVING**	**9 Periods**

Listening - Listening to Short-Stories / Personal Experiences/Watching Movies.
Speaking - Narrating Personal Experiences / Events and Short Stories
Reading - Reading Travelogues and Books.
Writing - Report on an event (Field Trip, Industrial Visit, Educational Tours etc.), Review on Books and Movies.
Grammar –Past Tense (Simple Past, Past Progressive, Past Perfect, Past Perfect Continuous); Impersonal Passive
Vocabulary - Word Formation with suffixes; Synonyms; Phrasal Verbs.

UNIT – III	**DESCRIPTION OF A PROCESS / PRODUCT**	**9 Periods**

Listening - Listening to Digital Marketing Advertisements for Product /Process Descriptions
Speaking –Describing/Interpreting a Picture; Giving instructions to use the product.
Reading – Reading Advertisements, Gadget Reviews; User Manuals.
Writing - Writing Definitions; Product /Process Description; Transcoding; Content Writing
Grammar -Future Tense(Simple Future, future continuous, Future Perfect, Future Perfect Continuous); If Clauses
Vocabulary - Homonyms; Homophones, One Word Substitutes.

UNIT – IV	**EXPRESSION**	**9 Periods**

Listening – Listening to/Watching Formal Job interviews or Celebrity Interviews
Speaking – Participating in a Face to Face or Virtual Interview (Job/Celebrity Interview), virtual interviews
Reading – Company profiles, Statement of Purpose, (SOP), Excerpts of interview with professionals from Newspaper, Magazine and other Resources
Writing – Job / Internship Application – Cover letter & Resume
Grammar – Question types: 'Wh' / Yes or No/ and Tags; Subject- Verb Agreement.
Vocabulary – Idiomatic Expressions

UNIT – V	**PUBLIC SPEAKING**	**9 Periods**

Listening – Listening to Ceremonious Speeches on You Tube and Jotting down phrases
Speaking – Delivering Welcome Address; Introducing the Chief-Guest; Proposing Vote of Thank and Felicitation
Reading – Excerpts of Speeches from Newspaper, Magazines and Motivational Books
Writing – Drafting a Welcome Address, Introduction to the Chief-Guest, Vote of Thanks and Felicitation
Grammar –Common Errors
Vocabulary – Commonly Confused Words

Contact Periods:
Lecture: 30 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK

1	***English for Science & Technology*** *Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.*
2	***Communicative English,*** *Global Publishers, Chennai 2017 by Dr.J.Anbazhagan Vijay*

REFERENCES

1	*Raman.Meenakshi,Sharma.Sangeeta(2019).* ***Professional English.*** *Oxford University Press. New Delhi.*
2	***Learning to Communicate*** *– Dr. V. Chellammal, Allied Publishing House, New Delhi,2003*
3	***Using English****, Orient Blackswan, Chennai, 2017 by Board of Editors*
4	***OER****(Authentic Open Educational Resources)*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Participate in a basic communicative task.	K3
CO2	Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.	K3
CO3	Describe a product or process or mechanism.	K2
CO4	Present their opinions in a planned and logical manner, and draft effective resumes in context of job search.	K3
CO5	Deliver speeches at formal functions.	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	-	-	1	-	-	2	-	-	3	3	-	-	1	1
CO2	-	1	1	-	-	2	-	-	1	3	-	1	1	1
CO3	-	-	-	1	-	-	-	-	-	3	-	-	-	-
CO4	-	-	1	-	-	-	-	-	2	3	-	-	1	1
CO5	-	-	-	-	-	-	-	-	2	2	-	-	-	-
22IHS1Z2	**-**	**1**	**1**	**1**	**-**	**1**	-	-	**2**	**3**	-	**1**	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	3.3.2, 6.1.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2.
CO2	2.1.1, 2.2.3, 2.2.4, 3.1.2, 6.2.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 12.3.1, 12.3.2.
CO3	4.1.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2.
CO4	3.3.2, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2
CO5	9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.3, 10.2.1, 10.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	12	88	-	-	-	100
CAT2	-	18	82	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	100	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	-	20	80	-	-	-	100

22IBS1Z1	LINEAR ALGEBRA AND CALCULUS *(Common to all Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	1. To acquire knowledge of system of equations, eigenvalues, eigenvectors, diagonalization of matrices and reduction of quadratic forms to canonical forms. 2. To obtain the knowledge of analyze the functions using Limits and derivative recognize the appropriate tools of differential calculus to solve applied problems. 3. To obtain the knowledge of definite and improper integration and recognize the appropriate tools of Integral Calculus to solve applied problems 4. To develop the skills in solving the functions of several variables by partial derivatives. 5. To acquire knowledge of multiple integration and related applied problems in various geometry

UNIT – I	**LINEAR ALGEBRA**	**9+3 Periods**
Consistency of System of Linear Equations - Eigen values and eigenvectors - Diagonalization of matrices by orthogonal transformation - Cayley-Hamilton Theorem - Quadratic to canonical forms.		
UNIT – II	**DIFFERENTIAL CALCULUS**	**9+3 Periods**
Limit and continuity of function - Rolle's theorem - Mean value theorems - Taylor's and Maclaurin's theorems. Application of Differential Calculus: Radius of curvature, Centre of curvature, Circle of curvature and Evolutes of a curve.		
UNIT – III	**INTEGRAL CALCULUS**	**9+3 Periods**
Evaluation of definite integral by trigonometric substitution - Convergence and Divergence of improper integrals - Beta & Gamma functions and their properties - Applications of definite integrals to evaluate surface areas and volume of revolution (Cartesian coordinates only).		
UNIT – IV	**PARTIAL DERIVATIVES AND ITS APPLICATIONS**	**9+3 Periods**
Partial derivatives - total derivative - Taylor's series – Jacobians - Maxima, minima and saddle points - Method of Lagrange multipliers.		
UNIT – V	**MULTI VARIABLE INTEGRAL CALCULUS**	**9+3 Periods**
Double integral - Area as double integral - change of order of integration in double integrals - Triple Integrals - Volume as Triple Integral. Change of variables: Cartesian to polar, Spherical polar coordinates, Cylindrical polar coordinates.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK

1	*Veerarajan T., **"Engineering Mathematics I"**, Tata McGraw-Hill Education(India)Pvt. Ltd, New Delhi,2015.*
2	*David C.Lay, **"Linear Algebra and Its Application"**, Pearson Publishers, 6th Edition, 2021.*

REFERENCES

1	*B.S.Grewal, **"Higher Engineering Mathematics"**, Khanna Publishers, 44th Edition, 2017.*
2	*Howard Anton, **"Elementry Linear Algebra"**, 11thEdition, Wiley Publication, 2013.*
3	*Narayanan.S and Manicavachagom Pillai. T.K. – **"Calculas Vol I and Vol II",** S.chand & Co, Sixth Edition, 2014.*
4	*H.K. Dass, **"Advance Engineering Mathematics"**, S. Chand and company, Eleventh Edition, 2015.*
5	*Jain R.K. and Iyengar S.R.K., **"Advanced Engineering Mathematics"**, Narosa Publicaitons, Eighth Edition, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Solve the linear system of equations, diagonalize matrix by orthogonal transformation and reduce quadratic form to canonical form.	K5
CO2	Compare and contrast the ideas of continuity and differentiability and use them to solve engineering problems.	K5
CO3	Acquire fluency in integration of one variable and apply them to find surface area and volumes.	K5
CO4	Apply the techniques of partial derivatives in functions of several variables.	K5
CO5	Use multiple integration for finding area, surface and volume of different geometry.	K5

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1	-	-	-	-	-	-	-	1	2	2
CO2	3	3	1	1	-	-	-	-	-	-	-	1	2	2
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	2
CO4	3	3	1	1	-	-	-	-	-	-	-	1	2	2
CO5	3	3	1	1	-	-	-	-	-	-	-	1	2	2
22IBS1Z1	**3**	**3**	**1**	**1**	-	-	-	-	-	-	-	**1**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1.
CO2	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1.
CO3	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1.
CO4	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1.
CO5	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	30	10	-	-	100
CAT2	20	40	30	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	30	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	30	10	-	-	100
ESE	20	40	30	10	-	-	100

22IBS1Z2	ENGINEERING PHYSICS *(Common to all Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	0	0	3

Course Objectives	1. To understand the basics about crystal systems and defects. 2. To understand the principle, characteristics, working and applications of laser and optical fiber. 3. To solve problems in bending of beams. 4. To solve quantum mechanical problems with the understanding of Quantum Principles. 5. To understand the properties, production and applications of ultrasonic waves.

UNIT – I	**CRYSTAL PHYSICS**	**9 Periods**

Introduction – Crystalline and amorphous materials – Lattice – Unit Cell –Crystal system - Bravais lattices – Miller indices – Reciprocal lattice - d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, and HCP structures – Crystal defects – Point, line and surface defects.

UNIT – II	**LASER PHYSICS AND FIBER OPTICS**	**9 Periods**

Introduction- Principle of laser action - characteristics of laser - Spontaneous emission and Stimulated emission – Einstein's coefficients - population inversion – methods of achieving population inversion –Optical Resonator -Types of Lasers – Principle, construction and working of CO_2 Laser - applications of laser.

Introduction – Basic Principles involved in fiber optics- Total internal reflection–Propagation of light through optical fiber –Derivation for Numerical Aperture and acceptance angle - fractional index change.

UNIT – III	**PROPERTIES OF MATTER**	**9 Periods**

Elasticity- Hooke's law- stress-strain diagram - Factors affecting elasticity – Moment (Q) - Couple (Q) – Torque (Q) – Beam - Bending moment - Depression of a cantilever – Twisting Couple- Young's modulus by uniform bending - I shaped girders.

UNIT – IV	**QUANTUM PHYSICS AND APPLICATIONS**	**9 Periods**

Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation- de-Broglie wavelength in terms of voltage, energy, and temperature –Heisenberg's Uncertainty principle – verification – physical significance of a wave function- Schrödinger's Time independent and Time dependent wave equations –- Particle in a one dimensional potential well - Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM).

UNIT – V	**ULTRASONICS**	**9 Periods**

Introduction - properties of ultrasonic waves - production of ultrasonic waves - Magnetostriction effect- Magnetostriction generator- Piezoelectric effect- Piezoelectric generator- Acoustic grating - Determination of wavelength and velocity of ultrasonic waves- cavitation - applications- ultrasonic drilling- ultrasonic welding- ultrasonic soldering and ultrasonic cleaning- Non- destructive Testing- Pulse echo system.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*K. Rajagopal**, "Engineering Physics"**, PHI Learning Private Limited, 2015.*
2	*P. K. Palanisamy, **"Engineering Physics-I",** Scitech publications Private Limited, 2015.*
3	*M. Arumugam, **"Engineering Physics"**, Anuradha Publishers, 2010.*

REFERENCES:

1	*Arthur Beiser, **"Concepts of Modern Physics"**, Tata McGraw-Hill, 2010.*
2	*D. Halliday, R. Resnick and J. Walker, **"Fundamentals of Physics"**, 6th Edition, John Wiley and Sons, 2001.*
3	*William T. Silfvast, **"Laser Fundamentals"**, 2nd Edition, Cambridge University Press, New York 2004.*
4	*M. N. Avadhanulu and P.G. Kshirsagar, **"A Textbook of Engineering Physics"**, S. Chand and Company Ltd, 2010.*
5	*R. K. Gaur and S. L. Gupta, **"Engineering Physics",** Dhanpat Rai Publishers, 2009.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the crystal structure and analyse the type of defect.	K4
CO2	Explain the principle, characteristics, working and applications of laser and optical fiber. Analyse and solve problems in laser and optical fiber.	K4
CO3	Solve problems in bending of beams. Apply the knowledge in construction of buildings.	K3
CO4	Explain the importance of quantum mechanics. Solve problems in basic quantum physics. Apply the wave equations in real time problems.	K3
CO5	Explain the properties and production of ultrasonic waves. Apply ultrasonic waves for industrial problems.	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	1	1
CO5	2	1	-	-	-	-	-	-	-	-	-	-	-	-
22IBS1Z2	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1.
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1.
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.3.1, 2.4.1.
CO4	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1.
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	15	15	10	-	100
CAT2	30	30	15	15	10	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	30	30	15	15	10	-	100

22IES101	PROGRAMMING IN C *(Common to all Branches Except MECH & PRODN)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	1. To study the basic concepts of computer and programming fundamentals. 2. To understand the data types in C, flow control statements, Arrays, Functions Pointers, Structures, Unions and File concepts in C.	
UNIT – I	**COMPUTER AND PROGRAMMING FUNDAMENTALS**	**9 Periods**
Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O –Introduction to software –Classification of programming languages – Compiling –Linking and loading a program – Introduction to OS – Types of OS.		
UNIT – II	**DATATYPES AND FLOW OF CONTROL**	**9 Periods**
Structured programming – Algorithms – Structure of a C program – Variables – Data types – Operators and expressions – Input and Output statements – Tokens –Type Conversion – Control statements.		
UNIT – III	**ARRAYS AND FUNCTIONS**	**9 Periods**
1D Arrays– 2D Arrays – Multidimensional Arrays – Strings – String handling functions – Functions – Recursion – Array as function arguments – Storage Classes – Enumerations.		
UNIT – IV	**POINTERS**	**9 Periods**
Introduction to pointers – Pointers arithmetic – call by reference – Relationship between Array and Pointers – Relationship between String and pointers – pointers to pointers – array of pointers – pointers to an array – Dynamic memory allocation – Arguments to main().		
UNIT – V	**STRUCTURES AND UNIONS, FILE OPERATIONS**	**9 Periods**
Preprocessor directives – Structures – Unions – Bit fields – Opening and closing a file – Working with file of records – Random access to file of records.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

Pradip Dey, Manas Ghosh, ***"Computer Fundamentals and Programming in C",*** *Second Edition, Oxford University Press, 2018.*

REFERENCES

1	*Al Kelley, Ira Pohl,* ***"A Book on C- Programming in C "****, Fourth Edition, Addison Wesley,2001.*
2	*Herbert Schildt ,* ***"C: The Complete Reference",*** *Fourth Edition, McGraw Hill Education, 2017.*
3	*YashavantP. Kanetkar,* ***" Let Us C",*** *15th edition, BPB Publications, 2016.*
4	*Brian W. Kernighan and Dennis Ritchie,* ***"The C Programming Language",*** *Second Edition, Prentice Hall Software Series, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Articulate the basics of computer and evolution of programming languages.	K1
CO2	Write simple C programs using appropriate datatypes and control statements.	K3
CO3	Write C programs using arrays, functions and enumerations.	K3
CO4	Use pointers effectively to develop programs.	K3
CO5	Create user defined datatypes using structures & union and effectively manipulate them in file operations.	K6

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	1	-	-	-	-	-	-	-	-	1	3	3
CO2	1	3	1	-	-	-	-	-	-	-	-	1	3	3
CO3	1	3	1	-	-	-	-	-	-	-	-	1	3	3
CO4	1	3	1	-	-	-	-	-	-	-	-	1	3	3
CO5	1	3	1	-	-	-	-	-	-	-	-	1	3	3
22IES101	**1**	**3**	**1**	-	-	-	-	-	-	-	-	**1**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 12.2.1.
CO2	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2.
CO3	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2.
CO4	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2.
CO5	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	20	30	-	-	-	100
CAT2	20	30	50	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	-	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	20	30	50	-	-	-	100

22IMC1Z1	ENVIRONMENTAL SCIENCE AND ENGINEERING *(Common to all Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	MC	3	0	0	0

Course Objectives	1. To study the modern agriculture related problems, natural resources and its harnessing methods. 2. To study the interrelationship between living organism and environment. 3. To educate the people about causes of pollutions and its controlling methods. 4. To impart the knowledge of various environmental threats and its consequences. 5. To study the various water conservation methods, Act, Population policy, Welfare programs.

UNIT – I	**ENVIRONMENTAL ENERGY RESOURCES**	**9 Periods**

Food-effects of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications-Energy resources: renewable resources - Hydro Energy, Solar & Wind. Non-renewable resources – Coal and Petroleum - harnessing methods.

UNIT – II	**ECO SYSTEM AND BIODIVERSITY**	**9 Periods**

Eco system and its components - biotic and abiotic components. Biodiversity: types and values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity: In situ and ex situ conservation. Threats to biodiversity-destruction of habitat, habit fragmentation, hunting, over exploitation and man-wildlife conflicts. The IUCN red list categories.

UNIT – III	**ENVIRONMENTAL POLLUTION**	**9 Periods**

Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_2, H_2S, CO, CO_2 and particulates. Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollution. Noise pollution - decibel scale, sources, effects and control.

UNIT – IV	**ENVIRONMENTAL THREATS**	**9 Periods**

Global warming-measure to check global warming - impacts of enhanced Greenhouse effect, Acid rain- effects and control of acid rain, ozone layer depletion- effects of ozone depletion, disaster management - flood, drought, earthquake and tsunami.

UNIT – V	**SOCIAL ISSUES AND ENVIRONMENT**	**9 Periods**

Water conservation, rain water harvesting, e-waste management, Pollution Control Act, Wild life Protection Act. Population growth- exponential and logistic growth, variation in population among nations, population policy. Women and Child welfare programs. Role of information technology in human and health, COVID-19 - effects and preventive measures.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Sharma J.P., **"Environmental Studies"**, 4th Edition, University Science Press, New Delhi 2016.*
2	*Anubha Kaushik and C.P.Kaushik**, "Environmental Science and Engineering"**, 7th Edition, New Age International Publishers, New Delhi, 2021.*

REFERENCES:

1	*A K De, **"Environmental Chemistry"**, 8th Edition, New Age International Publishers, 2017.*
2	*G. Tyler Miller and Scott E. Spoolman, **"Environmental Science"**, Cengage Learning India Pvt, Ltd, Delhi, 2014.*
3	*ErachBharucha, **"Textbook of Environmental Studies"**, Universities Press(I) Pvt, Ltd, Hyderabad, 2015.*
4	*Gilbert M.Masters**, "Introduction to Environmental Engineering and Science"**, 3rd Edition, Pearson Education, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Recognize and understandabout the various environmental energy resources and the effective utility of modern agriculture.	K2
CO2	Acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.	K2
CO3	Be aware of the sources of various types of pollution, their ill effects and preventive methods.	K2
CO4	Identify and take the preventive measures to control the environmental threats and effects of Global warming, Ozone depletion, Acid rain, and natural disasters.	K2
CO5	Demonstrate an idea to save water and other issues like COVID -19.	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	1	-	-	3	-	-	-	-	-	1	1
CO2	-	-	1	-	-	-	3	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	3	-	-	-	-	-	1	1
CO4	2	1	1	1	-	-	3	-	-	-	-	-	-	-
CO5	-	1	1	1	-	2	3	-	-	-	-	-	1	1
22IMC1Z1	**2**	**1**	**1**	**1**	-	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 3.2.1, 4.3.1, 7.1.1, 7.1.2, 7.2.1.
CO2	3.1.5, 7.1.1, 7.1.2, 7.2.1.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 3.2.1, 4.1.3, 4.3.1, 7.1.1, 7.1.2, 7.2.1.
CO4	1.2.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 4.1.3, 4.3.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2.
CO5	2.1.2, 2.2.2, 3.1.5, 4.1.3, 4.3.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	-	-	100
CAT2	20	40	20	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	20	20	-	-	100
ESE	20	40	20	20	-	-	100

22IBS1Z3	**PHYSICS LABORATORY** *(Common to all Branches)*	**SEMESTER I**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**BS**	**0**	**0**	**3**	**1.5**

Course Objectives	1. To impart practical knowledge on the concept of properties of matter and utilize the experimental techniques to measure the properties 2. To impart practical knowledge on the modulii of elasticity 3. To analyze the properties of semiconductors 4. To learn practically the basic electronic concepts of transistor and logic gates 5. To realize the principle, concepts and working of a solar cell and study the properties of ferromagnetic material 6. To understand the concept of quantum physics
S. No.	**LABORATORY EXPERIMENTS**
1.	Determination of refractive index of the glass and given liquid – Spectrometer diffraction method
2.	Determination of Planck's constant
3.	Determination of Young's Modulus of the material in the form of bar – Cantilever Bending -Koenig's Method
4.	a) Particle size determination using diode laser b) Determination of numerical aperture and acceptance angle in an optical fiber
5.	Hall effect - Determination of semiconductor parameters
6.	Determination of band gap of semiconductor material
7.	Determination of velocity of sound and compressibility of the given liquid-Ultrasonic Interferometer
8.	Determination of moment of inertia of disc and rigidity modulus of a wire-Torsional pendulum
9.	Transistor characteristics
10.	Solar cell characteristics
11.	Determination of Hysteresis losses in a Ferromagnetic material-B-H curve unit
12.	Logic Gates – Verification and Construction
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**	

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Determine refractive index and compressibility of liquids, micro size of particles and numerical aperture of an optical fibre	K5
CO2	Measure the Young's and rigidity modulii of the given material	K5
CO3	Determine the bandgap of a given semiconductor material and identify the type of semiconductor and its carrier concentration through Hall measurement	K5
CO4	Analyze the characteristics of transistor and verify the truth table of logic gates	K5
CO5	Measure the efficiency of a solar cell and energy loss associated with the ferromagnetic material by plotting B-H curve	K5
CO6	Determine the Planck's constant and work function	K5

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	1
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	-	-
22IBS1Z3	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4.
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4.
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4.
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4.
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4.
CO6	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4.

221ES1Z2	WORKSHOP PRACTICE *(Common to all Branches)*	SEMESTER I

PREREQUISTES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	1. To make various basic prototypes in the carpentry trade such as Half Lap joint, Lap Tee joint, Dovetail joint, Mortise & Tenon joint. 2. To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint. 3. To make various moulds in foundry such as Cube, Straight pipe, V pulley, and Conical bush. 4. To make various components using sheet metal such as Tray, Frustum of cone and Square box. 5. To understand the working and identify the various components of CNC Machines.

LIST OF EXPERIMENTS			
1. Introduction to use of tools and equipment's in Carpentry, Welding, Foundry and Sheet metal. 2. Safety aspects in Welding, Carpentry, Foundry and sheet metal. 3. Half Lap joint and Dovetail joint in Carpentry. 4. Welding of Lap joint and Butt joint and T-joint. 5. Preparation of Sand mould for Cube, Conical bush, Pipes and V pulley. 6. Fabrication of parts like Tray, Frustum of cone and Square box in sheet metal. 7. CNC Machines demonstration and lecture on working principle. 8. Electrical wiring and simple house wiring.			
Contact periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Safely Use tools and equipment's used in Carpentry, Welding, Foundry and Sheet metal to create basic joints.	K2
CO2	Prepare sand mould for various basic pattern shapes.	K3
CO3	Fabricate parts like Tray, Frustum of cone and Square box in sheet metal.	K3
CO4	Practice on the Welding and Carpentry.	K3
CO5	Demonstrate the working of CNC Machines.	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	2	1	3	1	2	3	3	2	3	1	1
CO2	2	2	3	2	1	3	3	2	3	3	2	3	1	1
CO3	2	2	3	2	1	3	3	2	3	3	2	3	1	1
CO4	2	2	3	2	1	3	3	2	3	3	2	3	1	1
CO5	2	2	3	2	3	-	-	2	3	3	2	2	1	1
22IES1Z2	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1 ,7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4,9.3.1,10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1,7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1, 12.3.2.

22IES103	PROGRAMMING IN C LABORATORY *(Common to all Branches Except MECH & PRODN)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course objectives	To understand the concepts like Data types, Flow control statements, Functions, Arrays, command line arguments, Pointer, Dynamic memory allocation, Preprocessor Directives, Structures, Unions and Files in C.

EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:			
1	Operators, Expressions and IO formatting		
2	Decision Making and Looping		
3	Arrays and Strings		
4	Functions and Recursion		
5	Pointers		
6	Dynamic Memory Allocation		
7	Command line arguments		
8	Preprocessor Directives		
9	Structures		
10	Unions		
11	Files		
12	Mini Project		
Contact periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Use appropriate data types and flow control statements to write C programs.	K6
CO2	Write C programs using arrays, functions and command line arguments.	K6
CO3	Write C programs using pointers, dynamic memory allocation and preprocess or directives.	K6
CO4	Implement user defined data types using structures & union and effectively manipulate them in file operations.	K6
CO5	Develop simple applications using C.	K6

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1	1	-	-	-	-	-	-	-	-	3	3
CO2	2	3	1	1	-	-	-	-	-	-	-	-	3	3
CO3	2	3	1	1	-	-	-	-	-	-	-	-	3	3
CO4	2	3	1	1	-	-	-	-	-	-	-	-	3	3
CO5	2	3	2	1	-	-	-	-	3	3	-	1	3	3
22IES103	**2**	**3**	**2**	**1**	-	-	-	-	**1**	**1**	-	**1**	**3**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO3	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.3, 3.3.1

22IHS2Z4	தமிழரும் தொழில்நுட்பமும் **TAMILS AND TECHNOLOGY** *(Common to all Branches)*	**SEMESTER II**

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

UNIT – I	WEAVING AND CERAMIC TECHNOLOGY	3 Periods
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3 Periods**
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 Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3 Periods**
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 Periods**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, 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 Periods**
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.		
Contact Periods: **Lecture: 15 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 15 Periods**		

TEXT BOOK:

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)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)(Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22IHS2Z4	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY *(Common to all Branches)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

அலகு I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3 Periods

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்– பாண் டங்களில் கீறல் குறியீடுகள்.

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3 Periods

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்– சிலப்பதிகாரத்தில் மேடைஅமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும் , கோவில்களும்-சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள்-மாதிரிகட்டமைப்புகள் பற்றி அறிதல் , மதுரை மீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர்மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III	உற்பத்தித் தொழில் நுட்பம்	3 Periods

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

அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3 Periods

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

அலகு V	அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்	3 Periods

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

Contact Periods:
Lecture: 15 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 15 Periods**

TEXT BOOK:

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)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)(Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22IHS2Z5	VALUES AND ETHICS *(Common to all Branches)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	3	0	0	3

Course Objectives	1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity. 2. To learn about Engineering Ethics and case studies. 3. To understand the negative health impacts of certain unhealthy behaviours. 4. To appreciate the need and importance of physical, emotional health and social health. 5. To get familiar with the global issues.

UNIT – I	**BEING GOOD AND RESPONSIBLE**	**9 Periods**

Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self-Confidence – Character.

UNIT – II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9 Periods**

Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas moral autonomy - Models of Professional Roles.

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – Case studies: Chernobyl disaster and Titanic disaster.

UNIT – III	**ADDICTION AND HEALTH**	**9 Periods**

Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention– illeffects of smoking-
Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases.
Drug Abuse: Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention.

UNIT – IV	**PROFESSIONAL ETHICS**	**9 Periods**

Abuse of Technologies**:** Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social net working websites.

UNIT – V	**GLOBAL ISSUES**	**9 Periods**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Code of Conduct – Corporate Social Responsibility.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Mike W Martin and Roland Schinzinger, **"Ethics in Engineering"**, 4 th Edition, McGraw-Hill, New York 2017.*
2	*Govindarajan M, Natarajan S and Senthil Kumar VS, **"Engineering Ethics"**, Prentice Hall of India, New Delhi, 2013.*

REFERENCES:

1	*Dhaliwal, K.K ,**"Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts",** Writers Choice, New Delhi, India,2016.*
2	*Jayshreesuresh, B.S.Raghavan, **"Human values and professional ethics"**, S.Chand& company Ltd, New Delhi, 2nd Edition, 2007.*
3	*L.A. and Pagliaro, A.M, **"Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological, Developmental and Clinical Considerations",** Wiley Publishers, U.S.A, 2012.*
4	*Pandey, P. K(2012), **"Sexual Harassment and Law in India"**, Lambert Publishers, Germany, 2012.*
5	*Kiran D.R, **"Professional ethics and Human values",** Tata McGraw Hill, New Delhi, 2007.*
6	*Edmund G See Bauer and Robert L Barry, **"Fundamentals of Ethics for Scientists and Engineers"**, Oxford University Press, Oxford, 2001.*
7	*David Ermann and Michele S Shauf, **"Computers, Ethics and Society"**, Oxford University Press, 2003.*
8	*Govindarajan M, Natarajan S, Senthil Kumar V. S, **"Engineering Ethics"**,Prentice Hall of India, New Delhi, 2004.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Follow sound morals and ethical values scrupulously to prove as good citizens.	K3
CO2	Assess the relevance of ethics and morals in engineering and to learn case studies.	K3
CO3	Describe the concept of addiction and how it will affect the physical and mental health.	K2
CO4	Identify ethical concerns while using advanced technologies.	K2
CO5	Judge the code of conduct, Environmental ethics and computer ethics.	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	3	3	3	3	3	3	-	1	1
CO2	-	-	-	-	-	3	1	3	3	-	-	-	1	1
CO3	-	-	-	-	-	3	1	3	3	2	3	-	1	1
CO4	-	-	-	-	-	3	3	3	3	1	3	1	1	1
CO5	-	-	-	-	-	3	3	3	3	-	1	3	1	1
22IHS2Z5	-	-	-	-	-	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1.
CO2	6.1.1, 6.2.1, 7.1.1, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1.
CO3	6.1.1, 6.2.1, 7.1.1, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.2.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1.
CO4	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1.
CO5	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	20	20	-	-	100
CAT2	30	30	20	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	30	20	20	-	-	100
ESE	30	30	20	20	-	-	100

22IBS204	VECTOR SPACES AND DIFFERENTIAL EQUATIONS WITH MATLAB *(Common to CSE & IT Branches)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	1. To be familiar with MATLAB and solving the simple equations. 2. To gain methods to solve second order differential equations with constant and variable coefficients. 3. To acquire knowledge of testing convergence of sequences and series. 4. To gain the concepts of vector spaces and linear transformations. 5. To obtain the knowledge of decomposition and inner product spaces.	
UNIT – I	**MATLAB**	**9+3 Periods**
MATLAB Basics- Simple problems: solving equations, matrix operations, calculating eigen values and eigen vectors, solving linear system of equations, differentiation.		
UNIT – II	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER**	**9+3 Periods**
Higher order linear differential equations with constant coefficients -variable coefficients: Cauchy-Euler equation, Cauchy-Legendre equation-Method of variation of parameters-Simultaneous first order linear equations with constant coefficients.		
UNIT – III	**SEQUENCES AND SERIES**	**9+3 Periods**
Convergence of sequence, tests for convergence of series of positive terms: comparison test, D' Alembert's ratio test, Cauchy's Integral test, Raabe's test, logarithmic test, Gauss test, Cauchy's root test-alternating series: Leibnitz test – power series: absolutely convergent, conditionally convergent.		
UNIT – IV	**VECTOR SPACES I**	**9+3 Periods**
Vector Space, linear dependence of vectors, basis, dimension, Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, composition of linear maps, Matrix associated with a linear map.		
UNIT – V	**VECTOR SPACES II**	**9+3 Periods**
Eigen bases, Cholesky Decomposition, Inner product spaces- norm, orthogonality, orthonormal set, Gram-Schmidt orthogonalization.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK

1	*B.S.Grewal,* ***"Higher Engineering Mathematics"****, Khanna Publishers, New Delhi, 44th Edition, 2018.*
2	*Howard Anton, Chris Rorres,* ***"Elements of Linear Algebra with Applications"****, Wiley, New Delhi, 2nd Edition, 2015.*
3	*Brain R.Hunt, Ronald L.Lipsman, Jonathan M. Rosenberg with Kevin R.Coombes, John E. Osborn and Garrett J.Stuck,* ***"A Guide to MATLAB for beginners and experienced users"****, Published in the United States of America by Cambridge University Press, New York 2001.*

REFERENCES

1	*E. A. Coddington, **"An Introduction to Ordinary Differential Equations"**, Prentice Hall India, 1995*
2	*G.F. Simmons and S.G. Krantz, **"Differential Equations"**, Tata McGraw Hill, 2007.*
3	*Srimanta Pal and suboth.C.Bhunia, **"Engineering Mathematics"**, Oxford university publications, New Delhi, 2015.*
4	*Gilbert Strang, **"Linear Algebra and its Applications"**, Cengage Learning, Delhi, 4th Edition, 2006*
5	*D.Poole, **"Linear Algebra: A Modern Introduction"**, 2nd Edition, Brooks/Cole, 2005.*
6	*V. Krishnamurthy, V.P. Mainra and J.L. Arora, **"An introduction to Linear Algebra"**, Affiliated East–West press, Reprint 2005.*
7	*Amos Gilat, **"MATLAB:An Introduction with Applications"**, Wiley, The Ohio State University, 6th Edition, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Solve algebraic equations by using MATLAB.	K5
CO2	Find solution for higher order linear differential equation with constant and variable coefficients and simultaneous differential equation.	K5
CO3	Perform basic computation in convergence and divergence of sequences and series.	K5
CO4	Demonstrate the concepts of vector spaces and linear transformation orientation with matrices.	K5
CO5	Use Cholesky Decomposition and orthogonal transformation including Inner product spaces in the applications of many different fields.	K5

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	3	-	-	-	-	-	1	-	2	2	2
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	1
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	1
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	1
22IBS204	**3**	**2**	-	1	-	-	-	-	-	1	-	**2**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.4.1, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 10.1.1, 12.1.1, 12.2.1, 12.2.2
CO2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.4.1, 4.4.1, 12.1.1, 12.2.1, 12.2.2
CO3	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.4.1, 4.4.1, 12.1.1, 12.2.1 ,12.2.2
CO4	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.4.1, 4.1.1, 12.1.1, 12.2.1, 12.2.2
CO5	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.4.1, 4.1.1, 12.1.1, 12.2.1, 12.2.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	20	10	-	-	100
CAT2	30	40	20	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	20	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	40	20	10	-	-	100
ESE	30	40	20	10	-	-	100

22IBS205	PHYSICS FOR INFORMATION SCIENCE *(Common to CSE & IT Branches)*	SEMESTER II

PREREQUISTIES	CATEGORY	L	T	P	C
NIL	BS	3	0	0	3

Course Objectives	1. To understand the properties of electronic materials. 2. To understand the characteristics of semiconductors. 3. To explain different number systems and their application in logic gates. 4. To understand the properties of magnetic and superconducting materials and apply them for specific purpose. 5. To explain engineered semiconductor materials and their Applications.

UNIT – I	**ELECTRONIC MATERIALS**	**9 Periods**

Classical Free electron theory of metals – Postulates – Electrical and Thermal conductivity of metals – Derivation of Wiedeman – Franz law – Lorentz number – Drawbacks of Classical theory – Fermi distribution Function – Effect of temperature – Density of energy states in metals (derivation) – Carrier concentration in metals - Calculation of Fermi energy at 0 K

UNIT – II	**SEMICONDUCTORS**	**9 Periods**

Properties of semiconductors – elemental and compound semiconductors - Direct and indirect band gaps - Intrinsic and extrinsic semiconductors - Fermi level - Carrier concentration in intrinsic semiconductor - Dependence of Fermi level on temperature – Electrical conductivity – band gap determination – extrinsic semiconductors – Carrier concentration in P- type and N-type semiconductors - Dependence of Fermi level on impurity concentration and temperature for P-type and N-type semiconductors.

UNIT – III	**DIGITAL ELECTRONICS**	**9 Periods**

Introduction – Binary number system – place value – decimal to Binary conversion – Binary to decimal conversion – Octal and hectadecimal numbers. Logic Gates – Three basic Logic Gates:OR, AND, NOT: operation, circuit, truth table, Boolean expression – Universal gate: NAND and NOR Gates:NOT, AND and OR from NAND & NOR Gates – Exclusive OR Gate - Problems

UNIT – IV	**MAGNETIC AND SUPER CONDUCTING MATERIALS**	**9 Periods**

Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Magnetic recording – Magnetic Tapes – Floppy disk – Optical Recording – Magneto Optical Recording – Principle – Recording – Reading – Construction.

Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- Meissner effect, effect of magnetic field and current - Applications of superconductors: Cryotron, Magnetic levitation.

UNIT – V	**ENGINEERED SEMICONDUCTOR MATERIALS**	**9 Periods**

Introduction - Quantum confinement – Density of states in 2D, 1D and 0D (qualitatively) - Practical examples of low-dimensional systems such as quantum wells, wires, and dots – Nanomaterials – Properties – Methods of synthesize – Top-down & Bottom-up Approach – Ball Milling – Chemical vapour deposition – Applications of Nanomaterials.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1.	*P.K.Palanisamy, **"EngineeringPhysics-II"**, Scitech Publications (India) pvt.Ltd, 2015.*
2.	*V. Rajendran, **"Material Science"**, Tata McGraw-Hill Publications, 2011.*
3.	*S. Jayakumar, **"Materials Science"**, R. K.publishers, 2008.*
4.	*V. K. Mehta and Shalu Mehta, **"Principles of Electronics"**, S.Chand & Company Ltd., 2001.*

REFERENCES:

1.	*William D Callister and David G. Rithwish , **"Materials science & Engineering**: **An introduction"**, Wiley, 2013.*
2.	*P. Bhattacharya, **"Semiconductor Optoelectronic Devices"**, Prentice Hall of India, 1997.*
3.	*G.W. Hanson, **"Fundamentals of Nanoelectronics"**, Pearson Education, 2009.*
4.	*M. Moris Mano, **"Digital Logic and Computer Design"**, Prentice- Hall of India Pvt. Ltd., 1998.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the physical properties of conducting materials.	K2
CO2	Explain thecharacteristics of intrinsic and extrinsic semiconductors.	K2
CO3	Explain different number systems. Apply logic gates in circuits.	K3
CO4	Explain magnetic and superconductor characteristics. Apply magnetic materials and superconductors for industrial problems.	K3
CO5	Explain low dimensional systems and Choose suitable method for the synthesis. Apply nanomaterials for real time problems.	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	3	1	-	1	-	-	-	-	-	-	-	1	1
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	1
CO5	3	2	1	-	-	-	-	-	-	-	-	-	1	1
22IBS205	**3**	**3**	**1**	**1**	**1**	-	-	-	-	-	-	-	**1**	**1**
1-Slight, 2 – Moderate, 3 - Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.2.3, 2.2.4, 2.2.5, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4.
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.2.3, 2.2.4, 2.2.5, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4.
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.2.3, 2.2.4, 2.2.5, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 5.1.1.
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.2.3, 2.2.4, 2.2.5, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 4.3.1, 5.1.1.
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.2.3, 2.2.4, 2.2.5, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	30	10	-	-	100
CAT2	30	30	30	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	30	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	30	30	10	-	-	100
ESE	30	30	30	10	-	-	100

22IBS206	APPLIED CHEMISTRY *(Common to EEE, ECE, EIE, CSE & IT Branches)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	0	0	3

Course Objectives	1. To know about the second law of thermodynamics and its various functions. 2. To understand the concept of electrochemistry, primary, secondary batteries, construction and its uses. 3. To understand the basic principles of corrosion, mechanism and its protection methods. 4. To acquire basic knowledge about the nanoparticles, its preparations, properties, types and applications in various field. 5. To impart the knowledge of preparations of single crystal, wafer preparation, P-N junction formation by various methods.	
UNIT – I	**CHEMICAL THERMODYNAMICS**	**9 Periods**
The Second law of thermodynamics-Concepts of entropy, Work and free energy functions - Maxwell's relationships for reversible and irreversible process - Gibbs Helmholtz equation – Partial molar free energy-Chemical potential-Gibb's Duhem Equation, Clausius - Clapeyron equation.		
UNIT – II	**ELECTRO CHEMISTRY AND STORAGE DEVICES**	**9 Periods**
Cells–Electro chemical cell and electrolytic cell – electrodes– electrode potentials – standard oxidation and reduction potentials-Hydrogen and Calomel electrodes- EMF series and its significance. Batteries - Types of batteries- Primary - Zn/MnO_2 and $Li/SOCl_2$ - Construction, working and applications. Secondary batteries- Lead acid battery and lithium-ion battery – $Li\text{-}TiS_2$- Construction, working and Applications.		
UNIT – III	**CORROSION**	**9 Periods**
Corrosion-Definition -Classifications: Chemical Corrosion and Electro chemical corrosion mechanism-Pilling Bedworth rule–Galvanic series and its importance- preventing methods-Cathodic protection (sacrificial anode and impressed current conversion method). Protective Coatings-Inorganic coating-surface preparation-Electro plating method applied to Cr and Ni, Organic coating- paints - constituents and its functions.		
UNIT – IV	**NANO MATERIALS**	**9 Periods**
Nanomaterials and bulk materials; Size-dependent properties (Optical, Electrical and Mechanical); Types of nanomaterials: Definition- properties and uses of nanoparticle, nanorod and nanotube. Preparation of nanomaterials: chemical vapour deposition, electrochemical deposition. Applications of nanomaterials in medicine and electronics.		
UNIT – V	**FABRICATION**	**9 Periods**
Silicon for IC chips - single crystal – preparation by Czochralski and float zone processes- wafer preparation, P-N junction formation – Ion implantation. Diffusion and epitaxial growth techniques - Insulator layer by oxidation-Printing of circuits by photolithography – masking and electron beam methods- etching by chemical and electrochemical methods.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Jain. P.C. and Monica Jain,* ***"Engineering Chemistry"****, DhanpatRai Publications Pvt Ltd, New Delhi, 16th Edition, 2017.*
2	*S.S. Dara****, "A text book of Engineering Chemistry"****, S. Chand Publishing, 12th Edition, 2018.*

REFERENCES:

1	*Dara. S.S, Umarae,* ***"Text book of Engineering Chemistry"****, S. Chand Publications, 2013.*
2	*M.S.Tyagi,* ***"Introduction to semiconductor materials and devices"****, WileyIndia, 2012.*
3	*B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday****, "Textbook of nanoscience and nanotechnology"****, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.*
4	*B.R Puri, L.R Sharma & M. S. Pathania,* ***"Principles of Physical Chemistry" Nagin .S****Chand and Co., 2017.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze the applications of thermodynamics and its various functions.	K3
CO2	Implement the new ideas related to batteries which find uses in the society including engineering fields.	K3
CO3	Identify the corrosion mechanisms and its controlling methods.	K3
CO4	Applying the concepts of nanoscience and nanotechnology in the synthesis of nanomaterials for engineering applications.	K3
CO5	Construct the silicon chips and their fabrication methods and to apply in preparation of electrical and electronic instruments.	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	1	-	-	-	-	-	-	-	1	-
CO3	1	1	1	1	1	2	1	-	-	-	-	-	-	-
CO4	1	1	1	1	1	-	-	-	-	-	-	-	1	-
CO5	1	1	1	1	1	-	-	-	-	-	-	-	1	-
22IBS206	**2**	**1**	**1**	**1**	**1**	**1**	**1**	-	-	-	-	-	**1**	-
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 2.1.2, 2.1.3, 2.3.1, 3.2.2, 5.1.1.
CO2	1.1.2, 1.2.1, 2.3.1, 3.2.2, 5.1.1.
CO3	1.2.1, 2.3.1, 3.2.2, 4.1.1, 4.3.1, 5.1.1, 6.1.1, 7.1.1.
CO4	1.2.1, 2.2.2, 2.3.1, 3.2.2, 4.1.1, 4.3.1, 5.1.1, 5.1.2, 7.1.1.
CO5	1.2.1, 2.3.1, 3.2.2, 4.1.2, 5.1.1.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	20	10	-	-	100
CAT2	30	40	20	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	20	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	40	20	10	-	-	100
ESE	30	40	20	10	-	-	100

22IES204	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING *(Common to CIVIL, MECH, PRODN, CSE, IT & IBT Branches)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	1. To study the basic concepts of electric circuits, electronic devices and communication engineering. 2. To know the fundamentals of DC and AC machines. 3. To familiar with the basics of analog and digital electronics. 4. To understand the basics of house wiring. 5. To introduce the components of electrical installations and energy conservation.	
UNIT – I	**ELECTRICAL CIRCUITS**	**9 Periods**
Electrical circuit elements (R,L and C) - Voltage and Current sources – Ohm's Law – Kirchoff laws – Time domain analysis of First order RL and RC circuits – Representation of sinusoidal waveforms – Average, RMS and Peak values – Phasor representation – Real, Reactive, Apparent power and power factor.		
UNIT – II	**ELECTRICAL MACHINES AND MEASUREMENTS**	**9 Periods**
Construction, Principle of Operation, basic equations and Types, Characteristics and Applications of DC generators, DC motors, Single phase Transformer, Single phase and Three phase Induction motor. Operating principles of Moving coil, Moving iron Instruments (Ammeter and Voltmeters).		
UNIT – III	**ANALOG AND DIGITAL ELECTRONICS**	**9 Periods**
Analog Electronics: Semiconductor devices – P-N junction diode, Zener diode, BJT, Operational amplifier – principle of operation, Characteristics and applications. Digital Electronics: Introduction to numbers systems, basic Boolean laws, reduction of Boolean expressions and implementation with logic gates.		
UNIT – IV	**FUNDAMENTAL OF COMMUNICATION AND TRANSDUCERS**	**9 Periods**
Types of Signals : Analog and Digital Signals – Modulation and Demodulation :Principles of Amplitude and Frequency Modulations – Resistive, Inductive, capacitive Transducers- Introduction.		
UNIT – V	**ELECTRICAL INSTALLATIONS AND ENERGY CONSERVATION**	**9 Periods**
Single phase and three phase system – phase, neutral and earth, basic house wiring -tools and components, different types of wiring - basic safety measures at home and industry – Energy efficient lamps - Energy billing. Introduction to UPS and SMPS.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*R.Muthusubramaniam, R.Salivaganan, Muralidharan K.A., **"Basic Electrical and Electronics Engineering"** Tata McGraw Hill , Second Edition 2010.*
2	*Mittle V.N and Aravind Mittal, **"Basic Electrical Engineering"**, Tata McGraw Hill, Second Edition, New Delhi, 2005.*

REFERENCES:

1	*D.P.Kothari, I.J. Nagrath,* ***"Basic Electrical Engineering"****, Tata McGraw Hill, 2010.*
2	*Nagsarkar T.K and Sukhija M.S,* ***"Basic Electrical Engineering"****, Oxford Press, 2005.*
3	*E.Hughes,****"Electrical and Elecronics Technology"****, Pearson, 2010.*
4	*MohmoodNahvi and Joseph A.Edminister,* ***"Electric Circuits"****, Shaum Outline series, McGraw Hill, Sixth edition, 2014.*
5	*Premkumar N and Gnanavadivel J,* ***"Basic Electrical and Electronics Engineering"****, Anuradha Publishers, 4th Edition, 2008.*
6	*Allan S Morris,* ***"Measurement and Instrumentation Principles"*** *Elsevier, First Indian Edition, 2008.*
7	*S.L. Uppal,* ***"Electrical Wiring Estimating and Costing"****, Khanna publishers, New Delhi, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze the DC and AC circuits	K4
CO2	Describe the operation and characteristics of electrical machines	K4
CO3	Classify and compare various semiconductor devices and digital electronics.	K3
CO4	Infer the concept of communication engineering and Transducers.	K2
CO5	Assemble and Implement electrical wiring and electrical installations	K6

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	3	3	2	1	-	-	-	-	-	-	-	-	-
CO2	2	2	3	2	1	-	2	1	-	-	-	-	-	1
CO3	3	2	3	2	1	-	-	-	-	1	-	-	1	1
CO4	2	3	3	2	-	-	3	-	-	-	-	1	1	-
CO5	2	2	3	2	-	-	-	-	-	-	-	-	-	-
22IES204	**3**	**3**	**3**	**2**	**1**	-	**1**	**1**	-	**1**	-	**1**	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.3, 5.2.1, 5.2.2.
CO2	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3,2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 5.2.1, 5.2.2, 7.2.1, 7.2.2, 8.1.1.
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.2.1, 5.2.2, 10.3.1.
CO4	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 7.1.1, 7.1.2, 7.2.1, 12.3.1, 12.3.2.
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3,2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.3.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	35	35	20	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	25	25	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	25	25	40	10	-	-	100
ESE	35	35	20	10	-	-	100

22IBS2Z7	CHEMISTRY LABORATORY *(Common to all Branches)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	0	0	3	1.5

Course objectives:	* To inculcate the practical applications of Chemistry to students and make them apply in the fields of engineering and technology.

LIST OF EXPERIMENTS	
1.	Estimation of hardness by EDTA method.
2	Conductometric titration of mixture of strong acid and weak acid using strong base.
3.	Estimation of chloride by Argentometric method.
4.	Potentiometric titration of ferrous iron by dichromate.
5.	Determination of Saponification value of an oil.
6.	Estimation of Iron by Spectrophotometry.
7.	Estimation of Dissolved Oxygen.
8.	Estimation of HCl by pH titration.
9.	Estimation of Copper in brass sample.
10.	Estimation of Manganese in Pyrolusite ore.
11.	Anodiziation of aluminium.
12.	Determination of corrosion rate and inhibitor efficiency of mild steel in acid media by weight loss method.

Contact Periods:

Lecture: 0 Periods	Tutorial: 0 Periods	Practical: 45 Periods	Total: 45 Periods

REFERENCE BOOKS:

1	*A.O. Thomas, **"Practical Chemistry"**, Scientific Book Centre, Cannanore, 2006.*
2	*Vogel's **"Text book of Quantitative Analysis"**, Jeffery G H, Basset J. Menthom J, Denney R.C., 6th Edition, EBS, 2009.*

COURSE OUTCOMES: Upon the completion of the course, the student will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze the quality of water samples with respect to their hardness and DO.	K3
CO2	Determine the amount of metal ions through potentiometric and spectroscopic techniques.	K3
CO3	Infer the strength of acid, mixtures of acids by pH meter and conductivity cell.	K3
CO4	Estimate the chloride, manganese and copper from various samples.	K3
CO5	Interpret the corrosion rate determination and anodizing method.	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	1	-	1	-	-	-	-	-	-	-	-	1	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	1	-	-	1	-	-	-	-	-	-	-
22IBS2Z7	**2**	**1**	**1**	**1**	-	-	**1**	-	-	-	-	-	**1**	-
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 2.3.1, 3.1.5.
CO2	1.1.1, 1.2.1, 1.3.1, 2.1.2.
CO3	1.1.1, 1.2.1, 2.1.3, 4.1.3.
CO4	1.2.1, 1.3.1, 2.3.1.
CO5	1.1.1, 1.2.1, 1.3.1, 2.3.1, 3.1.5, 4.2.1, 7.1.1.

22IES2Z5	ENGINEERING GRAPHICS *(Common to all Branches)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	1	0	4	3

Course Objectives	1. To Understand the geometrical constructions. 2. To Study the various types of projections. 3. To Identify different section of solids. 4. To Perform the development of surfaces and view of solids. 5. To Familiarize with CAD packages.

UNIT – I	**GEOMETRICAL CONSTRUCTIONS AND PLANE CURVES**	**3+12 Periods**

Principles of Engineering Graphics and their significance - Basic geometrical constructions. Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves.

UNIT – II	**ORTHOGRAPHIC PROJECTIONS**	**3+12 Periods**

Introduction to Orthographic Projection - Conversion of pictorial views to orthographic views. Projection of points - Projection of straight lines with traces - Projection of planes (polygonal and circular surfaces) inclined to both the principal planes.

UNIT – III	**PROJECTION AND SECTION OF SOLIDS**	**3+12 Periods**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids, when the axis is inclined to both the principal planes by rotating object method. Sectioning of prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT – IV	**DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS**	**3+12 Periods**

Development of lateral surfaces of simple and sectioned solids – prisms, pyramids, cylinder and cone. Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids - prisms, pyramids, cylinder, cone- combination of two solid objects in simple vertical positions.

UNIT – V	**COMPUTER AIDED DRAFTING**	**3+12 Periods**

Introduction to computer aided drafting package to make 2D Drawings. Object Construction: Page layout – Layers and line types – Creating, editing and selecting the geometric objects. Mechanics: Viewing, annotating, hatching and dimensioning the drawing – Creating blocks and attributes. Drafting: Create 2D drawing. A number of chosen problems will be solved to illustrate the concepts clearly.
(Demonstration purpose only, not to be included in examination).

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods

TEXT BOOKS:

1	*K.Venugopal, **"Engineering Graphics"**, New Age International (P) Limited, 2016.*
2	*K.V.Natarajan, **"A text book of Engineering Graphics"**, Dhanalakashmi Publishers, Chennai, 2016.*

REFERENCES:

1	*K.L.Narayana and P.Kannaiah, **"Text book on Engineering Drawing"**, 2nd Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*
2	*N.S.Parthasarathy and Vela Murali, **"Engineering Graphics"**, Oxford University Press, New Delhi, 2015.*
3	*K.R.Gopalakrishna, **"Engineering Drawing" (Vol. I&II combined),** Subhas Publications, Bangalore, 2014.*
4	*Basant Agarwal and C.M.Agarwal, **"Engineering Drawing"**, Tata McGraw Hill Publishers, New Delhi, 2013.*
5	*Kevin Lang and Alan J.Kalameja, **"AutoCAD 2012 Tutor for Engineering Graphics"**, Cengage Learning Publishers, 1st Edition, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Acquire on representing solids as per international standards.	K3
CO2	Impart knowledge on different types of projections.	K3
CO3	Generate and interrupt the true shape of section.	K3
CO4	Develop the various surfaces according to the standards.	K3
CO5	Know the concept of computers in drafting engineering diagrams.	K6

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	1	2	-	3	1	3	1	3	1	1
CO2	3	1	1	1	1	2	-	3	1	3	1	3	1	1
CO3	3	1	1	1	1	2	-	3	1	3	1	3	1	1
CO4	3	1	1	1	1	2	-	3	1	3	1	3	1	1
CO5	3	1	1	1	1	2	-	3	1	3	1	3	1	1
22IES2Z5	**3**	**1**	**1**	**1**	**1**	**2**	-	**3**	**1**	**3**	**1**	**3**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO4	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1 ,4.3.3, 5.1.1, 6.2.1, 8.1.1 , 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO5	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2.

22IBS308	PROBABILITY, RANDOM PROCESSES AND QUEUING THEORY *(Common to CSE& IT Branches)*	SEMESTERIII

TOTAL	360	440	800	18	1	6	22

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	To enhance the fundamental knowledge in probability concepts and its applications relevant to various streams of Engineering and Technology. This is a foundation course which mainly deals with topic such as probability, standard statistical distributions, statistical averages regarding one or more random variables, random process, Markov chains and queueing models with finite/infinite capacity in single/multi servers and plays an important role in the understanding of Science, Engineering and Computer Science among other disciplines.	
UNIT – I	**PROBABILITY AND RANDOM VARIABLES**	**9+3 Periods**
Sample spaces–Events – Probability Axioms–Conditional Probability–Independent Events – Baye's Theorem. RandomVariables: Distribution Functions–Expectation–Moments–Moment Generating Functions.		
UNIT – II	**PROBABILITY DISTRIBUTIONS**	**9+3 Periods**
Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems). Functions of random variables.		
UNIT – III	**MULTI DIMENSIONAL RANDOM VARIABLES**	**9+3 Periods**
Two dimensional: Joint distributions – Marginal Distributions – Conditional distributions – Covariance – Correlation and Regression lines. Multidimensional: Mean vectors and covariance matrices.		
UNIT – IV	**RANDOM PROCESSES**	**9+3 Periods**
Definition and Examples – first and Second order, Strict sense stationary, Wide sense stationary and ergodic processes- Markov processes – Poisson processes – Birth and Death processes – Markov chains – Transition probabilities – Limiting distributions.		
UNIT – V	**QUEUEING THEORY**	**9+3 Periods**
Markovian models-M/M/1 and M/M/C, finite and infinite capacity, M/G/1 queue (steady state solutions only) PollazackKhintchine formula-Problems only.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK

1	*Veerarajan T., **Probability and Random Processes**, with Queueing Theory and Queueing Networks), Fourth Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.*
2	*Veerarajan T., **Higher Engineering Mathematics**, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.*

REFERENCES

1	*Gupta S.C and Kapoor V.K..,* ***Fundamentals of Mathematical Statistics****, Sultan Chand & Sons, New Delhi, 2015.*
2	*Gupta S.P.,* ***Statistical methods****, Sultan Chand & Sons, New Delhi, 2015.*
3	*Trivedi K.S.,* ***Probability and Statistics with Reliability, Queueing and Computer Science Applications****, Prentice Hall of India, New Delhi.*
4	*Hwei Hsu.,* ***SchauPm's outline series of Theory and Problems of Probability and Random Process,*** *Tata McGraw Hill Publishing Co., New Delhi, 2015.*
5	*Kandasamy, Thilagavathy and Gunavathy,****Probability and Random Process,*** *S. Chand & Co. Ramnagar, New Delhi, Reprint 2013.*
6	*Richard A. Johnson and Dean W. Wichern.,* ***Applied Multivariate Statistical Analysis,*** *Sixth Edition, Pearson Education, Asia, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the knowledge of basic probability concepts in engineering problems.	K5
CO2	Identify various standard probability distributions and apply them in real life.	K5
CO3	Find the correlation and regression for multi dimensional random variables.	K5
CO4	Apply the random process in Markovian and Birth- death problems.	K5
CO5	Utilize queuing models in real life problems.	K5

COURSE ARTICULATION MATRIX :
a) CO and PO Mapping

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO10**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3	3	2	2	-	-	-	-	-	-	-	2	2	1
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2	1
CO3	3	3	2	2	-	-	-	-	-	-	-	2	2	1
CO4	3	3	2	2	-	-	-	-	-	-	-	2	2	1
CO5	3	3	2	2	-	-	-	-	-	-	-	2	2	1
22IBS308	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 12.1.2 , 12.2.1, 12.2.2
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 12.1.2 , 12.2.1, 12.2.2
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 12.1.2 , 12.2.1, 12.2.2
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 12.1.2 , 12.2.1, 12.2.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 12.1.2 , 12.2.1, 12.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	20	10	-	-	100
CAT2	30	40	20	10	-	-	100
Individual Assignment 1 / Case Study 1 / Seminar 1 / Project 1	30	40	20	10	-	-	100
Individual Assignment 2 / Case Study 2/ Seminar 2 / Project 2	30	40	20	10	-	-	100
ESE	30	40	20	10	-	-	100

22IES306	COMPUTER ORGANIZATION AND ARCHITECTURE	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	To impart knowledge on the functional units of digital computer system with the understanding of computer arithmetic and tracing the execution sequence of an instruction through the processor. To inculcate the memory and I/O systems fundamentals and their interfaces with the processor for the evaluation of different computer systems based on performance metrics.	
UNIT – I	**ARCHITECTURE: AN OVERVIEW**	**9 Periods**
Functional units of a Digital Computer – Translation from a High Level Language to Hardware Language – Technology – Performance – Power wall – RISC Vs CISC Characteristics – Instructions – Operations and Operands– Representing instructions – Logical and Control Operations – Addressing modes.		
UNIT – II	**COMPUTER ARITHMETIC**	**9 Periods**
Number and Character Representation – Addition/Subtraction Logic Unit – Design of Fast Adder – Ripple-carry adder, Carry-look ahead adder – Multiplication – Array and sequential circuit – Booth Algorithm – Fast Multiplication – Division – Restoring and Non-Restoring methods – Floating point numbers and operations.		
UNIT – III	**PROCESSOR DESIGN**	**9 Periods**
Processor and Register Organization – Instruction Cycle – Logic Design Conventions – Building a Data path and Control path – Micro-programming and Hard-wired Control – Pipelining – Pipelining Hazards – Exceptions Handling.		
UNIT – IV	**MEMORY AND I/O INTERFACING**	**9 Periods**
Memory Technologies – Basics of Cache – Measuring and Improving Cache Performance –Virtual Machines and Memory – Memory Hierarchy – RAID – Accessing I/O devices – Interrupts – Buses and bus arbitration – DMA – Interface Circuits – Standard I/O interfaces		
UNIT – V	**PARALLEL PROCESSING**	**9 Periods**
Classification of Parallel Structures – Challenges and Benefits – SISD, MIMD, SIMD, SPMD and Vector – Hardware Multithreading – Multi-core and other Shared memory Multiprocessors – Interconnection Networks – Performance Considerations.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*David A. Patterson, John L. Hennessy,* ***"Computer Organization and Design: The Hardware/Software Interface",*** *Fifth Edition, Morgan Kaufmann/Elsevier, 2013*
2	*Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian,* ***"Computer Organization and Embedded Systems",*** *Sixth Edition, Tata McGraw Hill, 2012.*

REFERENCES

1	*William Stallings,* ***"Computer Organization and Architecture – Designing for Performance",*** *Tenth Edition, Pearson Education, 2016.*
2	*John L. Hennessey, David A. Patterson,* ***"Computer Architecture – A Quantitative Approach",*** *Morgan Kaufmann / Elsevier Publishers, Fourth Edition, 2007.*
3	*V.P. Heuring, H.F. Jordan,* ***"Computer Systems Design and Architecture",*** *Second Edition, Pearson Education, 2004. 6. BehroozParhami, "Computer Architecture", Oxford University Press, 2007.*
4	*Douglas E. Comer,* ***"Essentials of Computer Architecture",*** *Sixth Edition, Pearson Education, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Interpret assembly language instructions.	K2
CO2	Design and analyze ALU circuits.	K3
CO3	Point out the hazards present in a pipeline and suggest remedies.	K2
CO4	Design and analyze memory, I/O devices and cache structures for processor.	K3
CO5	Evaluate the performance of computer systems.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	3	1	1	-	-	-	-	-	1	1	3
CO2	3	3	3	3	3	1	-	-	-	-	-	1	3	3
CO3	3	3	3	3	3	1	-	-	-	-	-	1	3	3
CO4	3	3	3	3	3	1	-	-	-	-	-	1	3	3
CO5	3	3	3	3	3	1	-	-	-	-	-	1	3	3
22IES306	**3**	**3**	**3**	**3**	**3**	**1**	**-**	-	-	-	-	**1**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.1, 5.1.2, 6.1.1, 6.1.2, 12.3.2
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 6.1.1, 6.1.2, 12.3.2
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 6.1.1, 6.1.2, 12.3.2
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 6.1.1, 6.1.2, 12.3.2
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 6.1.1, 6.1.2, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	30	30	20	20	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	30	30	20	20	100
ESE	30	40	30	-	-	-	100

22IES307	DIGITAL LOGIC DESIGN	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	To impart the knowledge of Boolean algebra and Logic Gates with the understanding of designing and analyzing the Boolean functions, combinational and sequential circuits. To know the basic memory devices and programmable logic devices for building simple and hazardless digital systems.	
UNIT – I	**BOOLEAN ALGEBRA AND LOGIC GATES**	**9 Periods**
Number Systems – Binary, Octal and Hexadecimal – Complements - Signed Binary Numbers – Arithmetic Operations - Binary Codes - Boolean Algebra - Theorems and Postulates –Boolean Functions – Truth Tables – Logic Gates – Universal Gates - Canonical and Standard Forms – Minterms and Maxterms.		
UNIT – II	**GATE-LEVEL MINIMIZATION**	**9 Periods**
Karnaugh Map – 2, 3, 4 variables – Quine-McCluskey Technique – Product of Sums – Sum of Product Simplification - Don't Care Conditions - NAND/NOR Implementations – Introduction to HDL.		
UNIT – III	**COMBINATIONAL AND PROGRAMMABLE LOGIC**	**9 Periods**
Combinational Circuits – Analysis and Design - Binary Adder / Subtractor – Carry Look-ahead Adder – BCD Adder - Binary Multiplier – Magnitude Comparator – Code Converters - Decoders – Encoders - Mux/Demux – RAM – ROM – PLA - PAL		
UNIT – IV	**SYNCHRONOUS SEQUENTIAL LOGIC**	**9 Periods**
Sequential Circuits – Latches - Flip flops – Analysis of clocked sequential circuits – Moore/Mealy models – State Reduction and Assignment – Design Procedure – Shift Registers – Ripple counters - Synchronous Counters.		
UNIT – V	**ASYNCHRONOUS SEQUENTIAL LOGIC**	**9 Periods**
Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-Free Assignment - Hazards		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK

1	*M.Morris Mano and Michael D. Ciletti,* ***"Digital Design: with an Introduction to the Verilog HDL"****, Pearson Education, 6th edition, 2021.*

REFERENCES

1	*Charles H.Roth, Larry L.Kinney,* ***"Fundamentals of Logic Design"****, 7thEdition, Cengage Learning, 2013.*
2	*John F. Wakerly,* ***"Digital Design Principles and Practices"****, 4th Edition, Pearson Education, 2018.*
3	*D.P. Leach, A. P. Malvino, GoutamGuha,* ***"Digital Principles and Applications"****, 7th Edition Tata Mc-Graw Hill, New Delhi, 2011.*
4	*S.Salivahanan and S. Arivazhagan,* ***"Digital Circuits and Design"****, 5th Edition, Oxford University Press, 2018.*
5	*Donald D. Givone,* ***"Digital Principles and Design"****, Tata McGraw-hill, 2017.*
6	*R. P. Jain,* ***"Modern Electronics"****, 4th Edition, McGraw-Hill Education Limited, 2021.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the significance of Boolean Algebra and Logic Gates	K2
CO2	Design digital circuits using Boolean functions	K3
CO3	Implement digital circuits using combinational logic ICs and PLDs.	K3
CO4	Design digital circuits with synchronous sequential components.	K3
CO5	Design and analyze digital system with synchronous sequential components.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	1	-	-	1	-	-	-	-	3	1
CO2	3	3	3	3	1	-	-	1	-	-	-	-	3	1
CO3	3	3	3	2	3	-	-	1	-	-	-	-	3	1
CO4	3	3	3	3	3	-	-	1	-	-	-	-	3	1
CO5	3	3	3	3	3	-	-	1	-	-	-	-	3	1
22IES307	**3**	**3**	**3**	**3**	**3**	-	-	**1**	-	-	-	-	**3**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 5.1.2, 5.3.2, 8.1.1
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.3.2, 8.1.1
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 8.1.1
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 8.1.1
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 8.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	30	20	30	20	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	30	20	30	20	100
ESE	20	40	40	-	-	-	100

22IPC301	DATA STRUCTURES AND ALGORITHMS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To understand the concepts of programming in C++, Linear data structures, non-linear data structures, Sorting, Searching and hashing techniques.	
UNIT – I	**LINEAR DATA STRUCTURES**	**9 Periods**
Abstract Data Types (ADTs) – List ADT – vector and list in the STL– Implementation of vector - Implementation of list - The Stack ADT - Stack Model - Implementation of Stacks - Applications -The Queue ADT - Queue Model - Array Implementation of Queues - Applications of Queues		
UNIT – II	**SORTING AND SEARCHING**	**9 Periods**
Sorting algorithms- Insertion sort –shell sort - Heap Sort - Merge sort – Quick sort - Bucket Sort - Radix sort – External Sorting - Linear search – Binary Search		
UNIT – IV	**NON - LINEAR DATA STRUCTURES – TREES**	**9 Periods**
Preliminaries - Binary Trees- The Search Tree ADT: Binary Search trees-insertion-deletion-find - Traversal - AVL trees – Splay trees - Red Black trees - B-Trees		
UNIT – V	**NON - LINEAR DATA STRUCTURES - GRAPHS**	**9 Periods**
Representation of Graphs – Topological Sort - Shortest path algorithms – Dijkstra's algorithm - All-Pairs Shortest Path - Network Flow Problems - Breadth first search– Depth first search –Minimum Spanning Trees – Kruskal's and Prim's algorithm		
UNIT – V	**HASHING AND PRIORITY QUEUES**	**9 Periods**
Hash Function – Separate chaining – hash tables without linked list – rehashing – Hash tables with worst case O(1) Access- universal hashing – extendible hashing – Binary heap – applications of priority queue		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK

1	*Mark Allen Weiss,* ***"Data Structures and Algorithm Analysis in C++",*** *Fourth Edition, Pearson Education, 2014.*

REFERENCES

1	*T. H. Cormen, C. E. Leiserson, R. L. Rivest,* ***"Introduction to Algorithms",*** *Third Edition, Prentice Hall, 2012*
2	*Michael T, Goodrich, Roberto Tamassia, David Mount,* ***"Data Structures and Algorithms in C++",*** *Seventh Edition, Wiley Publishers, 2004*
3	*Robert Sedgewick,* ***"Algorithms in C++",*** *Third Edition, Pearson Education, 1998.*
4	*SartajSahni,* ***"Data Structures, Algorithms and Applications in C++",*** *Universities Press Pvt. Ltd.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Design, implement, and analyze linear data structures, such as lists, queues, andstacks,according to the needs of different applications	K4
CO2	Apply sorting and searching	K3
CO3	Design, implement, and analyze efficient tree data structures to meet requirements of real time applications	K4
CO4	Model problems as graph problems and implement efficient graph algorithms to solve them	K5
CO5	Apply suitable hashing and heap concepts to perform efficient insertion, deletion and searching technique	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	3	3	3	3	-	-	1	-	-	-	1	3	2
CO2	2	3	3	3	3	-	-	1	-	-	-	2	3	2
CO3	2	3	3	3	3	-	-	1	-	-	-	2	3	2
CO4	2	3	3	3	3	-	-	1	-	-	-	2	3	2
CO5	2	3	3	3	3	-	-	1	-	-	-	2	3	2
22IPC301	**2**	**3**	**3**	**3**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 12.2.2, 12.3.2
CO2	1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO3	1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO4	1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO5	1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	-	50	40	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	-	50	40	10	100
ESE	20	40	40	-	-	-	100

22IPC302	JAVA PROGRAMMING	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	2	4

Course Objectives	To understand concepts of Object Oriented Programming, principles of packages, inheritance, interfaces, threads, generic classes, exceptions, I/O streams and JAVAFX

UNIT – I	INTRODUCTION TO OOP AND JAVA	9+6Periods

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members- JavaDoc comments

UNIT – II	INHERITANCE, PACKAGES AND INTERFACES	9+6Periods

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces

UNIT – III	EXCEPTION HANDLING AND MULTITHREADING	9+6Periods

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread CommunicationSuspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT – IV	I/O, GENERICS, STRING HANDLING	9+6Periods

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT – V	JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS	9+6Periods

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.

List of Experiments

1. Write a program to demonstrate the use of basic java programming constrcuts
2. Write a program to demonstrate the application of String handling functions.
3. Write a program to demonstrate the use of Inheritance
4. Write a program to demonstrate the application of user-defined packages and sub-packages
5. Write a program to demonstrate the use of Java Exception handling methods.
6. Write a program to demonstrate the use of threads in Java.
7. Demonstrate with a program the use of File handling methods in Java.
8. Develop applications to demonstrate the features of generics classes.
9. Develop applications using JavaFX controls, layouts and menus.
10. Develop a mini project for any application using Java concepts

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 30 Periods** **Total: 75 Periods**

TEXT BOOK

1	Herbert Schildt, **"Java: The Complete Reference",** 11 th Edition, McGraw Hill Education, New Delhi, 2019.
2	Herbert Schildt, **"Introducing JavaFX 8 Programming",** 1 st Edition, McGraw Hill Education, New Delhi, 2015.

REFERENCES

1	Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015
2	Paul Deitel Harvey Deitel, Java, How to Program, Prentice Hall; 9th edition , 2011
3	Cay Horstmann BIG JAVA, 4th edition, John Wiley Sons,2009
4	Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.
5	Cay S. Horstmann, **"Core Java Fundamentals",** Volume 1, 11 th Edition, Prentice Hall, 2018

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the concepts of classes and objects to solve simple problems	K3
CO2	Develop programs using inheritance, packages and interfaces	K4
CO3	Make use of exception handling mechanisms and multithreaded model to solve real world problems	K4
CO4	Build Java applications with I/O packages, string classes, and generics concepts	K4
CO5	Integrate the concepts of event handling and JavaFX components and controls for developing GUI based applications	K5

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	3	3	-	-	-	2	2	2	3	3	2
CO2	2	3	2	3	3	-	-	-	2	2	2	3	3	2
CO3	2	3	3	3	3	-	-	-	3	2	2	3	3	2
CO4	3	3	3	3	3	-	-	-	3	3	2	3	3	2
CO5	3	3	3	3	3	-	-	-	3	3	2	3	3	2
22IPC302	**2**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**	**3**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators	
CO1	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	40	40	20	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	40	40	20	-	100
ESE	20	40	40	-	-	-	100

22IES308	ENGINEERING EXPLORATION FOR INFORMATION TECHNOLOGY *(Common to CSE & IT Branches)*	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	The objective of the course is to provide an introduction to the engineering exploration	
UNIT – I	**INTRODUCTION**	**15 Periods**
Introduction to Engineering and Engineering study: Difference between science and engineering, scientist and engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, expectation for the 21st century engineer and Graduate Attributes- Evolution of OS - Software Requirement Specification Document- Engineering Failures and Software bugs		
UNIT – II	**PC HARDWARE AND TROUBLESHOOTING**	**15 Periods**
Formatting PC- Installation of Operating system - Device Drivers Installation –study on Networking devices -network interfacing - Troubleshooting PC		
UNIT – III	**APPS AND GAME DESIGN**	**15 Periods**
Case Study 1: Tic Tac Toe -Hangman- Rock, Paper and scissor game -Pacman Case Study2: Text to Speech convertor- Voice based calculator- ChatGPT App- Classification of Images Case study 3: Pong game -Space invaders game- Dobble game- Snake and ladder		
Contact Periods: **Lecture: 0 Periods** **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**		

REFERENCES

1	*Ryan A Brown, Joshua W. Brown and Michael Berkihiser,"**Engineering Fundamentals: Design, Principles and Careers**", Goodheart-Willcox Publisher, Second edition, 2014.*
2	*Saeed Moaveni, "**Engineering Fundamentals: An Introduction to Engineering**", Cengage learning, Fourth Edition, 2011.*
3	*G. Polya, "**How to Solve It: A New Aspect of Mathematical Method**", Princeton Science Library, Second Edition, 2014.*
4	*K.L. James,"**COMPUTER HARDWARE, Installation, Interfacing, Troubleshooting andMaintenance**",PHI learning, 2013*
5	https://appinventor.mit.edu/
6	https://gamemaker.io/en

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand basic engineering concepts	K2
CO2	Write SRS for the given problem statement	K4
CO3	Format and configure OS and device drivers	K4
CO4	Troubleshoot PC and configure networking	K4
CO5	Design apps and games	K6

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	1	-	-	-	-	2	-	-	2	2	2
CO2	3	3	2	3	2	-	-	-	2	-	3	2	2	2
CO3	3	3	2	1	2	-	-	-	2	-	-	2	2	2
CO4	3	3	2	1	2	-	-	-	2	-	-	2	2	2
CO5	3	3	3	1	3	3	-	3	2	2	3	2	2	2
22IES308	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**1**	**2**	**1**	**2**	**2**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,1.3.1, 3.1.1,3.1.4, 3.1.6, 4.1.1,4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3,4.3.4, 5.1.1,6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3,9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2,12.3.1
CO2	1.2.1,1.3.1, 3.1.1,3.1.4,3.1.6, 4.1.1,4.1.3, 4.1.4,4.3.1, 4.3.2, 4.3.3, 4.3.4,5.1.1,6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3,9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2,12.3.1
CO3	1.2.1,1.3.1, 3.1.1,3.1.4, 3.1.6, 4.1.1,4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3,4.3.4, 5.1.1,6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3,9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2,12.3.1
CO4	1.2.1,1.3.1, 3.1.1,3.1.4, 3.1.6, 4.1.1,4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3,4.3.4, 5.1.1,6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3,9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2,12.3.1
CO5	1.2.1,1.3.1, 3.1.1,3.1.4, 3.1.6, 4.1.1,4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3,4.3.4, 5.1.1,6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3,9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2,12.3.1

ASSESSMENT PATTERN – CDIO:

Component	**Preparation/Design**	**Presentation**	**Viva**	**Total**
Study on Engineering Exploration	10	-	-	10
Software Requirement Specification Document Preparation for given problem	10	5	5	20
Formatting PC, Installation of OS and Device drivers	5	5	10	20
Troubleshooting of PC and configuration of Networks	5	5	10	20
Design of Apps and Games	10	10	10	30
Continuous Assessment				100
Model Lab				100

Weightage for record of work done: 75%; Weightage for Model Exam: 25%

22IES309	DIGITAL LOGIC DESIGN LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	2	1

Course Objectives	To implement various logic gates, combinational and sequential circuits and to understand the execution of the coding using Hardware Description Language.

LIST OF EXPERIMENTS

1. Verification of Boolean theorems and truth table using logic gates.
2. Design and implementation of combinational circuits using gates for arbitrary functions.
3. Implementation of 4-bit binary adder/subtractor circuits
4. Implementation of combinational circuits using code converters.
5. Implementation of BCD adder, encoder and decoder circuits.
6. Implementation of 2-bit Magnitude Comparator
7. Implementation of Multiplexers and Demultiplexers.
8. Verification of Flip-flop's truth table
9. Implementation of a Universal Shift register.
10. Implementation of synchronous and asynchronous counters.
11. HDL coding for any of the combinational and sequential circuits.
12. Mini project on design of a digital circuit for solving practical problems.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Verify Boolean theorems and truth table using logic gates	K2
CO2	Design and implement combinational circuits for Boolean functions	K3
CO3	Understand and verify the truth tables of Flip-flops	K2
CO4	Design and implement shift registers and counters.	K3
CO5	Implement combinational/sequential circuits using HDL	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	3	3	2	3	-	-	-	2	-	-	-	2	1
CO2	3	3	3	3	3	-	-	-	2	-	-	-	2	1
CO3	3	3	3	2	3	-	-	-	3	-	-	-	3	1
CO4	3	3	3	3	3	-	-	-	3	-	-	-	3	1
CO5	3	3	3	3	3	-	-	-	3	-	-	-	3	1
22IES309	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 9.1.1, 9.2.2, 9.2.3
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 9.1.1, 9.2.2, 9.2.3
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 9.1.1, 9.2.2, 9.2.3, 9.3.1
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 9.1.1, 9.2.2, 9.2.3, 9.3.1
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 9.1.1, 9.2.2, 9.2.3, 9.3.1

22IPC303	DATA STRUCTURES AND ALGORITHMS LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	Develop applications using Linear data structures, non-linear data structures, Sorting, Searching and hashing techniques.

LIST OF PROGRAMS

1. Implementation of List, Stack and Queue ADTs
2. Applications of List, Stack and Queue ADTs
3. Implementation of sorting algorithms
4. Implementation of searching algorithms
5. Implementation of Hash tables
6. Tree representation and traversal algorithms
7. Implementation of Binary Search Tree
8. Implementation of AVL Tree
9. Implementation of Heaps
10. Graph representation and Traversal algorithms
11. Implementation of single source shortest path algorithm
12. Implementation of minimum spanning tree algorithms

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Implementlinear data structures, such as lists, queues, and stacks	K5
CO2	Apply suitable linear data structures, such as lists, queues, and stacks,according to the needs of different applications	K5
CO3	Apply sorting, searching and hashing techniques.	K5
CO4	Design, implement, and analyze efficient tree structures to meet requirements such as searching, indexing, and sorting	K5
CO5	Model problems as graph problems and implement efficient graph algorithms to solve them	K6

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	3	3	-	-	1	3	1	2	1	3	2
CO2	3	3	3	3	3	-	-	1	3	1	2	2	3	2
CO3	3	3	3	3	3	-	-	1	3	1	2	2	3	2
CO4	3	3	3	3	3	-	-	1	3	1	2	2	3	2
CO5	3	3	3	3	3	-	-	1	3	1	2	2	3	2
22IPC303	**2**	**3**	**3**	**3**	**3**	**-**	**-**	**1**	**3**	**1**	**2**	**1**	**3**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO4	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2

22IES410	ELEMENTS OF DISCRETE STRUCTURES	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	To inculcate the knowledge of Mathematical Logic, Inference theory, relations, functions, number theory, counting techniques and fundamental algebraic structures and graph models, their representation, connectivity and traversability.	
UNIT – I	**SET THEORY AND LOGIC**	**9 Periods**
Introduction – Combinations of Sets – Mathematical Induction – Principle of Inclusion and Exclusion – Propositions – Logical Connectives – Conditionals and Biconditionals – Tautologies – Logical Equivalences – Theory of inference for Statement calculus – Inference Theory of Predicate Calculus		
UNIT – II	**RELATIONS AND FUNCTIONS**	**9 Periods**
Introduction – Properties of binary relations – Closure of relations – Warshall's Algorithm – Equivalence relations and Partitions – Partial ordering relations and Lattices – Functions – Composition of functions – Invertible Functions – Recursive Functions		
UNIT – III	**NUMBER THEORY AND COUNTING**	**9 Periods**
Divisibility and Modular Arithmetic – Primes and Greatest Common Divisors – Solving Congruences – Pigeon-hole Principle – Permutations and Combinations – Generalized Permutations and Combinations – Solving Linear Recurrence Relations – Generating Functions		
UNIT – IV	**ALGEBRAIC STRUCTURES**	**9 Periods**
Introduction – Groups – Subgroups – Cosets and Lagrange's Theorem – Permutation groups and Burnside's Theorem – Isomorphisms and Automorphisms – Homomorphisms and Normal subgroups – Rings – Integral domains and Fields		
UNIT – V	**GRAPH THEORY**	**9 Periods**
Graphs and Graph Models – Special Types of Graphs – Representing Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths – Planar Graphs – Graph Coloring.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*C.L. Liu,D.P. Mohapatra,* ***"Elements of Discrete Mathematics: A Computer Oriented Approach",*** *Tata McGraw Hill, Fourth Edition (SIE), 2012.(UNIT I, II & IV)*
2	*Kenneth H. Rosen,* ***"Discrete Mathematics and Its Applications",*** *Tata McGraw Hill, Eighth Edition, 2019.(UNIT – III & V)*

REFERENCES

1	*Ralph P. Grimaldi,* ***"Discrete and Combinatorial Mathematics",*** *Fifth Edition, PHI/Pearson Education, 2006.*
2	*Tremblay.J.P and Manohar.R,* ***"Discrete Mathematical Structures with Applications to Computer Science",*** *Tata McGraw Hill Company, 1997, 35 th reprint 2008.*
3	*Lipschutz, S. and Mark Lipson.,* ***"Discrete Mathematics",*** *Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.*
4	*SatinderBal Gupta,* ***"Discrete Mathematics and Structures",*** *University Science Press, Fifth edition, 2008.*
5	*Oscar Levin,* ***"Discrete Mathematics",*** *CreateSpace Independent Publishing Platform*, 2018.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Verify the validity of the logical arguments**,** mathematical proofs and correctness of the algorithm.	K2
CO2	Interpret the properties of relations and functions.	K2
CO3	Apply combinatorial counting techniques in solving combinatorial related problems.	K3
CO4	Understand the significance of algebraic structures.	K2
CO5	Use graph models and their connectivity, traversability in solving real world problems.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	3	2	-	-	2	-	-	1	2	3	1
CO2	3	3	3	3	2	-	-	2	-	-	1	2	3	1
CO3	3	3	3	3	2	-	-	2	-	-	1	2	3	1
CO4	3	3	3	3	2	-	-	2	-	-	1	2	3	1
CO5	3	3	3	3	2	-	-	2	-	-	1	2	3	1
22IES410	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**1**	**2**	**3**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.3.2, 11.2.1,12.1.1, 12.1.2, 12.2.1
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.3.2, 11.2.1,12.1.1, 12.1.2, 12.2.1
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.3.2, 11.2.1,12.1.1, 12.1.2, 12.2.1
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.3.2, 11.2.1,12.1.1, 12.1.2, 12.2.1
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.2, 5.3.2, 11.2.1,12.1.1, 12.1.2, 12.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	20	30	30	20	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	20	30	30	20	100
ESE	30	40	30	-	-	-	100

22IPC404	EMBEDDED SYSTEMSARCHITECTURE	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To inculcate the differences between embedded and generic purpose systems and to impart knowledge on architecture and programming concepts of embedded systems in managing the processes and RTOS.	
UNIT – I	**INTRODUCTION TO MICROPROCESSOR AND EMBEDDED SYSTEM**	**9 Periods**
Embedded systems – Processor embedded into system – embedded hardware and software – examples – Embedded SoC – complex system design – Design process in embedded system and example – Classification of embedded systems.		
UNIT – II	**ARCHITECTURE, MEMORY, INTERFACING AND INTERRUPTS**	**9 Periods**
8051 architecture – I/O types and examples – serial and parallel communication – wireless devices – Timer, counter and clocks – networked embedded systems – Programmed I/O busy-wait without IS mechanism – ISR concept – interrupt sources – Interrupt servicing mechanism – Multiple interrupts – classification of interrupt servicing mechanisms – DMA		
UNIT – III	**PROGRAMMING CONCEPTS**	**9 Periods**
Programming in assembly and high level language – C program elements – object oriented programming – embedded programming in C++ and java – Program models – DFG models – state machine programming models for event controlled program flow – Multiprocessor system modeling – UML modeling.		
UNIT – IV	**IPC, PROCESS SYNCHRONIZATION, THREADS AND TASKS**	**9 Periods**
Multiple processes in an application – Multiple threads in an application – Tasks – task states – task and data – semaphores – shared data – IPC – signal function – semaphore function – message queue function – mailbox function – pipe function – socket function – RPC function		
UNIT – V	**REAL TIME OPERATING SYSTEMS**	**9 Periods**
OS services – Process management – Timer function – Event function – Memory management – Device– file– I/O subsystem management – Interrupt routines – RTOS systems – design using RTOS – RTOS task scheduling models– interrupt latency and response of tasks – OS security issues.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*RajKamal,* ***"Embedded Systems: Architecture, Programming and Design",****Tata McGraw Hill, 2nd edition, 2011.*

REFERENCES

1	*K.V.K.K.Prasad,* ***"Embedded Real-Time Systems: Concepts, Design &Programming",****Dreamtech press, 2005.*
2	*David E-Simon,* ***"An Embedded Software Primer"*** *Pearson Education, 2007.*
3	*Wayne Wolf,* ***"Computers as Components- Principles of Embedded Computer System Design",*** *Morgan Kaufmann Publisher, 2006.*
4	*Tammy Noergaard,* ***"Embedded Systems Architecture",*** *Elsevier, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Compare embedded system with general purpose system.	K3
CO2	Explain the functional dependency of components in embedded system.	K2
CO3	Program the embedded systems.	K3
CO4	Understand the communication between processes and task management.	K2
CO5	Design systems using RTOS	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	2	-	-	-	-	-	3	3	1
CO2	3	3	3	3	2	2	-	-	-	-	-	3	3	1
CO3	3	3	3	3	2	2	-	-	-	-	-	3	3	1
CO4	3	3	3	3	2	2	-	-	-	-	-	3	3	1
CO5	3	3	3	3	2	2	-	-	-	-	-	3	3	1
22IPC404	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 3.1.3, 3.1.4, 3.1.5, 4.1.1, 4.2.1, 4.3.2, 4.3.3, 5.1.2, 6.1.1, 12.1.1, 12.2.2
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 3.1.3, 3.1.4, 3.1.5, 4.1.1, 4.2.1, 4.3.2, 4.3.3, 5.1.2, 6.1.1, 12.1.1, 12.2.2
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 3.1.3, 3.1.4, 3.1.5, 4.1.1, 4.2.1, 4.3.2, 4.3.3, 5.1.2, 6.1.1, 12.1.1, 12.2.2
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 3.1.3, 3.1.4, 3.1.5, 4.1.1, 4.2.1, 4.3.2, 4.3.3, 5.1.2, 6.1.1, 12.1.1, 12.2.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 3.1.3, 3.1.4, 3.1.5, 4.1.1, 4.2.1, 4.3.2, 4.3.3, 5.1.2, 6.1.1, 12.1.1, 12.2.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	40	30	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	40	30	20	10	100
ESE	30	40	30	-	-	-	100

22IPC405	DATABASE SYSTEMS	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	• To learn the basics of designing the database and performing operations on database without compromising desired properties.	
UNIT – I	**DATA MODELING AND DATABASE DESIGN**	**9 periods**
Database system concepts and architectures – ER model – relational model and constraints - Functional Dependencies and Normalization for Relational Databases.		
UNIT – II	**QUERY PROCESSING AND SQL**	**9 periods**
Basic SQL – Complex SQL retrieval queries – Triggers – Views – Schemas – Relational algebra and relational calculus – Strategies for query processing – query optimization.		
UNIT – III	**DATA STORAGE**	**9 periods**
Disk storage – Basic file structures – Hashing – Modern storage architectures – Indexing structure for files and physical database design.		
UNIT – IV	**TRANSACTION MANAGEMENT**	**9 periods**
Introduction to Transaction Processing - Desirable Properties of Transactions - Concurrency Control Techniques – Database recovery techniques.		
UNIT – V	**NoSQL DATABASE DATA MODEL AND IMPLEMENTATION**	**9 periods**
Emergence of NoSQL - Data Models: Aggregates, Key value and document data models, Column Family Stores, Relationships, Graph Databases, Schemaless Databases, Materialized views – Consistency: Update, Read, Relaxing – Map and Reduce – Implementation: Key value databases, Document Databases, Column Family Stores, Graph databases.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*RamezElmasri and Shamkant B. Navathe,* ***"Fundamental of Database Systems",*** *Pearson Education, 7th Edition, 2016.*
2	*Pramod J. Sadalage Martin Fowler,* ***"NoSQL Distilled A Brief Guide to the Emerging World of Polyglot Persistence",*** *Pearson, 2012.*

REFERENCES

1	*Abraham Silberschatz, Henry F. Korth and S. Sudarshan,* ***"Database System Concepts",*** *McGraw Hill, 7th Edition, 2021.*
2	*Corlos Coronel and Steven Morris,* ***"Database Systems: Design, Implementation, & Management",*** *Cengage Learning, 13th edition, 2019*
3	*Kristina Chodorow,* ***"MongoDB: The Definitive Guide",*** *O'Reilly Publication, 2nd Edition, 2013.*
4	*Shashank Tiwari,* ***"Professional NoSql",*** *John Wiely& Sons, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Design database using ER model	K3
CO2	Construct and execute SQL queries using relational algebra.	K4
CO3	Apply indexing to improve the performance	K4
CO4	Construct queries for performing transactions without compromising the consistency.	K3
CO5	Analyze various advanced databases and adopt suitable one.	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	2	1	-	-	-	-	-	-	-	-	2	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-	2	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-	2	-
CO5	2	2	2	1	-	-	-	-	-	-	-	-	2	-
22IPC405	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 2.1.3, 2.2.1, 2.2.2, 2.2.4, 2.4.1, 3.1.1, 3.2.1, 3.2.2, 3.4.1, 3.4.2, 4.2.2
CO2	1.1.1,1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.4, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.4.1, 3.4.2, 4.1.1, 4.1.4, 4.2.1,
CO3	1.1.1,1.3.1, 2.2.1, 2.3.1, 3.1.1, 4.3.3, 4.3.4
CO4	1.1.1,1.3.1,2.2.1, 2.4.1, 3.1.1, 3.2.2, 4.1.2
CO5	1.1.1,1.3.1, 2.1.3, 2.2.1, 2.3.1, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.2, 4.3.2.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	20	20	30	30	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	20	20	30	30	100
ESE	30	40	30	-	-	-	100

22IES411	PRINCIPLES OF COMMUNICATION ENGINEERING	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	To understand the analog and digital communication techniques, data and pulse communication techniques, source and Error control coding and multi-user radio communication	
UNIT – I	**ANALOG COMMUNICATION**	**9 Periods**
Introduction to Communication Systems - Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).		
UNIT – II	**PULSE AND DATA COMMUNICATION**	**9 Periods**
Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of Pulse Communication Systems (PAM – PTM – PCM) - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Data communication Hardware - serial and parallel interfaces.		
UNIT – III	**DIGITAL COMMUNICATION**	**9 Periods**
Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM)		
UNIT – IV	**SOURCE AND ERROR CONTROL CODING**	**9 Periods**
Entropy, Source encoding theorem, Shannon Fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes - ARQ Techniques.		
UNIT – V	**MULTI-USER RADIO COMMUNICATION**	**9 Periods**
Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes - Satellite Communication – Bluetooth.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*Wayne Tomasi,* ***"Advanced Electronic Communication Systems",*** *6th Edition, Pearson Education, 2009.*

REFERENCES

1	*Simon Haykin,* ***"Communication Systems",*** *4th Edition, John Wiley & Sons, 2004*
2	*Rappaport T.S,* ***"Wireless Communications: Principles and Practice",*** *2nd Edition, Pearson Education, 2007*
3	*H.Taub, D L Schilling and G Saha,* ***"Principles of Communication",*** *3 rd Edition, Pearson Education, 2007.*
4	*B.Sklar,* ***"Digital Communication Fundamentals and Applications"*** *2 nd Edition Pearson Education 2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply analog communication techniques.	K3
CO2	Apply digital communication techniques.	K3
CO3	Use data and pulse communication techniques.	K3
CO4	Analyze Source and Error control coding.	K4
CO5	Utilize multi-user radio communication	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO2	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO3	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	3	2	2
22IES411	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3,1.4,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,12.1.2,12.2.2,12.3.1,12.3.2
CO2	1.3,1.4,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,12.1.2,12.2.2,12.3.1,12.3.2
CO3	1.3,1.4,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,12.1.2,12.2.2,12.3.1,12.3.2
CO4	1.3,1.4,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,12.1.2,12.2.2,12.3.1,12.3.2
CO5	1.3,1.4,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,12.1.2,12.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	50	50	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	50	50	-	-	100
ESE	20	40	40	-	-	-	100

22IPC406	DESIGN AND ANALYSIS OF ALGORITHMS *(Common to CSE & IT Branches)*	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
DATA STRUCTURES	PC	3	1	0	4

Course Objectives	Toapplyimportantalgorithmicdesignparadigmsandmethodsofanalysisandsynthesizeefficient algorithmsincommonengineeringdesignsituations	
UNIT – I	**INTRODUCTION TO ALGORITHM ANALYSIS**	**9+3 Periods**
Fundamentals of Algorithmic Problem Solving - Important Problem Types - Fundamentals ofthe Analysis of Algorithm Efficiency - Asymptotic Notations and Basic Efficiency Classes -Mathematical Analysis of Non-recursive Algorithms - Mathematical Analysis of RecursiveAlgorithms-AmortizedAnalysis		
UNIT – II	**DECREASE AND CONQUER TECHNIQUE**	**9+3 Periods**
Decrease by constant:Insertionsort-Topologicalalgorithm.Decrease-by-a-Constant-Factor:BinarySearch-Fake-CoinProblem-RussianPeasantMultiplication -JosephusProblem. Variable-Size Decrease-ComputingaMedianandtheSelectionProblem–InterpolationSearch-SearchingandInsertionin aBinarySearch Tree-The Game of Nim.		
UNIT – III	**ALGORITHM DESIGN TECHNIQUES -I**	**9+3 Periods**
Greedy Approach : Prim's algorithm- Kruskal's Algorithm- Dijkstra's Algorithm - HuffmanTrees and codes .Divide and Conquer : Merge Sort – Quick sort - Matrix Multiplication ofLargeIntegers-Strassen'sMatrixMultiplication DynamicProgramming:MatrixChain Multiplication – Knapsack problem and Memory Function – optimal binary search tree -Warshall'sand Floyd'sAlgorithms–Longest commonSubsequence		
UNIT – IV	**ALGORITHM DESIGN TECHNIQUES -II**	**9+3 Periods**
Backtracking:n-Queenproblem–HamiltonCircuitProblem–Subsetsumproblem-CNF–SAT. BranchandBound:Assignmentproblem–Knapsackproblem-TravellingSalesman Problem.		
UNIT – V	**NP COMPLETENESS**	**9+3 Periods**
Limitations of algorithm power – Lower bound arguments – Decision Trees - P,NP and –NPComplete problem -ApproximationAlgorithm for NP Hard Problems: TSP - Knapsack problem Case study (not for evaluation) : Randomized Algorithms - Exact Exponential Algorithm		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK

1	*AnanyLevitin**"IntroductiontotheDesignandAnalysisofAlgorithms"**ThirdEdition, PearsonEducation,2012*
2	*Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein **"Introduction to Algorithms"** Fourth Edition, MIT Press/McGraw-Hill, 2022.(unit 1-Amortized analysis)*

REFERENCES

1	*Singhal, Shefali, and Neha Garg "**Analysis and Design of Algorithms: A Beginner's Hope**", BPB Publications, 2018.*
2	*Sedgewick, Robert, and Kevin Wayne. "**Algorithms**". Fourth edition, Addison-wesley professional, 2011.*
3	*MichaelTGoodrichandRobertoTamassia,"**AlgorithmDesign:Foundations,Analysis, andInternetExamples**", SecondEdition, Wiley,2006*
4	*NPTEL Course : Design and Analysis of Algorithms https://archive.nptel.ac.in/courses/106/106/106106131/*

	COURSE OUTCOMES: Upon completion of the course, the students will be able to:	Bloom's Taxonomy Mapped
CO1	Arguethecorrectnessofalgorithmsandanalyzetherunningtimeusingasymptotic notations and amortizedanalysis	K4
CO2	Explore different algorithmic approaches, such as Decrease by Constant, Decrease by a Constant Factor, and Variable-Size Decrease and solve problems associated with these paradigms.	K2
CO3	Develop problem-solving skills through practical application of Greedy Approach, Divide and Conquer, and Dynamic Programming.	K3
CO4	Cultivate proficient problem-solving abilities through the utilization of advanced Backtracking and Branch and Bound algorithms.	K3
CO5	Grasp the limitations of algorithmic capabilities and explore approaches to address them through the use of approximation algorithms.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	1	1	1	-	-	-	-	-	1	2	3	3
CO2	2	2	1	1	1	-	-	-	-	-	1	2	3	3
CO3	2	2	3	1	1	-	-	-	-	-	1	2	3	3
CO4	2	2	1	1	1	-	-	-	-	-	1	2	3	3
CO5	2	1	1	1	1	-	-	-	-	-	1	2	3	3
22IPC406	**2**	**2**	**1**	**1**	**1**	-	-	-	-	-	**1**	**2**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.4.1,3.2.2,3.2.3,3.3.1,4.1.2,4.2.1,5.1.2,5.3.1,11.3.1,12.3.2
CO2	1.1.1, 1.3.1,1.4.1, 2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.4.1,3.2.2, 3.1.6, 3.2.3,3.3.1,4.1.2,4.2.1,5.1.2,5.3.1, 11.3.1,12.3.2
CO3	1.1.1, 1.3.1,1.4.1, 2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.4.1,3.2.2, 3.1.6, 3.2.3,3.3.1,4.1.2,4.2.1,5.1.2,5.3.1, 11.3.1,12.3.2
CO4	1.1.1, 1.3.1,1.4.1, 2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.4.1,3.2.2, 3.1.6, 3.2.3,3.3.1,4.1.2,4.2.1,5.1.2,5.3.1, 11.3.1,12.3.2
CO5	1.1.1, 1.3.1,1.4.1, 2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.4.1,3.2.2, 3.1.6, 3.2.3,3.3.1,4.1.2,4.2.1,5.1.2,5.3.1, 11.3.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	30	30	40	-	-	100
CAT2	10	40	50	-	-	-	100
Individual Assignment1 /Case Study 1/ Seminar 1 / Project1	-	-	50	50	-	-	100
Individual Assignment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	10	40	50	-	-	-	100

22IES412	FOUNDATIONS OF DATA SCIENCE *(Common to CSE & IT Branches)*	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	This course will introduce the fundamental concepts in the field of data science required for solving data science problems	
UNIT – I	**R FOR DATASCIENCE**	**9 Periods**
Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions and statistical models in R - Introduction to graphical analysis –plots – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph using graphics parameters.		
UNIT – II	**INTRODUCTION TO DATA SCIENCE AND DESCRIBING DATA**	**9 Periods**
Data Science Process: Roles and stages. Basic Statistical descriptions of Data - Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores		
UNIT – III	**DESCRIBING RELATIONSHIPS**	**9 Periods**
Correlation –correlation coefficient for quantitative data –computational formula for correlation coefficient – Populations, Samples and Probability – Sampling distribution of the mean		
UNIT – IV	**GENERALIZING BEYOND DATA**	**9 Periods**
Hypothesis testing: z-test, Null Hypothesis and Alternate Hypothesis, One tailed and Two Tailed Tests, Estimation of Confidence Interval		
UNIT – V	**MODELING METHODS**	**9 Periods**
Choosing and evaluating models -Linear and logistic regression: Building a model, Making Predictions, Reading Model summary and characterizing co-efficient quality unsupervised methods: Cluster Analysis		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS

1	*Nina Zumel, John Mount,* ***"Practical Data Science with R",*** *Manning Publications, 2014. (Unit I and V)*
2	*Robert S. Witte and John S. Witte,* ***"Statistics",*** *Eleventh Edition, Wiley Publications, 2017. (Units II, III and IV)*

REFERENCES

1	*W. N. Venables, D. M. Smith and the R Core Team,* ***"An Introduction to R",*** *2013.*
2	*Mark Gardener,* ***"Beginning R - The Statistical Programming Language",*** *John Wiley & Sons, Inc., 2012.*
3	*Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta,* ***"Practical Data Science Cookbook",****Packt Publishing Ltd., 2014*
4	*Montgomery, D. C. and G. C. Runger.* ***"Applied Statistics and Probability for Engineers"****. 5th Edition. John Wiley & Sons, Inc., NY, USA, 2011*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Use R Libraries for Data Wrangling	K3
CO2	Define the data science process	K1
CO3	Analyze and interpret data using an ethically responsible approach.	K4
CO4	Apply hypotheses and data into actionable predictions	K3
CO5	Formulate and use appropriate models of data analysis to solve problems	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2
CO1	1	1	2	1	3	-	-	-	-	-	1	-	2	2
CO2	1	1	1	1	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	3	3	-	3	-	-	-	-	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	-	2	2
CO5	3	3	3	3	-	-	-	-	-	-	-	1	2	2
22IES412	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.3.2, 3.1.2, 3.2.1, 3.2.2, 4.1.3, 5.1.1, 5.1.2, 5.2.2, 5.3.1, 5.3.2, 11.3.2
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.3.2, 3.1.2, 3.2.1, 3.2.2, 4.1.3
CO3	1.3.1, 1.4.1, 2.2.4, 2.4.1, 2.4.2, 2.4.4, 3.1.5, 3.2.2, 3.4.2, 4.1.2, 4.1.4, 4.3.2, 5.2.1, 5.3.1, 5.3.2, 6.2.1, 8.1.1, 8.2.1
CO4	1.3.1, 1.4.1, 2.2.4, 2.4.1, 2.4.2, 2.4.4, 3.1.5, 3.2.2, 3.4.2, 4.1.2, 4.1.4, 4.3.2
CO5	1.3.1, 1.4.1, 2.2.4, 2.4.1, 2.4.2, 2.4.4, 3.1.5, 3.2.2, 3.4.2, 4.1.2, 4.1.4, 4.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Individual Assignment1 /Case Study 1/ Seminar 1 / Project1	30	20	40	5	5	-	100
Individual Assignment 2 /Case Study 2/ Seminar 2 / Project 2	30	20	30	10	5	5	100
ESE	30	30	40	-	-	-	100

22IPC407	DATABASE SYSTEMS LABORATORY	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	* Usage of DDL, DML and TCL commands. * Querying the database using relational algebra. * Concepts of triggers, functions and stored procedures in PL/SQL and NoSQL. * Creating and accessing NOSQL database.

LIST OFEXPERIMENTS

1. DDL, DML, DCL and TCL commands.
2. Built-Infunctions and Relational Algebra operations in open source DBMS-MySQL.
3. Materialized views.
4. Stored Procedures, Functions and Triggers in PL/SQL.
5. Cursor Implementation in PL/SQL.
6. Create, update and delete NoSQL database NoSQL.
7. Querying NoSQL database using NoSQL.
8. Build and utilize index of NoSQL
9. Cursor Implementation in NoSQL
10. Study of Mysql DB on cloud virtual machine
11. Study of Cockroach DB, Yugabyte DB and snowflake.
12. Developing an application to simulate bank transactions.
13. Developing an application for college management
14. Developing an application for inventory control system
15. Developing an application for payroll process management
16. Mini Project:(Any application development using MySQL/NoSQL)

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Design and implement a database schema for a given problem-domain	K4
CO2	Populate and query a database using SQL DDL/ DML/TCL commands.	K4
CO3	Declareandenforceintegrityconstraintsonadatabaseusing RDBMS.	K4
CO4	ProgramPL/SQLandNoSQL includingstoredprocedures,storedfunctions,cursorsandpackages	K4
CO5	DesignandbuildaGUIapplication	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	1	2	1	-	-	1	-	-	-	-	2	1
CO2	2	2	1	2	1	-	-	1	-	-	-	-	2	1
CO3	2	2	1	2	1	-	-	1	-	-	-	-	2	1
CO4	2	2	1	2	1	-	-	1	-	-	-	-	2	1
CO5	2	2	1	2	1	-	-	1	1	2	-	1	2	1
22IPC408	2	2	1	2	1	-	-	1	1	1	-	1	2	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 3.1.6, 3.2.1, 3.2.3, 3.4.2, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 4.3.4, 5.2.1, 8.1.1.
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 3.1.6, 3.2.1, 3.2.3, 3.4.2, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 4.3.4, 5.2.1, 8.1.1.
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 3.1.6, 3.2.1, 3.2.3, 3.4.2, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 4.3.4, 5.2.1, 8.1.1.
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 3.1.6, 3.2.1, 3.2.3, 3.4.2, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 4.3.4, 5.2.1, 8.1.1.
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 3.1.6, 3.2.1, 3.2.3, 3.4.2, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 4.3.4, 5.2.1, 8.1.1, 9.2.1, 9.2.3, 10.1.2, 10.2.1, 10.3.2, 12.3.1, 12.3.2.

22IPC408	EMBEDDED SYSTEMS LABORATORY	SEMESTER IV

REREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	To study ARM processor kit and its architecture and to program the ARM processor and impart interfaces with display module and timer and to provide serial transmission of ARM processor.

LIST OF EXPERIMENTS

1. Study of ARM processor kit.
2. Simulation of arithmetic operation on arm in assembly.
3. Simulation of assembly level program for soft delay.
4. Simple LED blinking with variable speed in ASM.
5. Seven segment LED display interface in C.
6. Realizing timer peripheral in arm by polling method/Interrupt driven method.
7. Serial transmission and reception of a character in C by polling method/Interrupt method.
8. Displaying alphanumeric characters in 2x16 line LCD module.
9. Number conversion in ARM processor.
10. Accessing internal ADC of the ARM processor and to display in LCD.

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the functional architecture of ARM processor	K2
CO2	Execute assembly language program to perform operation in ARM processor.	K3
CO3	Evaluate and implement assembly language program to interface ARM processor with the display module	K2
CO4	Write assembly language program to access the timer	K3
CO5	Write assembly language program to transmit data in serial with ARM processor	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	3	-	3	3	-	-	-	3	2	2
CO2	3	3	3	3	3	-	1	3	-	-	-	3	2	1
CO3	3	3	3	2	3	-	1	3	-	-	-	3	2	2
CO4	3	3	3	3	3	-	1	1	-	-	-	3	2	1
CO5	3	3	3	3	3	-	1	3	-	-	-	3	2	1
22IPC408	**3**	**3**	**3**	**3**	**3**	**-**	**1**	**2**	**-**	**-**	**-**	**3**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 2.1.1,2.1.2,2.1.3, 2.2.1,2.2.2, 2.2.3, 2.2.4, 2.3.1,2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4,3.1.4, 3.1.6, 3.2.1,3.2.2, 3.4.2, 4.1.1, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 7.1.1, 7.1.2,7.2.1, 8.1.1, 8.2.1, 12.1.1, 12.2.2, 12.3.1
CO2	1.3.1, 2.1.1,2.1.2,2.1.3, 2.2.1,2.2.2, 2.2.3, 2.2.4, 2.3.1,2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4,3.1.4, 3.1.6, 3.2.1,3.2.2, 3.4.2, 4.1.1, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 7.1.1, 8.1.1, 8.2.1, 12.1.1, 12.2.2, 12.3.1
CO3	1.3.1, 2.1.1,2.1.2,2.1.3, 2.2.1,2.2.2, 2.2.3, 2.2.4, 2.3.1,2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4,3.1.4, 3.1.6, 3.2.1,3.2.2, 3.4.2, 4.1.1, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 7.1.1, 8.1.1, 8.2.1, 12.1.1, 12.2.2, 12.3.1
CO4	1.3.1, 2.1.1,2.1.2,2.1.3, 2.2.1,2.2.2, 2.2.3, 2.2.4, 2.3.1,2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4,3.1.4, 3.1.6, 3.2.1,3.2.2, 3.4.2, 4.1.1, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 7.1.1, 8.1.1, 12.1.1, 12.2.2, 12.3.1
CO5	1.3.1, 2.1.1,2.1.2,2.1.3, 2.2.1,2.2.2, 2.2.3, 2.2.4, 2.3.1,2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4,3.1.4, 3.1.6, 3.2.1,3.2.2, 3.4.2, 4.1.1, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 7.1.1, 8.1.1, 8.2.1, 12.1.1, 12.2.2, 12.3.1

22IPC509	COMPUTER NETWORKS *(Common to ECE, CSE $ IT)*	SEMESTERV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	Upon completion of the course, the students will be familiar with, 1. The division of network functionalities into layers 2. The component required to build different types of networks 3. Identifying the solution for the functionalities in each layer.

UNIT – I	INTRODUCTION AND PHYSICAL LAYER	9 Periods

Overview of how the Internet works: browser, webserver, URL, domain name, IP address, packets, Hubs, Bridges, Switches.Overview of the design principles of the Internet: packet switching vs circuit switching, store-and forward networks, layering for modularity. Introduction to the various layers in the Internet. Introduction to performance metrics: end-to-end throughput, delay, jitter and drop rates in a network. Statement of Little's Law. How performance is measured.

Physical layer: signalto-noise ratio, bit error rate, modulation, multipath interference. Data Transmission – Transmission Media – Signal Encoding Techniques – Multiplexing – Spread Spectrum

UNIT – II	DATALINK LAYER	9 Periods

Medium access protocols: Polling vs. contention-based: TDM, Aloha, CSMA/CD. Data Link Layer: Mechanisms for error detection/recovery: Parity checks, CRC and data link layer protocols. Switched LANs: L2 addressing and ARP– Virtual LAN (VLAN) –Ethernet frame structure, Wireless LAN (802.11)

UNIT – III	NETWORK LAYER	9 Periods

Network Layer: Network architecture and performance: Network topology; Router architecture: queueing and switching. Performance evaluation of a network link: traffic characteristics, performance measures, Kendall's notation. IP Protocol: - Need for an Internet address, and its design. Hierarchical IP addressing, Subnetting, IPv4 and IPv6, structure of IP datagram, IP forwarding. Routing protocols: Link state routing. Distance vector routing: count-to-infinity, routing convergence. Structure of the Internet: end-user organizations and ISPs. difference between intra-domain (OSPF) and inter-domain (BGP) routing, Congestion Avoidance in Network Layer

UNIT – IV	TRANSPORT LAYER	9 Periods

Transport Layer: Importance of the transport layer; end-to-end principle. Transport layer protocols: TCP and UDP, process-to process delivery, multiplexing, port numbers, header structure - Reliable transmission of packets over an unreliable network: sequence numbers, ACKs, timeout, retransmissions. Stop and wait, and sliding window - TCP connection setup and teardown - Flow control and congestion control at the transport layer. Differences between the two. Overview of TCP congestion control: Slow start and reaction to timeouts - TCP congestion control: Slow start; congestion avoidance using loss-based and delay-based control. Introduction to Quality of services (QOS).

UNIT – V	APPLICATION LAYER	9 Periods

Application Layer: Internet names, how DNS works, Application layer protocols: HTTP, SMTP, SNMP, web applications. Security attacks and defences: DMZ, firewalls. Peer-to-peer applications. P2P file distribution. Audio and video streaming. Challenges of streaming over best effort IP

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1	A.S. Tanenbaum and D.J. Wetherall, **"*Computer Networks"*,** 5th edition, Pearson, 2013.
2	J.F. Kurose and K.F. Ross, **"*Computer networking: a top-down approach"***, 6th edition, Pearson, 2017.

REFERENCES:

1	Larry L. Peterson, Bruce S. Davie, ***"Computer Networks: A Systems Approach",*** Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
2	William Stallings, ***"Data and Computer Communications",*** Eighth Edition, Pearson Education, 2011.
3	*Behrouz A. Forouzan and Firouz Mosharraf,* ***"Computer Networks a Top Down Approach",*** *Tata McGraw-Hill, 2011.*
4	R. Jain, **"*The art of computer systems performance analysis",*** Wiley India, 1991
5	S.K. Bose, **"*An Introduction to Queueing Systems",*** Springer Science + Business Media New York, 2012

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Summarize layering as a means of tackling complexity, layering applied to the Internet	K2
CO2	Explain protocols as a structured means of reliable communications	K3
CO3	Explain the architecture principles that have enabled the orders of magnitude expansion of the Internet	K3
CO4	Explain networked applications and their protocols, their installation, operation and performance tuning	K3
CO5	Choose the required functionality at each layer for a given application and trace the flow of information from one node to another node in the network.	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	1	-	-	-	-	2	2
CO2	2	2	2	2	-	-	-	1	-	-	-	-	2	2
CO3	2	2	2	2	-	-	-	1	-	-	-	-	2	2
CO4	2	2	2	2	-	-	-	1	-	-	-	-	2	2
CO5	2	3	3	3	-	-	-	1	-	-	-	-	3	2
22IPC509	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**2**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.2.1, 2.1.1, 2.1.2, 3.1.1, 3.1.2, 4.1.1, 4.2.1, 8.1.1
CO2	1.1.1, 1.2.1, 2.1.1, 2.1.2, 3.1.1, 3.1.2, 4.1.1, 4.2.1, 8.1.1
CO3	1.1.1, 1.2.1, 2.1.1, 2.1.2, 3.1.1, 3.1.2, 4.1.1, 4.2.1, 8.1.1
CO4	1.1.1, 1.2.1, 2.1.1, 2.1.2, 3.1.1, 3.1.2, 4.1.1, 4.2.1, 8.1.1
CO5	1.1.1, 1.2.1, 2.1.1, 2.1.2, 2.3.1, 3.1.1, 3.1.2, 3.4.1, 4.1.1, 4.2.1, 4.2.2, 8.1.1

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	20	40	5	5	-	100
Assignment 2	30	20	30	10	5	5	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPC510	THEORY OF COMPUTATION *(Common to CSE and IT)*	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	1	0	4

Course Objectives	Understand the foundations of computation including grammars, formal languages, Automata and Turing machines.	
UNIT – I	**INTRODUCTION TO FORMAL LANGUAGES AND FINITE AUTOMATA**	**9+3 Periods**
Introduction to Formal Languages, Grammars and Automata; Types of Grammars - Chomsky's hierarchy of languages, Regular Languages and Regular Expressions, Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA), Non-deterministic Finite Automata with Epsilon transitions, Conversion of NFA into DFA, DFA Minimization.		
UNIT – II	**REGULAR LANGUAGES, CONTEXT FREE GRAMMARS AND NORMAL FORMS**	**9+3 Periods**
Kleene's theorem - Equivalence of Regular Expressions and Finite Automata, Myhill-Nerode Theorem, Moore and Mealy machines and its equivalence, Closure properties of Regular Languages, Pumping Lemma for regular languages. Context-Free Grammar (CFG) and Languages, Derivations and Parse trees, Ambiguity in grammars and languages, Normal forms for CFG, Simplification of CFG, Chomsky Normal Form (CNF) and Greibach Normal Form (GNF)		
UNIT – III	**CONTEXT FREE LANGUAGES AND PUSHDOWN AUTOMATA**	**9+3 Periods**
Closure properties of Context Free Languages, Pumping lemma for CFL, Ogden's Lemma, Push Down Automata (PDA), Languages of pushdown automata, Equivalence of pushdown automata and CFG-CFG to PDA-PDA to CFG, Deterministic Pushdown Automata.		
UNIT – IV	**TURING MACHINES**	**9+3 Periods**
Turing Machines, Language of a Turing Machine, Turing Machine as a Computing Device, Modifications of Turing Machines, Two-way Infinite Tape, Equivalence of One Way Infinite Tape and Two-way Infinite Tape Turing Machines, Multi Tape Turing Machines, Nondeterministic Turing machine, Universal Turing machines.		
UNIT – V	**RECURISVE, RECURSIVELY ENUMERABLE PROBLEMS AND UNDECIDABILITY**	**9+3 Periods**
Recursive and recursively enumerable languages, Properties, Reducibility Theory, Rice Theorem for Recursive and Recursively Enumerable Languages, Halting Problem and undecidability, Post's Correspondence Problem (PCP), Modified Post Correspondence Problem.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOKS:

1	*John C Martin, **"Introduction to Languages and the Theory of Computation"**, 4th Edition, Tata McGraw Hill, 2015.*

REFERENCES:

1	*Harry R Lewis and Christos H Papadimitriou, **"Elements of the Theory of Computation"**, 2nd Edition, Prentice Hall of India, 2015.*
2	*Peter Linz, **"An Introduction to Formal Language and Automata"**, 6th Edition, Jones & Bartlett, 2016.*
3	*Michael Sipser, **"Introduction to Theory of Computation"**, Third Edition, Cengage learning, 2013.*
4	*Adam Brooks Webber, **"Formal languages: a practical introduction"**, Jim Leisy, 2008.*
5	*Hopcroft J.E., Motwani R. & Ullman J.D., **"Introduction to Automata Theory, Languages and Computations"**, 3rd Edition, Pearson Education, 2008.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Write Regular Expression/Context free grammar for the given language	K2
CO2	Construct Automata/Turing Machines for the given language	K3
CO3	Explain the properties of Regular/Context Free/Recursive/Recursively Enumerable languages	K1
CO4	Use Pumping lemma	K2
CO5	Identify and prove the given problem is un-decidable using reducibility theory	K3

Course Articulation Matrix														
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	2	2	3	-	-	-	-	-	-	1	-	1	2	1
CO2	2	2	3	-	-	-	-	-	-	1	-	1	2	1
CO3	2	2	-	-	-	-	-	-	-	1	-	1	2	1
CO4	2	2	3	-	-	-	-	-	-	1	-	1	2	1
CO5	2	2	3	-	-	-	-	-	-	1	-	1	2	1
22IPC510	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**1**
1– Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	2.1.1, 2.1.2, 3.1.1, 3.1.2, 1.1.1, 1.1.1
CO2	2.1.1, 2.1.2, 3.1.1, 3.1.2, 1.1.1, 1.1.1
CO3	2.1.1, 2.1.2, 1.1.1, 1.1.1
CO4	2.1.1, 2.1.2, 3.1.1, 3.1.2, 1.1.1, 1.1.1
CO5	2.1.1, 2.1.2, 3.1.1, 3.1.2, 1.1.1, 1.1.1

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	20	40	5	5	-	100
Assignment 2	30	20	30	10	5	5	100
Other mode of internal assessments, if any	30	30	40	-	-	-	100
ESE	30	30	40	-	-	-	100

22IPC511	ARTIFICIAL INTELLIGENCE *(Common to CSE and IT)*	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	The objective of this course is to make the students understand about the importance and need of Artificial Intelligence in solving real world engineering problems.	
UNIT – I	**INTELLIGENT AGENTS**	**9 Periods**
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 Periods**
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 CONSTRAINT SATISFACTION PROBLEM**	**9 Periods**
Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games,Limitations of Game Search Algorithms. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP		
UNIT – IV	**LOGICAL REASONING**	**9 Periods**
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	**PROBABILISTIC REASONING AND GENERATIVE AI**	**9 Periods**
Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in Bayesian network – approximate inference in Bayesian network – causal networks.Understanding Generative AI-Evolution of AI: From rule-based to generative models– Key generative AI models: RNNs, LSTMs, GPT, and more, Popular use cases for generative AI–Introduction to Prompt Engineering-What is prompt engineering and why it matters– Prompt types: explicit, implicit, and creative prompts–Best Practices for Crafting Effective Prompts		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Stuart Russell and Peter Norvig,* ***"Artificial Intelligence – A Modern Approach",*** *Fourth Edition, Pearson Education, 2021.*
2	*Dan W. Patterson,* ***"Introduction to Artificial Intelligence and Expert Systems",*** *Pearson Education,2017*

REFERENCES :

1	*Deepak Khemani,* ***"Artificial Intelligence",*** *Tata McGraw Hill Education, 2016.*
2	*Kevin Night, Elaine Rich, and Nair B.,* ***"Artificial Intelligence",*** *McGraw Hill, 2017.*
3	*Patrick H. Winston,* ***"Artificial Intelligence",*** *Third Edition, Pearson Education, 2016*
4	*Christopher M. Bishop,* ***"Pattern Recognition and Machine Learning",*** *Springer, 2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the role of intelligent agents and associated frameworks.	K2
CO2	Apply problem solving techniques in real world problems.	K4
CO3	Apply game playing and CSP techniques in complex AI problems.	K4
CO4	Summarize logical reasoning techniques	K3
CO5	Evaluate probabilistic reasoning techniques to efficiently handle uncertain environments.	K5

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/Pos	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	3	2	2						2	1	3
CO2	3	3	3	3	2	2						2	1	3
CO3	3	3	3	3	2	2						2	1	3
CO4	3	3	3	3	2	2						2	1	3
CO5	3	3	3	3	2	2						2	1	3
22IPC511	3	3	3	3	2	2						2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3,4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1,3.1.2,3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO5	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40	-	-	-	100
CAT2	10	20	30	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	50	50	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	-	50	50	-	100
ESE	10	20	35	35	-	-	100

22IPC512	OPERATING SYSTEMS	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To understand the basics of OS structure, services, system calls,Virtual Machines, Mobile OS, concepts of Processes management, memory management, mass storage management, Scheduling, Concurrency and Deadlocks	
UNIT – I	**OPERATING SYSTEMS OVERVIEW**	**9 Periods**
Introduction to operating systems – Computer system organization, architecture – Operating system operations – Resource management –security and protection – Distributed systems – Computing Environments – Open- source operating systems – OS services – User operating-system interface – System calls – System services – OS structure – OS generation – System Boot.		
UNIT – II	**PROCESS MANAGEMENT**	**9 Periods**
Process concept, scheduling – Operations on processes – Inter-process communication – Examples - Multicore Programming – Multithreading models – Thread Libraries –Threading issues – OS examples CPU Scheduling: Basic concepts – Scheduling criteria – Scheduling algorithms – Thread scheduling – Multiple processor scheduling – Real Time CPU Scheduling - Operating system examples – Algorithm Evaluation.		
UNIT – III	**PROCESS SYNCHRONIZATION**	**9 Periods**
The critical section problem – Peterson‟s solution – Synchronization hardware – Mutex Locks - Semaphores – Monitors -- Classic problems of synchronization – Critical regions – Deadlocks – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock detection – Recovery from deadlock.		
UNIT – IV	**MEMORY AND STORAGE MANAGEMENT**	**9 Periods**
Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames –Thrashing. Mass Storage system – Disk Structure - Disk Scheduling and Management- I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.		
UNIT – V	**FILE SYSTEM AND VIRTUAL MACHINES**	**9 Periods**
File-System Interface - File concept - Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management;Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Case Study: Linux OS.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, **“Operating System Concepts”**, Edition, John Wiley and Sons Inc., 2018.	10th

REFERENCES:

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",** 7 th Edition, Prentice Hall, 2018
3	Achyut S.Godbole, Atul Kahate, **"Operating Systems",** McGraw Hill Education, 2016.
4	Deitel, Harvey M., Paul J. Deitel, and David R. Choffnes. Operating systems. Delhi. Pearson Education: Dorling Kindersley, 2004.
5	Neil Smyth, **"iPhone iOS 4 Development Essentials - Xcode"**, 4th Edition, Payload media,2011.
6	Andrew S Tanenbaum, **"Modern Operating Systems"**, Pearson, 5th Edition, 2022 New Delhi.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Outline the basic services and functionalities of operating systems	K2
CO2	Apply various CPU scheduling algorithms	K4
CO3	Apply process synchronization mechanisms, deadlock prevention, detection, and recovery schemes	K3
CO4	Apply different memory management schemes and disk management schemes	K3
CO5	Utilize the functionalities of file systems and virtual machines and different operating systems	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	3	3	2
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	2
CO3	3	3	3	3	2	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	2	-	-	-	-	-	-	3	3	2
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	2
22IPC512	3	3	3	3	2	-	-	-	-	-	-	3	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,3.1.1,3.1.2,3.1.3,3.1.4,3.2.1,3.2.2,3.2.3,3.3.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,12.1.1.12.1.2.12.2.1.12.2.2,12.3.1,12.3.2
CO2	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO3	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO4	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO5	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	40	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	40	40	20	-	-	100
ESE	40	40	20	-	-	-	100

22IPC513	ADVANCED PROGRAMMING USING PYTHON	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Python syntax and its flow control, Basic data structures like string, list, tuple, dictionary and set; Advanced data structures like Numpy, data frames; Object oriented concepts of Python; Exception handling, file handling and Web development	
UNIT – I	**CONTROL FLOW STATEMENTS AND BASIC DATA STRUCTURES**	**9 Periods**
Data types, Variables, Operators, Conditional statements, Loops- while, for; Functions- structure, parameters types, return types- single and multiple; packages and modules (modularization) - importing. Strings- indexing, slicing, operators and methods, List- creation, accessing, deleting, updating operations, functions, methods, comprehension, Tuple – creation, accessing, deleting, updating operations, conversion (list/string), methods and functions, Dictionary – accessing, deleting, updating operations methods and functions, sets - accessing, deleting, updating operations methods and functions. Case study – Anagrams, binary search, bubble sort, calendar, color picker, datetime, dictionary, FLAMES, Fibonacci recursion, Hangman, Magic square, guess the word, Montehall.		
UNIT – II	**ADVANCED DATA STRUCTURES IN PYTHON**	**9 Periods**
Numpy - Creating Arrays, Data Type Objects, Numerical Operations Numpy Arrays: Concatenating, Flattening and Adding Dimensions, Numpy: Boolean Indexing, Reading and Writing Data Files. DataFrames - Accessing and Changing values, Pandas - groupby, Reading and Writing Data, Dealing with NaN, Binning in Python and Pandas,Generators and Iterators. Case study – Analysis of graph, Gambling, gmplot, graph, graph edge node, image compression, image transposition, image enhancing, making an image, Numpy matrix operations, Tictactoe.		
UNIT – III	**OBJECT-ORIENTED PARADIGM AND GUI**	**9 Periods**
Classes and Objects, Method overloading and overriding, Data hiding, Data abstraction, Inheritance, copying, and cloning objects. Introduction to GUI, create a web page using GUI functionality. Case study – Rock paper scissor, snake and ladder.		
UNIT – IV	**FILES AND EXCEPTION HANDLING**	**9 Periods**
Files – opening, closing, reading and writing, renaming and deleting, file, and dictionary-related standard functions. Exception handling – introduction, use of finally and else block, raise statement, user-defined exception. Case study - simple web application creation using Python. Case study – time zones, substitution cipher.		
UNIT – V	**WEB DEVELOPMENT**	**9 Periods**
Creating models with SQLAlchemy, Views, Controllers, Securing App, RESTful API, Introduction about PySpark, Deploying and Testing Flask App.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Anuratha A. Puntambekar,* ***"Programming with Python",*** *Technical publications, 1st edition, 2020.*
2	*BerndKlein,* ***"Python Course Data Analysis With Python",*** *Bodenseo, 1st edition, 2021.*
3	*Daniel Gaspar, Jack Stouffer,* **"*Mastering Flask Web Development- Build enterprise-grade, scalable Python web applications*",** packt publishing, 2nd edition, 2018.
4	*https://spark.apache.org/docs/latest/api/python/getting_started/index.html*

REFERENCES :

1	Jeeva Jose, ***"Taming Python by Programming",*** Khanna Book Publishing Company, New Delhi, 1st edition, 2017.
2	Jeeva Jose, ***"Introduction to Computing and Problem Solving with Python",*** Khanna Book Publishing Company, New Delhi, 1st edition, 2016
3	*Case study- (Joy of computing in Python) - https://onlinecourses.nptel.ac.in/*
4	*https://www.udemy.com/course/complete-python-developer-zero-to-mastery/*
5	*https://www.coursera.org/learn/python-crash-course*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the syntax and control flow algorithms.	K2
CO2	Identify and apply the correct data structure for programming.	K3
CO3	Analyze the suitability of Numpy and data frames for organizing data.	K4
CO4	Program and debug object-oriented concepts.	K2
CO5	Handle exceptions in the program and the operations in files	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	3	2	3	1	-	-	-	2	3	1	2	1	3
CO2	2	1	1	2	2	-	-	-	3	2	2	3	1	2
CO3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO4	2	1	3	3	3	-	-	-	3	3	1	1	1	2
CO5	3	3	1	2	2	-	-	-	3	3	2	3	3	2
22IPC513	**3**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**3**	**3**	**1**	**2**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPC514	OPEN SOURCE TOOLS LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	Upon completion of the course, the students will be familiar with implementing Maven, CI/CD, Git operations and Scala programming.

LIST OF EXPERIMENTS

1. Maven Installation and Basics
2. Lifecycle and installation of various plugins in Maven
3. Create multimodule data engineering projects
4. Develop Web application using Maven
5. Scala Installation, conditional structure and looping constructs
6. Execute pattern matching, exception handling, Method creation, functional programming (Closures, Currying, Expressions, Anonymous Functions).
7. Scala Object Orientation (Primary, Auxiliary Constructors, Singleton Objects, Companion Objects), Traits and Abstract classes.
8. Create GitHub account and configure repository settings, versioning and branching
9. Make changes to files in different branches and perform pull requests and merging
10. Create story boards for a sample project
11. Integrate Git with Desktop and Maven
12. Create GitHub repository for CI/CD and configure continuous integration with GitHub Actions
13. Automatedtesting in the CI Workflow and Implement Continuous Deployment (CD)
14. Integration testing and quality gates and handling deployment failures
15. Deployment strategies and pipeline visualization and monitoring

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Implement Maven plugins and multimodule projects using Maven.	K2
CO2	Develop web applications using Maven	K3
CO3	Gain practical experience in Scala programming.	K2
CO4	Create repository and integrate Git with Desktop and Maven	K3
CO5	Configure and implement CI/CD	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	2	3	-	-	-	2	-	-	-	2	1
CO2	3	3	3	3	3	-	-	-	2	-	-	-	2	1
CO3	3	3	3	2	3	-	-	-	3	-	-	-	3	1
CO4	3	3	3	3	3	-	-	-	3	-	-	-	3	1
CO5	3	3	3	3	3	-	-	-	3	-	-	-	3	1
22IPC514	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO2	1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO3	.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO4	1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO5	1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	-	30	20	20	30	100
CAT2	-	-	30	20	20	30	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	30	20	30	20	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	30	20	30	20	100
ESE	40	40	20	-	-	-	100

22IPC515	COMPUTER NETWORKS LABORATORY *(Common to CSE & IT)*	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	The objective of this course is to make the students familiar with Linux and web based tools, Socket programming,NS2/NS3 Simulators

LIST OF EXPERIMENTS

1. (i) Use Linux tools like ifconfig, dig, ethtool, route, netstat, nslookup, and ip to understand the networking configuration of the computer that the student is working on.
   (ii) Install and configure some network applications, e.g. Apache, Bind (DNS)
2. (i) Use Wireshark to capture packets when browsing the Internet. Examine the structure of packets: the various layers, protocols, headers, payload
   (ii) Understand various header fields and their usage in different application layer protocols using Wireshark packet capture
3. Socket programming:
   a. write a simple clientserver program using TCP and UDP sockets
   b. Modify server to handle multiple clients concurrently
4. Measure TCP throughput between two hosts in a network using tools like iperf. Modify TCP configuration parameters. Use the **tc**Linux utility or similar to control bandwidth, delay, loss. Observe impact on measured throughput.
5. Experiment with multiple applications running concurrently to generate congestion: Observe the behaviour of congestion control protocols in NS-2/NS-3, change various network parameters and observe evolution of the TCP congestion window.
6. Use tools like ping and traceroute to explore various Internet paths to popular servers.
7. Use web-based tools like the **whois**utility to query Internet registries, and understand which IP addresses are allocated to the student's network. Find out which are the major ISPs, and which is the ISP of the student's network.
8. Configure a simple mesh network using computers in the lab, or using Mininet. Setup static routes to conform to the desired mesh topology.
9. Use NS-2/NS-3 to simulate a mesh of at least 4 nodes and 3 links to evaluate performance under various conditions
10. Use Linux network tools like ethtool to observe and analyze link layer packet statistics and errors
11. Use NS- 2/NS-3 to simulate medium access protocols. Observe contention, collisions and packet loss in medium access protocols. Observe the working of error detection/recovery mechanisms.
12. Understand the behavior of Wi-Fi using NS-2/NS-3.
13. Simulate transport protocols optimized for data centers in NS-2/NS-3.
14. Use cellphone to measure cellular signal strength (RSS) at various places in the campus. Draw a contour map with cellphone towers and RSS levels. Correlate with upload/download speed using tools like Measurement Lab speed test.
15. Implement a streaming audio/video server using open-source software.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Install and configure network applications	K3
CO2	Write a simple clientserver program using socket programming	K3
CO3	Measure TCP throughput between two hosts in a network using tools	K3
CO4	Use linux/web based tools to understand the network architecture	K3
CO5	Use NS- 2/NS-3 to simulate protocols	K3

COURSE ARTICULATION MATRIX														
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	1	3	1	-	1	-	-	-	-	1	1
CO2	2	2	2	2	2	1	-	1	-	-	-	-	2	2
CO3	2	2	2	2	2	1	-	1	-	-	-	-	2	2
CO4	1	1	1	1	3	1	-	1	-	-	-	-	1	1
CO5	1	1	1	1	3	1	-	1	-	-	-	-	1	1
22IPC515	**2**	**2**	**2**	**2**	**3**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**2**
1– Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 2.1.2, 3.1.1, 4.1.1, 5.1.1, 5.2.1, 5.3.1, 8.1.1
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 3.1.1, 3.2.1, 4.1.1, 4.1.2, 5.1.1, 5.2.1, 8.1.1
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2, 3.1.1, 3.2.1, 4.1.1, 4.1.2, 5.1.1, 5.2.1, 8.1.1
CO4	1.3.1, 2.1.2, 3.1.1, 4.1.1, 5.1.1, 5.2.1, 5.3.1, 8.1.1
CO5	1.3.1, 2.1.2, 3.1.1, 4.1.1, 5.1.1, 5.2.1, 5.3.1, 8.1.1

22IPC516	OPERATING SYSTEMS LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	To use basic Unix commands, shell programming, File allocation and organizations techniques and implement various CPU scheduling, Deadlock Avoidance & Deadlock Detection, Page Replacement algorithms.

LIST OF PROGRAMS:

1. Study of UNIX commands and system calls
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls : Fork, Exit, Getpid, Wait, Close
4. Implement the various CPU Scheduling Algorithms
5. Illustrate the inter process communication strategy
6. Implement mutual exclusion by Semaphore
7. Implement Deadlock avoidance Algorithm and Deadlock Detection Algorithm
8. Implement Threading
9. Implement the paging Techniques
10. Implement the following Memory Allocation Methods
    a. First Fit b. Worst Fit c. Best Fit
11. Implement the various Page Replacement Algorithms
12. Implement the various File Organization Techniques
13. Implement the following File Allocation Strategies
    a. Sequential b. Indexed c. Linked
14. Implement the various disk scheduling algorithms.
15. Install any guest operating system like Linux using VMware

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Implement UNIX Commands and shell programming.	K3
CO2	Compare the performance of various CPU Scheduling Algorithms.	K4
CO3	Compare and contrast various Memory Allocation Methods.	K4
CO4	Implement File Organization and File Allocation Strategies	K3
CO5	Implement various Disk Scheduling Algorithms and installation of guest OS	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	1	2	1	3	2	-	-	1	3	2	3	2	2
CO2	2	3	3	3	3	2	-	-	2	3	2	3	3	2
CO3	2	3	3	3	3	2	-	-	2	3	2	3	3	2
CO4	2	3	3	3	3	2	-	-	2	3	2	3	3	2
CO5	2	3	3	3	3	2	-	2	2	3	2	3	3	2
22IPC516	**2**	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**2**	**3**	**2**	**3**	**3**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1,2.2.2,2.2.3,2.2.4,2.4.3,3.1.1,3.1.2,3.1.3,3.1.4,3.2.1,3.2.2,3.2.3,3.4.2,4.1.1,4.1.2,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,6.2.1,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.3.1,11.3.2, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO2	1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.2.1,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,6.2.1,9.1.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.3.1,11.3.2, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO3	1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.2.1,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,6.2.1,9.1.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.3.1,11.3.2, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO4	1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,6.2.1,9.1.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.3.1,11.3.2,12.1.1, 12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO5	1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.2.1,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.2.1,8.1.1,8.2.2,9.1.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2, 11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2

22IPC617	SOFTWARE ENGINEERING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	Upon completion of the course, the students will be familiar with Software life cycle models and system engineering process and requirement engineering, modelling and design levels of software engineering with the analysis software testing strategies, project management and Test Driven Development concepts.	
UNIT – I	**SOFTWARE PROCESS AND REQUIREMENTS**	**9 Periods**
Introduction – Nature of Software – Software Process – Process models – Prescriptive and Specialized Process Models – Agile Development – Software Process Improvement - Understanding Requirements – Eliciting requirements – Developing Use Cases - Building the Requirements Model – Validating requirements		
UNIT – II	**MODELLING AND DESIGN**	**9 Periods**
Requirements Modeling: Scenario-based, Data, Class- based, Flow oriented, Behavioral models and Patterns - Design process and concepts – Design model – Architectural design – Component level design – User interface design – Pattern Based design.		
UNIT – III	**TESTING AND MANAGEMENT**	**9 Periods**
White Box Testing – Black Box Testing – System Testing – Debugging - Testing Object Oriented and Web based Applications – User interface Testing – Configuration Testing – Security Testing – Performance Testing - Project Management Concepts – Software Process and Project Metrics – Estimation for software projects – Project Scheduling – Risk Management – Software Configuration Management.		
UNIT – IV	**TEST DRIVEN DEVELOPMENT**	**9 Periods**
Introduction Test Driven development – Building Blocks of TDD - Writing effective test cases –TDD in practice - Test doubles and Mocking – Refactoring with confidence – TDD Vs BDD – Testing best practices.		
UNIT – V	**CASE STUDIES**	**9 Periods**
Cucumber/Gherkin – Mockito – TestNG – Jenkins – Phantom JS - Creation of Test cases based on the given use cases and take through the entire TDD cycle.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Roger Pressman.S, Bruce R.Maxim,* ***"Software Engineering: A Practitioner's Approach"****, Nineth Edition , McGraw Hill, 2019*
2	*Saleem Siddiqui,* ***"Learning Test-Driven Development",*** *First Edition, O'ReillyMedia Inc, 2022*
3	*David Astels,* ***"Test Driven Development: A Practical Guide",*** *Prentice Hall, 2003*

REFERENCES:

1	*Ian Sommerville ,* ***"Software Engineering",*** *10th Edition, Pearson Education Asia, 2017.*
2	*Pankaj Jalote,* ***"Software Engineering, A Precise Approach",*** *Wiley India, 2010.*
3	*Shari Pfleeger, Joanne Atlee,* ***"Software Engineering: Theory and Practice",*** *Fourth Edition, Pearson Education, 2010.*
4	*Kent Back,* ***"Test-Driven Development By Example",*** *Addison-Wesley Professional, 2002.*
5	*Stephen R. Schach,* ***"Software Engineering",*** *Tata McGraw-Hill Publishing Company Limited, 2007.*
6	*Ali Behforooz and Frederick J. Hudson,* ***"Software Engineering Fundamentals"*** *Oxford University Press, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Obtain an insight into the concepts of software engineering approaches and elicit the requirements for real-time problems.	K2
CO2	Analyze and resolve information technology problems through the application of systematic	K3
CO3	Apply testing methodologies and tools to estimate the cost of software with the understanding of risk and configuration management.	K3
CO4	Investigate TDD concepts to write effective test cases.	K2
CO5	Create test cases for real world problems	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	2	3	-	-	-	2	-	-	-	2	1
CO2	3	3	3	3	3	-	-	-	2	-	-	-	2	1
CO3	3	3	3	2	3	-	-	-	3	-	-	-	3	1
CO4	3	3	3	3	3	-	-	-	3	-	-	-	3	1
CO5	3	3	3	3	3	-	-	-	3	-	-	-	3	1
22IPC617	3	3	3	3	3	-	-	-	3	-	-	-	3	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	20	30	30	20	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	20	30	30	20	100
ESE	40	40	20	-	-	-	100

22IPC618	MACHINE LEARNING *(Common to CSE & IT)*	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	The objective of this course is to make the students will be familiar with the characteristics of Machine Learning algorithms, Supervised, Unsupervised and Reinforcement learning techniques, probability based learning techniques and graphical models of machine learning algorithms

UNIT – I	INTRODUCTION	9 Periods
Learning – Types of Machine Learning –Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm –Introduction to Machine learning tools		
UNIT – II	**SUPERVISED LEARNING**	**9 Periods**
Statistical decision theory: Regression and classification - Linear Separability – Linear Regression and Locally weighted regression – K Nearest Neighbour learning - Perceptron - Multi-layer Perceptron –Back-Propagation - Support Vector Machines – Decision Trees - Classification and Regression Trees – Random Forests - Different ways to Combine Classifiers – Ensemble Learning – Boosting – Bagging – Evaluation Measures – Multiclass classification		
UNIT – III	**DIMENSIONALITY REDUCTION AND UNSUPERVISED LEARNING**	**9 Periods**
Dimensionality Reduction: Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Unsupervised learning problems-Hierarchical Agglomerative Clustering (HAC)-Single-link, complete-link, group-average similarity- k-Means and Mixtures of Gaussians-Flat clustering, k-Means algorithms-Mixture of Gaussian model		
UNIT – IV	**GRAPHICAL MODELS**	**9 Periods**
Probability and Learning – Data into Probabilities –Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network –EM-algorithm - Markov Random Fields – Hidden Markov Models – Tracking Methods		
UNIT – V	**REINFORCEMENT LEARNING**	**9 Periods**
Reinforcement Learning – Introduction -Elements of Reinforcement Learning – Learning Task – Q-learning – k-armed Bandit Elements – Model-Based learning – Value Iteration – Policy iteration – Temporal Difference Learning - Exploration Strategies – non-deterministic rewards and actions		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	Ethem Alpaydin, ***"Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)",*** Fourth Edition, MIT Press, 2020

REFERENCES:

1	Jason Bell***, "Machine learning – Hands on for Developers and Technical Professionals",*** First Edition, Wiley, 2014
2	Peter Flach, ***"Machine Learning: The Art and Science of Algorithms that Make Sense of Data",*** First Edition, Cambridge University Press, 2012.
3	Stephen Marsland, ***"Machine Learning – An Algorithmic Perspective",*** Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
4	Tom M Mitchell, ***"Machine Learning",*** First Edition, McGraw Hill Education, 2017
5	Trevor Hastie, Robert Tibshirani, Jerome Friedman, ***"The Elements of Statistical Learning",*** Second Edition, Springer, 2017

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Differentiate between supervised, unsupervised, semi-supervised machine learning approaches	K2
CO2	Apply specific supervised or unsupervised machine learning algorithm for a particular problem	K3
CO3	Analyse and suggest the appropriate machine learning approach for the various types of problem	K3
CO4	Design and make modifications to existing machine learning algorithms to suit an individual application	K3
CO5	Provide useful case studies on the machine learning algorithms	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	1	-	-	-	-	-	-	-	-	2	1
CO2	2	2	3	3	-	-	-	-	-	-	-	-	2	1
CO3	2	2	3	3	-	-	-	-	-	-	-	-	2	1
CO4	2	2	3	3	-	-	-	-	-	-	-	-	2	1
CO5	2	2	3	3	-	-	-	-	-	-	-	-	2	1
22IPC618	**2**	**2**	**3**	**3**	**-**	-	-	-	-	-	**-**	**-**	**2**	**1**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 2.1.1, 3.1.1, 4.1.1
CO2	1.1.1, 1.2.1, 2.1.1, 2.2.1, 3.1.1, 3.3.1, 3.3.2, 3.4.1
CO3	1.1.1, 1.2.1, 2.1.1, 2.2.1, 3.1.1, 3.3.1, 3.3.2, 3.4.1
CO4	1.1.1, 1.2.1, 2.1.1, 2.2.1, 3.1.1, 3.3.1, 3.3.2, 3.4.1
CO5	1.1.1, 1.2.1, 2.1.1, 2.2.1, 3.1.1, 3.3.1, 3.3.2, 3.4.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	20	40	5	5	-	100
Assignment 2	30	20	30	10	5	5	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPC619	BIG DATA ANALYTICS	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	Upon completion of the course the students will be familiar with the characteristics of big data, the fundamentals and architecture of Hadoop, enabling informed decisions on when and how to leverage Hadoop's capabilities for efficient distributed computing and big data processing. manage and analyze large-scale structured and semi-structured data efficiently, able to understand the Spark framework that are used for in-memory, fast, scalable architecture for large scale computation and also describe graphs and streaming data in Spark	
UNIT – I	**INTRODUCTION TO BIG DATA**	**9 Periods**
Introduction - Characteristics of Big Data – scalability and parallel processing – Designing data architecture- Data sources, Quality, Preprocessing and storing, Data Storage and analysis- Big Data Analytics Applications and Case studies.		
UNIT – II	**HADOOP FRAMEWORK**	**9 Periods**
Introduction Hadoop- Hadoop and its ecosystem -Hadoop Distributed file system -Mapreduce framework and programming model- Hadoop Yarn- Hadoop ecosystem tools		
UNIT – III	**MAPREDUCE, HIVE AND PIG**	**9 Periods**
Introduction -MapReduce Map tasks, Reduce tasks and MapReduce Execution -Composing MapReduce for calculations and algorithms-Hive -Hive SQL-Pig		
UNIT – IV	**SPARK FRAMEWORK**	**9 Periods**
Introduction -Spark -Introduction to data analysis with spark – Downloading Spark, and Programming using RDD and Mlib-Data ETL- Introduction to Analytics, Reporting and Visualizing		
UNIT – V	**SPARK STREAMING AND GRAPH ANALYTICS**	**9 Periods**
Introduction -Data stream concepts and Data Stream Management -Stream Computing Aspects-Frequent item sets- Realtime Analytics platform (RTAP) spark streaming- Introduction to graph analytics- Graph Model-Graphs- network organization and graph analytics-Graph analytics algorithms and approaches – Spark GraphX platform		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	Raj Kamal, Preethi Saxena, **"Big Data Analytics: Introduction to Hadoop, Spark and Machine learning",** McGrawHill Education (India), 2019.

REFERENCES:

1	Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia, ***"Learning Spark: Lightning*-Fast Big Data Analysis",** O'Reilly Media, 2015
2	Mike Frampton, **"Mastering Apache Spark",** Packt Publishing, 2015
3	Wes McKinney, **"Python for Data Analysis",** O'Reilly Media,2017
4	Donald Miner, Adam Shook, **"Map Reduce Design Pattern",** O'Reilly, 2012
5	NickPentreath, Machine Learning with Spark, Packt Publishing, 2015
6	Mohammed Guller, Big Data Analytics with Spark, Apress,2015

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Discuss the challenges and their solutions in Big Data	K1
CO2	Understand and work on Hadoop Framework and eco systems	K2
CO3	Analyse the Big Data using Map-reduce programming, Hive and Pig	K3
CO4	Analyse the Big Data using Map-reduce programming in Spark framework.	K3
CO5	Demonstrate the graph algorithms and live streaming data in Spark	K3

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	-	-	-	-	-	-	-	-	-	2	1
CO2	3	1	3	3	2	-	1	-	-	-	-	-	2	1
CO3	3	1	3	3	2	-	1	-	-	-	-	-	2	1
CO4	3	1	3	3	2	-	1	-	-	1	-	-	2	1
CO5	3	1	3	3	2	-	1	-	-	1	-	-	2	1
22IPC619	**3**	**1**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**1**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.2.2,2.2.3,2.2.4,2.3.1,2.4.1,2.4.2,2.4.3,3.1.3
CO2	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1, 3.4.2,4.1.1,4.1.2,4.1.3,4.2.1,4.2.2,4.3.1,4.3.25.1.1,5.1.2,5.2.1,5.3.2,7.1.2
CO3	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.3.1,2.4.1,3.1.1, .2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2, 4.1.1,4.1.2,4.1.3,4.2.1,4.2.2,4.3.1,4.3.25.1.1,5.1.2,5.2.1,5.3.2,7.1.2
CO4	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.3.1,2.4.1,3.1.1,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2, 4.1.1,4.1.2,4.1.3,4.2.1,4.2.2,4.3.1,4.3.25.1.1,5.1.2,5.2.1,5.3.2,7.1.2,10.1.2,10.3.1
CO5	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.3.1,2.4.1,3.1.1,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2, 4.1.1,4.1.2,4.1.3,4.2.1,4.2.2,4.3.1,4.3.25.1.1,5.1.2,5.2.1,5.3.2,7.1.2,10.1.2,10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPC620	WEB ESSENTIALS	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	• To learn the basics of websites and web designing and to write and host client side scripts, server side scripts, servlets and databases.	
UNIT – I	**WEBSITE BASICS**	**9 periods**
Internet Overview - Fundamental computer network concepts - Web Protocols -URL – Domain Name- Web Browsers and Web Servers- Working principle of a Website –Creating a Website - Client-side and server-side scripting.		
UNIT – II	**WEB DESIGNING**	**9 periods**
HTML – Form Elements - Input types and Media elements - CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.		
UNIT – III	**CLIENT SIDE PROCESSING AND SCRIPTING**	**9 periods**
JavaScript Introduction – Variables and Data Types-Statements – Operators - Literals-Functions - Objects-Arrays-Built-in Objects- Regular Expression, Exceptions, Event handling, Validation - JavaScript Debuggers.		
UNIT – IV	**SERVER SIDE PROCESSING AND SCRIPTING**	**9 periods**
PHP - Working principle of PHP - PHP Variables - Constants - Operators – Flow Control and Looping - Arrays - Strings - Functions - File Handling - File Uploading – Email Basics - Email with attachments - PHP and HTML - Simple PHP scripts - Databases with PHP.		
UNIT – V	**SERVLETS AND DATABASE CONNECTIVITY**	**9 periods**
Servlets: Java Servlet Architecture – Servlet Life cycle- Form GET and POST actions -Sessions – Cookies – Database connectivity – JDBC - Creation of simple interactive applications - Simple database applications.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	Robin Nixon, ***"Learning PHP, MySQL, JavaScript, CSS & HTML5"*** Third Edition, O'Reilly publishers, 2014.
2	Paul Deitel, Harvey Deitel, Abbey Deitel, ***"Internet & World Wide Web - How to Program",*** 5th edition, Pearson Education, 2012.

REFERENCES :

1	Jeffrey C. Jackson, ***"Web Technologies--A Computer Science Perspective",*** Pearson Education, 2006.
2	James F. Kurose, ***"Computer Networking: A Top-Down Approach",*** Sixth Edition, Pearson Education, 2012
3	Steven Holzener , **"PHP – The Complete Reference",** 1st Edition, Mc-Graw Hill, 2017
4	Fritz Schneider, Thomas Powell, **"JavaScript – The Complete Reference"**, 3rd Edition, McGraw Hill Publishers, 2017.
5	Bates, **"Developing Web Applications",** Wiley Publishers, 2006

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites.	K3
CO2	Create simple PHP scripts	K3
CO3	Design and deploy simple web-applications.	K4
CO4	Create simple database applications.	K3
CO5	Handle multimedia components	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	2	-	-	-	-	-	-	-	2	1
CO2	2	1	1	-	2	-	-	-	-	-	-	-	2	1
CO3	-	2	2	1	3	-	-	-	-	-	-	-	-	2
CO4	-	2	2	1	3	-	-	-	-	-	-	-	-	2
CO5	-	2	2	1	3	-	-	-	-	-	-	-	-	2
22IPC620	**1**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.3.1,2.1.2,2.3.1,2.4.2,2.4.3,3.2.1,3.2.2,5.1.1,5.2.1,5.2.2,5.3.2.
CO2	1.1.1,1.3.1,2.1.2,2.3.1,2.4.2,2.4.3,3.2.1,3.2.2,5.1.1,5.2.1,5.2.2,5.3.2.
CO3	2.1.2,2.2.1,2.2.4,2.4.2,2.4.3,3.1.2,3.1.3,3.2.1,3.2.2,3.4.2,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.2
CO4	2.1.2,2.2.1,2.2.4,2.4.2,2.4.3,3.1.2,3.1.3,3.2.1,3.2.2,3.4.2,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.2
CO5	2.1.2,2.2.1,2.2.4,2.4.2,2.4.3,3.1.2,3.1.3,3.2.1,3.2.2,3.4.2,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	40	30	-	-	-	100
ESE	30	40	30	-	-	-	100

22IPC621	BIG DATA ANALYTICS LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	4	2

Course Objectives	Upon completion of the course, the students will be familiar withHadoop,Hiveand Spark.

LIST OF EXPERIMENTS

1. Explore the data tables (or large Data set) in a data lake.
2. Multimode cloud-based Hadoop cluster with tools (MapReduce, Hive, and MySQL)
3. Create Hive tables with various data types (primitive, collection, array, struct, map).

Load data into Hive tables using different methods and perform data manipulation.

4. Automate HQL queries using shell scripts for efficient execution.
5. Explore advanced table management concepts such as partitioning and repair
6. Practice working with views, joins, and aggregations in Hive
7. Handle distributed cache and create User-Defined Aggregation Functions (UDAFs).
8. Apply Hive to real-world use cases, designing end-to-end solutions using HQL queries and optimizations.
9. Create an RDD from a local collection and a file.
10. Perform transformations and actions on the RDD.
11. Create DataFrames from various data sources.
12. Execute SQL queries on DataFrames.
13. Set up a simple streaming application using Spark Structured Streaming.
14. Apply windowing functions to the streaming data.
15. Integrate Spark with Hadoop and perform operations on HDFS data.
16. Explore various Spark options and their effects on job execution
17. Analyze the Spark application UI to understand job performance
18. Apply performance tuning techniques based on the UI insights
19. Integrate Spark with multiple sources and targets (e.g., databases, file systems).
20. Ingest data, process it, and write the results to various targets.
21. Create a reusable framework for Spark applications.
22. Implement modular components that can be reused across projects.
23. Implement a Software Development Life Cycle (SDLC) for a Spark project.

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Install and configure Hadoop	K3
CO2	Implement a comprehensive big data analytics project utilizing Hadoop to process, analyze, and extract insights from a large dataset.	K3
CO3	Create a Hive table and integrate with Hadoop framework	K3
CO4	Create a simple streaming application using spark structured streaming	K3
CO5	Integrate multiple source and targets with spark	K3

COURSE ARTICULATION MATRIX :														
a) CO and PO Mapping														
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	3	3	2	1	1	-	3	2	2	2	2
CO2	3	2	2	3	3	2	1	1	-	3	2	2	2	2
CO3	3	2	2	3	3	2	1	1	-	3	2	2	2	2
CO4	3	2	2	3	3	2	1	1	-	3	2	2	2	2
CO5	3	2	2	3	3	2	1	1	-	3	2	2	2	2
22IPC621	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**1**	**-**	**3**	**2**	**2**	**2**	**2**
1– Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1..1.2,1.3.1,1.4.1,2.1.1,2.2.3,2.3.1,2.4.2,2.4.4,3.1.2,3.1.5,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3.4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4..3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,7.1.2,8.1.1,10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.3.2,12.1.2,12.2.2,12.3.2,
CO2	1.1.1,1..1.2,1.3.1,1.4.1,2.1.1,2.2.3,2.3.1,2.4.2,2.4.4,3.1.2,3.1.5,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3.4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4..3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,7.1.2,8.1.1,10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.3.2,12.1.2,12.2.2,12.3.2,
CO3	1.1.1,1..1.2,1.3.1,1.4.1,2.1.1,2.2.3,2.3.1,2.4.2,2.4.4,3.1.2,3.1.5,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3.4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4..3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,7.1.2,8.1.1,10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.3.2,12.1.2,12.2.2,12.3.2,
CO4	1.1.1,1..1.2,1.3.1,1.4.1,2.1.1,2.2.3,2.3.1,2.4.2,2.4.4,3.1.2,3.1.5,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3.4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4..3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,7.1.2,8.1.1,10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.3.2,12.1.2,12.2.2,12.3.2,
CO5	1.1.1,1..1.2,1.3.1,1.4.1,2.1.1,2.2.3,2.3.1,2.4.2,2.4.4,3.1.2,3.1.5,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3.4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4..3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,7.1.2,8.1.1,10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.3.2,12.1.2,12.2.2,12.3.2,

22IPC622	WEB ESSENTIALS LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	* Creation of websites * Creation Client side scripts * Creation and hosting of Server side scripts * Development of web applications with databases.

LIST OFEXPERIMENTS

1. Creation of interactive websites
2. Image mapping and cascading style sheets
3. Form validation using javascript
4. Design of a calculator using javascript
5. Simple web application using PHP
6. Simple web application using servlet.
7. Session and cookies management using PHP
8. Session and cookies management using servlet
9. Database connectivity using PHP
10. Database connectivity using servlet.
11. Form validation using AJAX.
12. Retrieval of data from XML stored in web server.
13. Develop an online quiz web application using PHP
14. Develop an online shopping site using servlets

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Design web pages using HTML and DHML	K4
CO2	Write client side scripting.	K4
CO3	Create and deploy server side scripting.	K4
CO4	Develop web applications using PHP and database	K4
CO5	Develop web applications using servlet and database	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	2	1	1	1	3	-	-	-	-	-	-	-	2	1
CO2	2	2	2	2	3	-	-	-	-	-	-	-	2	2
CO3	2	2	2	2	3	-	-	-	-	-	-	-	2	2
CO4	2	2	2	2	3	-	-	-	-	-	-	-	2	2
CO5	2	2	2	2	3	-	-	-	-	-	-	-	2	2
22IPC622	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.3.1,2.1.2,2.3.1,2.4.2,2.4.3,3.2.1,3.2.2,3.3.1,3.4.1,4.1.1,4.1.3,4.3.2,5.1.1,5.2.1,5.2.2, 5.3.1,5.3.2
CO2	1.1.1,1.3.1,2.1.2,2.2.1,2.2.4,2.3.1,2.4.2,2.4.3,3.1.2,3.1.3,3.2.1,3.2.2,3.3.1,3.4.1,3.4.2,4.1.1, 4.1.3,4.2.1,4.3.2,4.3.3,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2
CO3	1.1.1,1.3.1,2.1.2,2.2.1,2.2.4,2.3.1,2.4.2,2.4.3,3.1.2,3.1.3,3.2.1,3.2.2,3.3.1,3.4.1,3.4.2,4.1.1, 4.1.3,4.2.1,4.3.2,4.3.3,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2
CO4	1.1.1,1.3.1,2.1.2,2.2.1,2.2.4,2.3.1,2.4.2,2.4.3,3.1.2,3.1.3,3.2.1,3.2.2,3.3.1,3.4.1,3.4.2,4.1.1, 4.1.3,4.2.1,4.3.2,4.3.3,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2
CO5	1.1.1,1.3.1,2.1.2,2.2.1,2.2.4,2.3.1,2.4.2,2.4.3,3.1.2,3.1.3,3.2.1,3.2.2,3.3.1,3.4.1,3.4.2,4.1.1, 4.1.3,4.2.1,4.3.2,4.3.3,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2

22IES613	DESIGN THINKING FOR INFORMATION TECHNOLOGY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	Upon completion of the course, the students will be familiar with the understanding of the processes that enhances innovation activities and to develop capabilities to identify problems/issues/needs, sound hypotheses, collect and analyze appropriate data with a need to translate broadly defined opportunities into actionable innovation possibilities.

LIST OF EXPERIMENTS

1. Design a mind map for design thinking process.
2. Conduct survey and identify the problem by either individual or group and frame a problem statement.
3. Identify demographic or focus group for problem statement and create persona and explicitly define the characteristics of persona.
4. Build a customer journey map (CJM) for any mock scenario or persona created during last experiment and frame 2-3 questions using HMW (How Might We) tool(CJM-Before- During-After)
5. Design service blueprint and identify touch points from previously designed CJM.
6. Construct empathy map for a given case study.
7. Story boarding design ideas: Consider a scenario and create user stories and storyboards to transform information about user needs into design concepts.
8. Take product/system to be designed from previously framed problem statement from experiment 2 and apply Combine, Rearrange and Enhance triggers in CREATE (Combine, Rearrange, Enhance, Adapt, Turnaround, Eliminate) tool. Draw product/system after applying triggers.
9. Develop a function map for persona designed from experiment 3 or any mock scenario.
10. Identify the components to establish a banking system/company etc., through zap your logical brain and list the possible scenarios to analyze the components using what-if tool.
11. Make a paper prototype for user testing.
12. Create an application prototype for product recommendation using Marvel POP software or FIGMA
13. Development of 3D prototype for kids' toys using 3D tinker Cad or fusion 360.
14. Identify customer challenges for real world problems and enhance customer experience with the use of design thinking.
15. Design Thinking using sprint base software.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 3 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Investigate the requirements of a problem by conducting surveys.	K3
CO2	Create meaningful and actionable problem statements for creative problem solving.	K3
CO3	Construct blueprints to visualize user attitudes and behavior of gaining insights of customers.	K3
CO4	Design prototypes of innovative products or services for a customer base.	K3
CO5	Develop relevant products or services by choosing good design and applying empathy tools for experiencing user requirements.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	-	1	-	2	-	-	-	2	-	-	-	3	2
CO2	-	-	-	-	2	3	-	2	-	1	2	-	3	2
CO3	3	-	1	-	2	-	-	-	2	-	-	-	3	2
CO4	3	-	1	-	-	-	-	2	-	3	3	2	3	2
CO5	-	-	-	-	-	-	-	-	-	3	-	-	3	2
22IES613	**3**	**-**	**1**	**-**	**2**	**3**	**-**	**2**	**2**	**3**	**3**	**2**	**3**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 3.1.1, 5.1.1, 5.1.2, 9.1.1, 9.1.2, 9.2.1
CO2	5.2.1, 5.2.2, 6.1.1, 6.2.2, 8.1.1, 8.2.1, 10.1.1, 10.1.2, 11.1.1, 11.1.2
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 3.1.2, 3.1.3, 5.1.2, 5.2.1, 9.1.1, 9.1.2, 9.2.1
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 3.1.2, 3.1.3, 8.1.1, 8.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2
CO5	10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2

22IHS706	INDUSTRIAL MANAGEMENT AND ECONOMICS *(Common to EIE, CSE & IT)*	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HS	3	0	0	3

Course Objectives	1. To understand the role of ergonomics in organizational setting. 2. To understand the important legislations that govern organizational management. 3. To understand the microeconomic concepts and it's impact on engineering decisions and everyday life activities. 4. To understand the macroeconomic concepts and it's impact on organizations and everyday life activities. 5. To understand the role of stock markets and taxation on individual consumers and organizations.	
UNIT – I	**INDUSTRIAL MANAGEMENT**	**9 Periods**
Meaning, Scope, Importance, Evolution & growth, Need, Ergonomics – Need at Workplace, Reasons for importance, Benefits, Hazards of non-ergonomically designed workplace, Principles of ergonomics, Ergonomic Assessment Software Safety Culture – An Introduction.		
UNIT – II	**INDRODUCTION TO THE PROVISIONS OF LEGISLATIONS GOVERNING INDUSTRIES IN INDIA**	**9 Periods**
Factories Act, Employees State Insurance Act, Workmen's Compensation Act, Sexual Harassment of women at workplace (Prevention, Prohibition & Redressal) Act.		
UNIT – III	**MICROECONOMICS**	**9 Periods**
Definition, Scope, Differences with macro economics, Demand – Definition, Law of Demand, Demand Schedule, Exceptions to Law of Demand, Factors affecting demand, Elasticity of demand Supply – Definition, Law of Supply, Supply Schedule, Factors affecting supply, Elasticity of Supply.		
UNIT – IV	**MACROECONOMICS**	**9 Periods**
Definition, Scope, Money – Evolution, Types, Functions, Reserve Bank of India – Definition, Functions – Credit control measures, Commercial banks – Definition, Need, Functions, Types of deposits, Types of loans, Inflation & Deflation – Definitions, Types, Methods of controlling inflation and deflation, Impact of inflation and deflation on different segments of people.		
UNIT – V	**KEY ECONOMIC INDICATORS**	**9 Periods**
Gross Domestic Product, Unemployment, Stock Market trends, Taxation.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Kiran U.V* ***, "Fundamentals of Ergonomics,"*** *JTS Publications, 2020*
2	*Gupta C.B, Sultan, "****Management Theory and Practice,"*** *Chand and Sons, 2021*
3	*Gaurav Jain, "****Microeconomics,"*** *Neoblocks and Printers Private Limited, 2017*
4	*Gaurav Jain, "****Macroeconomics,"*** *Ajmer Graphics, 2019*

REFERENCES:

1	*Bridger, "****Introduction to Human Factors and Ergonomics,"*** *Taylor & Francis publishers, 2017*
2	*Koontz &Weihrich, "****Elements of Management"*** *McGraw Hill, 2020*
3	*Bright David, "****Principles of Management,"*** *Open Stax Textbooks, 2022*
4	*Robert Pindyck & Daniel, Rubinfeld, "****Microeconomics,"*** *Pearson Education, 2017*
5	*G.S.Gupta, "****Microeconomics – Theory and Applications,"*** *McGraw Hill Education, 2017*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Establish ergonomical workspaces and enhance productivity.	K3
CO2	Implement the statutory requirements for a safe workplace.	K4
CO3	Understand the impact of microeconomics concepts on individual behavior.	K2
CO4	Understand the interplay between the economics cycles, business performance and engineering decisions.	K2
CO5	Implement appropriate financial decisions that would contribute to the country's GDP and also suit the taxation policies in practice from time to time.	K4

COURSE ARTICULATION MATRIX :

a)CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PSO 3
CO1	-	-	3	-	-	3	3	-	-	-	2	-	-	-	1
CO2	-	-	-	-	-	3	-	3	2	-	-	1	-	-	1
CO3	-	-	-	-	-	-	2	-	-	-	3	-	-	-	1
CO4	-	-	2	-	3	-	-	-	-	-	-	-	-	-	1
CO5	-	-	-	2	-	-	-	-	-	-	1	-	-	-	1
22IHS706	-	-	1	1	1	2	1	1	1	-	2	1	-	-	1

b) CO and Key Performance Indicators Mapping	
CO1	3.1.3, 3.1.5, 3.4.1, 3.4.2, 6.1.1, 7.1.2, 11.2.1
CO2	6.2.1, 8.2.2, 9.1.1, 9.2.4, 12.1.2, 12.3.1
CO3	7.1.1, 11.1.1, 11.2.1
CO4	3.3.1, 3.4.1, 5.1.2, 5.2.2, 12.3.1, 12.3.2
CO5	4.3.2, 4.3.4, 11.1.1, 11.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	20	40	40	-	-	100
CAT2	-	20	40	40	-	-	100
Individual Assessment 1 /Case Study 1 /Seminar 1/ Project 1	-	-	50	50	-	-	100
Individual Assessment 2 /Case Study 2 /Seminar 2/ Project 2	-	-	50	50	-	-	100
ESE	-	20	50	30	-	-	100

22IPC723	INTERNET OF THINGS	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	Upon completion of the course, the students will be familiar with the understanding of the basic IoT concepts and architectures with the analysis of IoT design principles, data analytics, computing and exploring the technologies of sensors, actuators and security with IoT applications.	
UNIT – I	**INTERNET OF THINGS: AN OVERVIEW**	**9 Periods**
Internet of Things – IoT Conceptual Framework – IoT Architectural View – Technology behind IoT – Sources of IoT – M2M Communication – Examples of IoT		
UNIT – II	**DESIGN PRINCIPLES**	**9 Periods**
IOT/M2M Systems Layers and Design Standardisation – Communication Technologies – Web and Message Communication Protocols for Connected Devices – Web Connectivity for Connected Devices Network using Gateway, SOAP, REST, HTTP RESTful and Websockets – Internet Based Communication – IP Addressing – Media Access Control – Application Layer Protocols		
UNIT – III	**DATA ANALYTICS AND COMPUTING**	**9 Periods**
Data Acquiring and Storage – Organising the Data – Transactions, Business Processing, Integration and Enterprise Systems – Analytics – Cloud Computing Paradigm for Data Collection storage and Computing – IOT cloud-based services using Xively, Nimbits and other platforms.		
UNIT – IV	**SENSORS AND PROTOTYPING**	**9 Periods**
Sensor Technology – Actuator – Sensor Data Communication Protocols – Prototyping Embedded Device Software – Prototyping online component APIs and Web APIs.		
UNIT – V	**SECURITY AND APPLICATIONS**	**9 Periods**
Vulnerabilities – Security Requirements and Threat Analysis - IoT Security Tomography and Layered attacker model – Identity management and Establishment, Access Control and Secure message communication - Applications for Smart Homes, Cities, Environment Monitoring and Agriculture Case Study: Smart city streetlights control and monitoring.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Raj Kamal,* ***"Internet of Things: Architecture and Design Principles",*** *1st edition, McGraw Hill Education, May 2017*

REFERENCES :

1	*David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry,* ***"IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things",*** *Cisco Press, 2017.*
2	*Arshdeep Bahga, Vijay Madisetti,* ***"Internet of Things – A Hands-on Approach",*** *Universities Press, 2015.*
3	*Jan Holler et al.,* ***"From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence"****, Elsevier, 2014.*
4	*Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds),* ***"Architecting the Internet of Things",*** *Springer, 2011.*
5	*Olivier Hersent, David Boswarthick, Omar Elloumi ,* ***"The Internet of Things – Key applications and Protocol",*** *Wiley, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the concept of IoT	K2
CO2	Analyze the design principles of IOT	K3
CO3	Explore data analytics and Computing	K3
CO4	Understand sensor technology and prototyping software	K2
CO5	Apply security techniques in building an IOT application	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	2	3	-	-	-	2	-	-	-	2	1
CO2	3	3	3	3	3	-	-	-	2	-	-	-	2	1
CO3	3	3	3	2	3	-	-	-	3	-	-	-	3	1
CO4	3	3	3	3	3	-	-	-	3	-	-	-	3	1
CO5	3	3	3	3	3	-	-	-	3	-	-	-	3	1
22IPC723	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO2	1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO3	.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO4	1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3
CO5	1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 9.2.2, 9.2.3

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	20	30	30	20	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	20	30	30	20	100
ESE	40	40	20	-	-	-	100

22IPC724	FULL STACK WEB DEVELOPMENT	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Frontend Architecture, Databases and storage, API and security, JavaScript, App deployment.	
UNIT – I	**BASICS OF FULL STACK**	**9 Periods**
Understanding the Basic Web Development Framework -User -Browser –Webserver -Backend Services – MVC Architecture -Understanding the different stacks –The role of Express –Angular –Node –Mongo DB – React		
UNIT – II	**NODE JS**	**9 Periods**
Basics of Node JS –Installation –Working with Node packages –Using Node package manager –Creating a simple Node.js application –Using Events –Listeners –Timers -Callbacks –Handling Data I/O –Implementing HTTP services in Node.js		
UNIT – III	**MONGO DB**	**9 Periods**
Understanding NoSQL and MongoDB –Building MongoDB Environment –User accounts –Access control – Administering databases –Managing collections –Connecting to MongoDB from Node.js –simple applications		
UNIT – IV	**EXPRESS AND ANGULAR**	**9 Periods**
Implementing Express in Node.js -Configuring routes -Using Request and Response objects -Angular - Typescript -Angular Components -Expressions -Data binding -Built-in directives.		
UNIT – V	**REACT**	**9 Periods**
MERN STACK –Basic React applications –React Components –React State –Express REST APIs - Modularization and Webpack -Routing with React Router –Server-side rendering		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*Brad Dayley, Brendan Dayley, Caleb Dayley, "**Node.js, MongoDB and Angular Web Development**", Addison-Wesley, Second Edition, 2018*
2	*Vasan Subramanian, "**Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node**", Apress, 2nd Edition, 2019.*

REFERENCES:

1	*Chris Northwood, "**The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer**", Apress; 1st edition, 2018*
2	*Kirupa Chinnathambi, "**Learning React: A Hands-On Guide to Building Web Applications Using React and Redux**", Addison-Wesley Professional, 2nd edition, 2018*
3	*https://www.coursera.org/specializations/full-stack-react5.*
4	*https://www.udemy.com/course/the-full-stack-web-development/*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the various stacks available for web application development	K2
CO2	Use Node.js for application development	K3
CO3	Develop applications with MongoDB	K6
CO4	Use the features of Angular and Express	K2
CO5	Develop React applications	K6

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	1	1	1	1	1
CO2	3	3	3	3	2	-	-	-	2	0	2	3	2	2
CO3	3	3	2	2	2	-	-	-	2	2	2	3	2	1
CO4	3	3	2	2	2	-	-	-	1	1	2	2	2	1
CO5	3	3	3	3	3	-	-	-	1	1	2	2	2	1
22IPC724	**3**	3	2	2	2	-	-	-	1	1	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IMC7Z2	CONSTITUTION OF INDIA *(Common to all Branches)*	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	MC	3	0	0	0

Course Objectives	*The objective of the course is to familiarize the students on the role, powers and functions of Indian government. Also understand the recent acts in India.	
UNIT- I	**INTRODUCTION AND EMERGENCY PROVISIONS**	**9 Periods**
Historical Background: The Company rule, The Crown rule - Constituent Assembly: Composition, Objectives - Preamble and Salient features of the Indian Constitution - Fundamental Rights, Fundamental Duties, Directive Principles of state policy, Emergency Provisions - National Emergency, President Rule, Financial Emergency.		
UNIT- II	**SYSTEM OF GOVERNMENT**	**9 Periods**
Parliamentary system: merits, demerits, reasons for adopting parliamentary system – Federal system: Evaluation of federal features – Centre-State relations: Legislative, Administrative and Financial relations – Local Government: Panchayat Raj and urban local government.		
UNIT- III	**UNION AND STATE GOVERNMENT**	**9 Periods**
President of India: Election, Powers and functions - Prime Minister and Cabinet: Structure and functions – Governor: Powers and functions - Chief Minister and Council of Ministers: Functions.		
UNIT- IV	**ORGANS OF GOVERNANCE AND RECENT ACTS**	**9 Periods**
Parliament: Lok Sabha and Rajya Sabha, Composition and powers - State Legislative Assembly and Legislative Council: Composition and powers - Judicial System in India: Structure and features - Supreme Court and High Court: Composition, Jurisdiction, Recent acts in significance-RTI, Citizenship act, POCSO act.		
UNIT- V	**POLITICAL DYNAMICS**	**9 Periods**
Political parties: Party system, Recognition of National and State parties – Elections: Electoral system and reforms – Pressure groups – National Integration: Obstacles, National Integration Council – Foreign Policy: Principles and Objectives.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Period**		

TEXT BOOK:

1	*National portal of India, "**The Constitution of India**" (Full Text), https://legislative.gov.in/constitution-of-india*
2	*Dr.B.R.Ambedkar, "**The Constitution of India**", SudhirPrakashan, 2020*

REFERENCES:

1	*Durga Das Basu, "**Introduction to the Constitution of India**, LexisNexis, 2022*
2	*P.M.Bakshi, "**The Constitution of India**", LexisNexis, 2020*
3	*Subash C Kashyap, "**Our Parliament**", National Book Trust, 2021*
4	*Subash C Kashyap, "**Our Political System**", National Book Trust, 2011*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Know the evolution of Indian Constitution and its basic premises.	K1
CO2	Explain the system of governance in India.	K2
CO3	Describe the structure of Union and State Governments	K2
CO4	Obtain the knowledge of functions of Legislature and Judiciary	K1
CO5	Know the political system of India	K1

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PSO 2**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	-	1	1	-	-	-	-	1
CO3	-	-	-	-	-	2	-	1	1	-	-	-	-	1
CO4	-	-	-	-	-	1	-	1	2	-	-	-	-	1
CO5	-	-	-	-	-	2	-	2	1	-	-	-	-	1
22IMC7Z2	-	-	-	-	-	**2**	-	**1**	**1**	-	-	-	-	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping

CO1	6.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.1.2
CO2	6.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.1.2
CO3	6.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2
CO4	6.1.1, 6.2.2, 9.1.2, 9.2.1
CO5	6.2.2, 8.1.1,8.2.2, 9.1.2, 9.2.1

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	50	50		-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	50	50	-	-	-	-	100

22IPC725	FULL STACK WEB DEVELOPMENT LABORATORY	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	Upon completion of this course, the students will be familiar with, Full stack applications with a clear understanding of user interface, business logic, and data storage; Design and development of user interface screens for a given scenario; Functionalities of web components as per the requirements; Implementation of the database according to the functional requirements; The integration of the user interface with the functionalities and data storage.

List of Experiments

The Instructor can choose the technology stack to develop the following full stack experiments –based on the Full Stack Web Development Theory Course.

1. Design and Develop a portfolio website user interface.
2. Create a database related to the portfolio user interface and access, retrieve, store, and modify the content passed from the user interface running in the web browser.
3. Include login user interface(Sign up/ login) and authorize the user through database. Connect the portfolio user interface once the login is successful.
4. Display the portfolio for yourself which gives details about yourself for a potential recruiter from the database
6. Create a web application to manage the TO-DO list of users, where users can log in and manage their to-do items.
7. Create a simple micro-blogging application (like Twitter) that allows people to post their content which can be viewed by people who follow them.
8. Develop a classified web application to buy and sell used products.
9. Develop an online survey application where a collection of questions is available and users are asked to answer any random 5 questions.
10. Create a food delivery website where users can order food from a particular restaurant listed on the website.
11. Develop a leave management system for an organization where users can apply for different types of leave such as casual leave and medical leave. They also can view the available number of days.
12. Develop a simple dashboard for project management where the statuses of various tasks are available. New tasks can be added and the status of existing tasks can be changed to Pending, InProgress, or Completed.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Design full-stack applications with a clear understanding of user interface, business logic, and data storage.	K6
CO2	Design and develop user interface screens	K6
CO3	Implement the functional requirements using the appropriate tool	K3
CO4	Design and develop a database based on the requirements	K6
CO5	Develop a full stack application based on used needs	K6

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	1	3	-	-	-	2	1	1	1	2	2
CO2	3	3	3	2	3	-	-	-	2	1	1	1	2	2
CO3	3	3	3	3	3	-	-	-	2	1	1	1	2	2
CO4	3	3	3	3	3	-	-	-	1	2	1	1	1	2
CO5	3	3	3	3	2	-	-	-	1	1	1	1	2	2
22IPC725	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IEE701	ENGINEERING PROJECTS IN COMMUNITY SERVICE	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	4	2

Course Objectives	To provide an environment where teams of students can exercise their engineering skills by being exposed to realistic systems and customers and at the same time helping their community.

Problem identification – Identifying the issues within the community -Preliminary survey - Preparing a questionnaire, formats and survey forms. - A preliminary survey including the socio-economic conditions of the allotted habitation - Different types of surveys, tools and techniques for collecting the information. - Analysis of collected data and mapping of issues with the solutions available. - Based on the survey and the specific requirements of the habitation, Community Awareness Campaigns – Identifying the factors – Normalization of factors and finding the path way for problem solution – Selection of problem from the community and mapping of issues - Planning for working: Aim, objective and scope, time line - Application of engineering knowledge and tools for solutions

Validation of the solution by supervising the execution of solution - Measuring the attainment of the solution: Feedback from community

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify engineering related problems in the community.	K2
CO2	Analyze and Design different solutions to solve the problems of community.	K4
CO3	Apply economical solution to those problems in the field.	K4
CO4	To understand complexity and ambiguity	K1
CO5	Connections with professionals and community members for learning and career opportunities	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO 2
CO1	-	2	2	-	1	2	1	-	2	-	1	-	1	1
CO2	-	2	2	-	1	2	1	-	2	-	1	-	1	1
CO3	-	2	2	-	1	2	1	-	2	-	1	-	1	1
CO4	-	2	2	-	1	2	1	-	2	2	1	-	1	1
CO5	-	2	2	-	1	2	1	-	2	2	1	-	1	1
22IEE701	**-**	**2**	**2**	**-**	**1**	**2**	**1**	**-**	**2**	**1**	**1**	**-**	**1**	**1**

1– Slight, 2 – Moderate, 3 – Substantial

22IEE803	CAPSTONE PROJECT	SEMESTER VIII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	16	8

Course Objectives	To provide sufficient hands-on learning experience related to the design, development and analysis of suitable process so as to enhance the technical skill sets in the chosen field.

Contents

1. Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, correlation and analysis of data, software development, applied research and any other related activities.
2. Project can be for one or two s
3. Can be individual work or a group project.
4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
5. Carried out inside or outside the university, in any relevant industry or research institution. 6. Publications in the peer reviewed journals / International Conferences will be an added advantage

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints	K2
CO2	Perform literature search and / or patent search in the area of interest	K3
CO3	Conduct experiments / Design and Analysis / solution iterations and document the results.	K4
CO4	Synthesize the results and arrive at scientific conclusions / products / solution	K4
CO5	Document the results in the form of technical report / presentation	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	2	3	3	2	2	3	3	2	3	2	2
CO2	3	3	3	3	3	2	2	2	3	3	2	3	3	3
CO3	3	3	3	3	3	2	2	2	3	3	2	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	2	3	3	2
CO5	2	2	2	3	3	2	1	-	3	3	2	3	2	2
22IEE803	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.2.4,2.3.1,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.2,3.4.2,4.1.1,4.1.2,4.2.2,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,6.1.1,6.2.1,7.1.1,7.2.2,8.1.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO2	1.1.1,1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.2.1,7.1.1,7.2.2,8.1.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO3	1.1.1,1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.2.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.2.1,7.1.1,7.2.2,8.1.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO4	1.1.1,1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.2.1,7.1.1,7.2.2,8.1.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO5	1.3.1,1.4.1,2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.3.1,3.3.2,3.4.2,4.1.1,4.1.2,4.2.1,4.2.2,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.2.1,7.2.2,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2

22IPE$01	EXPLORATORY DATA ANALYTICS (Common to CSE & IT)

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to make students to learn about how to explore and analyze datasets to gain insights, identify patterns, and formulate hypotheses using data visualization, descriptive statistics, data cleaning and preprocessing, dimensionality reduction, and exploratory data mining techniques.	
UNIT–I	**INTRODUCTION TO EDA**	**9 periods**
Exploratory Data Analysis (EDA) Fundamentals – Steps in EDA, Data Types: Numerical Data, Categorical data, Measurement Scales - Comparing EDA with classical and Bayesian Analysis – Software tools for EDA – Visual aids for EDA. Transformation Techniques: Performing data deduplication, replacing values, Discretization and binning, Handling missing data – Traditional methods - Maximum Likelihood Estimation.		
UNIT–II	**EDA USING PYTHON**	**9 periods**
Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations, Basics of Matplotlib and Scikit-learn.		
UNIT – III	**CORRELATION ANALYSIS AND TIME SERIES ANALYSIS**	**9 periods**
Types of analysis: Univariate analysis - bivariate analysis - multivariate analysis – Titanic dataset analysis – Simpson's paradox. Time Series Analysis (TSA): Fundamentals of TSA - Characteristics of TSA – TSA with Open Power System data: Time based indexing, Visualizing time series, Grouping time series data, Resampling time series data.		
UNIT – IV	**PATTERN DISCOVERY**	**9 periods**
Dimensionality Reduction – Linear methods: Principal Component Analysis (PCA), Intrinsic dimensionality, Non-linear methods: Multidimensional Scaling, Self-Organizing Maps. Clustering Algorithms – Spectral, Document clustering, Model based clustering. Data Summarization and Visualization – 1D, 2D Statistical data analysis, contingency tables, Scatter plots, Dot charts, Bar plots.		
UNIT – V	**MODEL DEVELOPMENT AND EVALUATION**	**9 periods**
Types of machine learning - Supervised, Unsupervised, Reinforcement learning. Unified machine learning workflow – Data preprocessing, data preparation, training sets and corpus creation, model creation and training, model evaluation, model selection, model deployment. Case Studies: Retail Sales analysis, Healthcare analytics, Social media engagement analysis, Financial market analysis, Customer churn prediction, E-Commerce Product recommendations, Transportation and Logistics optimization.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Suresh Kumar Mukhiya, Usman Ahmed, **"Hands-On Exploratory Data Analysis with Python"**, 1st Edition, Packt Publishing, 2020 (Units I, III, IV, V).*
2	*Jake Vander Plas, **"Python Data Science Handbook: Essential Tools for Working with Data"**, 1st Edition, O Reilly, 2017 (Unit II).*

REFERENCES :

1	*W.L. Martinez, A.R Martinez, J.L. Solka,**"Exploratory Data Analysis with MATLAB"**, CRC Press, Chapman & Hall Book, 3rd Edition, 2017*
2	*Claus O. Wilke, **"Fundamentals of Data Visualization"**, O'Reilly publications, 2019*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the importance of exploratory data analysis in the data science process	K2
CO2	Work with various open-source data analysis and manipulation tools available in python	K3
CO3	Use Data exploration and visualization techniques for multivariate and time series data.	K4
CO4	Apply exploratory data mining techniques to uncover hidden patterns and relationships in data.	K3
CO5	Apply exploratory data analysis techniques to solve real-world problems in various domains	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	3	3	1	-	-	-	-	-	2	3	3
CO2	3	3	3	3	3	1	-	-	-	-	-	1	3	3
CO3	3	3	3	3	3	1	-	-	-	-	-	1	3	3
CO4	3	3	3	3	3	1	-	-	-	-	-	1	3	3
CO5	3	3	3	3	3	1	-	-	-	-	-	1	3	3
22IPE$01	**3**	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3,2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1,4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 12.1.2, 12.2.1, 12.2.2
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2,2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 12.1.2, 12.2.1, 12.2.2
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2,2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 12.1.2, 12.2.1, 12.2.2
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2,2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 12.1.2, 12.2.1, 12.2.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2,2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 12.1.2, 12.2.1, 12.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	30	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	40	30	30	-	-	100
ESE	30	40	30	-	-	-	100

22IPE$02	RECOMMENDER SYSTEMS *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to cover diverse recommendation systems, including content-based and collaborative filtering, hybrid models and their evaluation strategies.	
UNIT – I	**INTRODUCTION**	**9 periods**
Basic concepts and recent developments – Collaborative recommendation – User based and Item based nearest neighbor recommendation, Rating, Model based and Preprocessing based approaches, Recent practical approaches and systems.		
UNIT – II	**CONTENT AND KNOWLEDGE BASED RECOMMENDATION**	**9 periods**
Content representation and content similarity – Similarity based retrieval, Text classification methods, Knowledge representation, Interacting with constraints based recommender systems - Interacting with Case based recommender systems – Example applications.		
UNIT – III	**HYBRID RECOMMENDATIONS**	**9 periods**
Opportunities for hybridization – Monolithic hybridization design – Parallelized hybridization design – Pipelined hybridization design – Explanations in recommender systems – Explanations in collaborative filtering recommenders		
UNIT – IV	**EVALUATING RECOMMENDER SYSTEMS**	**9 periods**
Properties of evaluations – Popular evaluation designs – Evaluations on historical datasets – Alternative evaluation designs - Case study: Personalized game recommendations on the mobile Internet.		
UNIT – V	**TRUST-AWARE AND CONTEXT AWARE RECOMMENDATION SYSTEMS**	**9 periods**
Trust-aware recommender systems- Folksonomies- Ontological filtering- Extracting semantics from the web- Recommendations in ubiquitous environments- Context-aware recommendation- Application domains.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Dietmar Jannach, Markus Zanker, Alexander Felfernig, and Gerhard Friedrich, "**RecommenderSystems An Introduction**", Cambrige University Press, 2011*
2	*Charu C. Aggarwal, " **Recommender Systems",** Springer, 2016.*

REFERENCES :

1	*Manouselis N, Drachsler H, Verbert K, Duval E, "**Recommender Systems For Learning** ",Springer, 2013*
2	*Ricci F, Rokach L, Shapira D, Kantor B.P, "**Recommender Systems Handbook**" Springer, 2015*
3	*Michael Schrage, "**Recommendation Engines**", MIT Press, 2020.*
4	*NPTEL Course:"**Recommender Systems", Https://onlinecourses.nptel.ac.in/noc24_ge35/preview***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explore fundamental principles and recent advancements in collaborative recommendation systems and recent practical implementations.	K3
CO2	Compare content based recommendations and Knowledge based recommendations	K2
CO3	Identify appropriate hybrid recommendation models for specific underlying applications	K3

CO4	Assess the recommendations based on well-defined metrics	K4
CO5	Explain the concepts behind Trust-aware and context aware recommender systems.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	-	-	2	2	2
CO2	2	2	2	1	1	-	-	-	-	-	-	2	2	2
CO3	2	3	2	1	1	-	-	-	-	-	-	2	2	1
CO4	2	3	2	1	1	-	-	-	-	-	-	2	2	1
CO5	2	2	2	1	2	-	-	1	-	-	-	3	2	1
22IPE$02	**2**	**3**	**2**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.2.2, 4.3.4, 5.2.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1
CO2	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.3.4, 5.2.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1
CO3	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 4.3.4, 5.2.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1
CO4	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.2, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 4.3.4, 5.2.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1
CO5	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.4.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 8.2.2, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	30	50	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	30	50	20	-	-	100
ESE	30	30	40	-	-	-	100

22IPE$03	**DEEP LEARING** *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The Objective of this course is to make the students familiar with Perceptron Learning Algorithms,Feedforward Neural Networks, Deep Neural Networks, Convolution Neural Networks, Recurrent Neural Networks	
UNIT – I	**INTRODUCTON TO DEEP LEARNING**	**9 Periods**
Basics: Biological Neuron, Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.		
UNIT – II	**FEEDFORWARD NETWORKS**	**9 Periods**
Representation Power of Feedforward Neural Networks, Backpropagation, Empirical Risk Minimization, Regularization, Autoencoders.		
UNIT – III	**DEEP NEURAL NETWORKS**	**9 Periods**
Difficulty of training deep neural networks, Greedy layerwise training. Gradient Descent (GD), Stochastic Gradient Descent (GD), Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), Regularization methods (dropout, drop connect, batch normalization).		
UNIT – IV	**CONVOLUTIONAL NEURAL NETWORKS**	**9 Periods**
Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet		
UNIT – V	**RECURRENT NEURAL NETWORKS**	**9 Periods**
Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	Ian Goodfellow and Yoshua Bengio and Aaron Courville., ***" Deep Learnin ",*** MIT Press, 2016

REFERENCES:

1	Raúl Rojas, ***"Neural Networks: A Systematic Introduction ",*** Springer-Verlag, Berlin, 1996.
2	Yegnanarayana, B., ***"Artificial Neural Networks ",*** PHI Learning Pvt. Ltd, 2009
3	Christopher Bishop., ***"Pattern Recognition and Machine Learning ",*** Springer,2016
4	Nikhil Buduma, ***"Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms",*** O'Reilly publications, 2017

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Summarize the basics of neural network and deep learning	K2
CO2	Implement basic neural network model with hidden layers	K3
CO3	Analyze optimization and generalization in deep learning	K3
CO4	Criticize convolutional neural network and how it is applied to analyzing visual imagery	K3
CO5	Appraise Recurrent Neural Network (RNN) and its temporal dynamic behavior which helps us to remembers some information about a sequence to predict the next information	K3

COURSE ARTICULATION MATRIX															
a) CO and PO Mapping															
COs/ Pos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO1	1	1	1	1	-	-	-	-	-	-	-	-	2	1	
CO2	2	2	2	2	1	-	-	-	-	-	-	-	2	1	
CO3	3	3	3	3	2	-	-	-	-	-	-	-	2	1	
CO4	3	3	3	3	2	-	-	-	-	-	-	-	2	1	
CO5	3	3	3	3	2	-	-	-	-	-	-	-	2	1	
22IPE$03	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	
1– Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 2.1.1, 3.2.1, 4.1.1
CO2	1.1.1, 1.2.1, 2.1.1, 2.2.2, 3.1.2, 3.3.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1
CO3	1.1.1, 1.2.1, 1.3.1, 1.3.2, 2.1.1, 2.2.2, 2.2.3, 2.3.1, 3.1.2, 3.3.2, 3.3.3, 3.4.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.2.1, 5.2.3
CO4	1.1.1, 1.2.1, 1.3.1, 1.3.2, 2.1.1, 2.2.2, 2.2.3, 2.3.1, 3.1.2, 3.3.2, 3.3.3, 3.4.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.2.1, 5.2.3
CO5	1.1.1, 1.2.1, 1.3.1, 1.3.2, 2.1.1, 2.2.2, 2.2.3, 2.3.1, 3.1.2, 3.3.2, 3.3.3, 3.4.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.2.1, 5.2.3

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	20	40	5	5	-	100
Assignment 2	30	20	30	10	5	5	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPE$04	TEXT TO SPEECH ANALYSIS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Understand natural language processing basics, text classification, phonetics and retrieve information using question answering and dialogue system.	
UNIT – I	**NATURAL LANGUAGE BASICS**	**9 Periods**
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		
UNIT – II	**TEXT CLASSIFICATION**	**9 Periods**
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 Periods**
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	**PHONETICS**	**9 Periods**
Speech,Sounds and Phonetic Transcription, Articulatory Phonetics, Prosody, Acoustic Phonetics and Signals, Phonetic Resources		
UNIT – V	**AUTOMATIC SPEECH RECOGNITION AND TEXT-TO-SPEECH**	**9 Periods**
The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture, CTC, ASR Evaluation: Word Error Rate, TTS, Other Speech Tasks		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Dipanjan Sarkar,* ***"Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data"****, APress,2018*
2	*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	*Tanveer Siddiqui, Tiwary U S,* ***"Natural Language Processing and Information Retrieval"****, Oxford University Press, 2008*
2	*. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana,* ***"Fundamentals of Speech Recognition"*** *, 1st Edition, Pearson, 2009.*
3	*. Steven Bird, Ewan Klein, and Edward Loper,* ***"Natural language processing with Python"****, O'REILLY.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand natural language processing basics	K2
CO2	Apply classification algorithms to text documents	K3
CO3	Build question-answering and dialogue systems	K2
CO4	Understand speech, sound and phonetics	K2
CO5	Develop a speech recognition system	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	2						2	3	1
CO2	3	3	3	3	2	2						2	3	1
CO3	3	3	3	3	2	2						2	3	1
CO4	3	3	3	3	2	2						2	3	1
CO5	3	3	3	3	2	2						2	3	1
22IPE$04	3	3	3	3	2	2						2	3	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	75	25	-	-	-	100
CAT2	-	-	100	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	75	25	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	-	75	25	-	-	-	100

22IPE$05	BUSINESS ANALYTICS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	• To understand and explore various descriptive, predictive and prescriptive analytics techniques and to understand various applications of analytics in decision making.	
UNIT – I	**INTRODUCTION TO BUSINESS ANALYTICS**	**9 periods**
Evolution of Business Analytics - Descriptive, Predictive, and Prescriptive Analytics - Data for Business Analytics - Models in Business Analytics - Problem Solving with Analytics – database analytics - Data Sets and Databases - Data Queries: Tables, Sorting, and Filtering - Logical Functions - Lookup Functions for Database Queries.		
UNIT – II	**DESCRIPTIVE ANALYTICS**	**9 periods**
Descriptive Statistics - Metrics and Data Classification - Frequency Distributions and Histograms- Computing Descriptive Statistics for Frequency Distributions - Random Variables and Probability Distributions - Discrete Probability Distributions - Continuous Probability Distributions - Data Modeling and Distribution Fitting - Sampling and Estimation - Statistical Inference		
UNIT – III	**PREDICTIVE ANALYTICS**	**9 periods**
Modeling Relationships and Trends in Data - Residual Analysis and Regression Assumptions - Multiple Linear Regression - Forecasting Techniques - Spreadsheet Modeling and Analysis - Model-Building Strategies - Descriptive Spreadsheet Models - Predictive Spreadsheet Models - Prescriptive Spreadsheet Models - Monte Carlo Simulation - Monte Carlo Simulation in Excel - Dynamic Systems Simulation.		
UNIT – IV	**PRESCRIPTIVE ANALYTICS**	**9 periods**
Optimization Models - Developing Linear Optimization Models - Solving Linear Optimization Models - Integer Linear Optimization Models - Nonlinear Optimization Models - Non-Smooth Optimization - What-If Analysis for Optimization Models - What-If Analysis for Integer Optimization Models.		
UNIT – V	**DECISION MAKING**	**9 periods**
Formulating Decision Problems - Decision Strategies without Outcome Probabilities - Decision Strategies with Outcome Probabilities - Decision Trees - The Value of Information - Decisions with Sample Information - Utility and Decision Making.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical:0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*James R. Evans, "**Business Analytics - Methods, models and decisions**", Pearson Education, 3rd Edition, 2020.*

REFERENCES :

1	*R N Prasad, Seema Acharya, "**Fundamentals of Business Analytics"**, Wiley publisher, 2nd Edition, 2016.*
2	*G.Shainesh Philip Kotler, Kevin lane Keller, Alexander Chernev, Jagdish N. Sheth, "**Marketing Management**", Pearson Education,16th Edition,2021.*
3	*KavithaVenkatachari,"**Fundamentals of Business Analytics Using Excel And R: Practical Manual For Beginners**", Shroff Publishers, 2016.*
4	*U. Dinesh Kumar,"**Business Analytics, 2ed: The Science of Data - Driven Decision Making**", wiley publishers, 2nd edition, 2021.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the basics of business analytics	K2
CO2	Apply different descriptive techniques for business analytics	K3
CO3	Apply different predictive techniques for business analytics	K3
CO4	Adopt different prescriptive techniques for business analytics	K4
CO5	Analyze the data to infer decisions using different decision making techniques	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	2	-	2	1	-	-	-	-	-	2	2
CO2	3	2	1	3	-	-	-	-	-	-	-	-	3	2
CO3	3	2	1	3	-	-	-	-	-	-	-	-	3	2
CO4	1	2	1	3	1	-	-	-	-	-	-	-	1	2
CO5	1	1	1	2	1	-	-	-	-	-	-	-	1	1
22IPE$05	**2**	**2**	**1**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.2.3, 2.4.1, 2.4.3, 3.1.2, 3.1.5, 3.1.6, 3.2.3, 4.1.1, 4.2.2, 4.3.3, 4.3.4, 6.2.1, 7.2.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.2.3,2.2.4,2.3.1,2.4.2,2.4.4,3.1.1,3.1.3,3.1.6,4.1.1,4.1.2, 4.1.3,4.1.4,4.3.1,4.3.2,4.3.3
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.2.3,2.2.4,2.3.1,2.4.2,2.4.4,3.1.1,3.1.3,3.1.6,4.1.1,4.1.2, 4.1.3,4.1.4,4.3.1,4.3.2,4.3.3
CO4	1.1.2,2.1.3,2.2.4,2.3.1,2.4.1,2.4.3,3.1.1,4.1.2,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2
CO5	1.1.2.2.1.3.2.2.4,2.3.1,2.4.3,3.1.1,3.1.6,4.1.1,4.1.3,4.1.4,4.2.2,4.3.2,4.3.3,5.1.1,5.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	40	30	-	-	-	100
ESE	30	40	30	-	-	-	100

22IPE$06	IMAGE AND VIDEO ANALYTICS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	• To learn and understand image processing and analysis techniques, video processing techniques, motion estimation algorithms and various techniques for segmentation and tracking for analysis of video data.	
UNIT – I	**FUNDAMENTALS OF IMAGE PROCESSING**	**9 periods**
Introduction – Steps in Image Processing - Applications –Elements of Visual Perception – Image Formation models - Sampling and Quantization – Image Enhancement in spatial and Frequency Domain - Image Transforms: DFT, FFT, DCT		
UNIT – II	**IMAGE SEGMENTATION AND FEATURE EXTRACTION**	**9 periods**
Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification – Object Recognition		
UNIT – III	**VIDEO FUNDAMENTALS**	**9 periods**
Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog to Digital Conversion – Sampling for analog and digital video – Rectangular and periodic 2-D sampling – Video Sampling Rate and Standards Conversion – Digital Video Formats – Video Features.		
UNIT – IV	**MOTION ESTIMATION**	**9 periods**
Fundamentals of Motion Estimation – Optical Flow Methods – 2D and 3D Motion Estimation – Block Based Methods - Point Correspondences Methods – Bayesien Methods –Frequency Domain Motion Estimation.		
UNIT – V	**VIDEO SEGMENTATION AND ANALYTICS**	**9 periods**
Video Segmentation – Video Shot Boundary Detection – Motion Segmentation: Direct and Optical Flow method – Stereo and Motion Tracking – Kalman, Particle Filter based tracking - Multi-target/Multi-camera tracking.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Rafael Gonzalez, Richard E. Woods, "**Digital Image Processing**", Fourth Edition, Pearson Education, 2018.*
2	*A. Murat Tekalp, "**Digital Video Processing**", Second Edition, Prentice Hall, 2015.*

REFERENCES:

1	*Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, **'Digital Image Processing using MATLAB'**, Pearson Education, Inc., 2011.*
2	*Milan Sonka, Vaclav Hlavac, Roger Boyle, "**Image Processing, Analysis and Machine Vision**", Second Edition, Thompson Learning, 2007*
3	*Oges Marques, "**Practical Image and Video Processing Using MATLAB**", Wiley and Sons (IEEE Press), 2011*
4	*Alan C. Bovik, "**Handbook of Image and Video processing"**, Second Edition, Academic Press, 2005*
5	*Al Bovik (Alan C Bovik, "**The Essential Guide to Video Processing**", Academic Press, Second Edition, 2009*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms	K2
CO2	Analyze the various Image segmentation and feature extraction methods	K4
CO3	Analyze and implement the basic video processing algorithms in modern technologies	K4
CO4	Analyze the approaches for identifying and tracking objects and person with motion based algorithms	K4
CO5	Segment video based on its features.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1	1	-	-	-	-	-	-	-	-	2	1
CO2	1	1	1	2	1	-	-	-	-	-	-	-	1	1
CO3	1	1	1	2	1	-	-	-	-	-	-	-	1	1
CO4	1	1	1	2	1	-	-	-	-	-	-	-	1	1
CO5	1	1	1	2	1	-	-	-	-	-	-	-	1	1
22IPE$06	2	1	1	2	1	-	-	-	-	-	-	-	2	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,1.3.1,2.1.1,2.1.2,2.1.3,2.3.1,3.1.6,4.1.1,4.2.2
CO2	1.1.1,2.2.1,2.4.1,2.4.4,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.2,5.1.1
CO3	1.1.1,2.2.1,2.4.1,2.4.4,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.2,5.1.1
CO4	1.1.1,2.2.1,2.4.1,2.4.4,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.2,5.1.1
CO5	1.1.1,2.2.1,2.4.1,2.4.4,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.2,5.1.1

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	40	30	-	-	-	100
ESE	30	40	30	-	-	-	100

22IPE$07	COMPUTER VISION (Common to CSE & IT)

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of the course is to familiarize the basic concepts of camera calibration, Image formation, color models, Filters, Edge detection and Texture, concepts of stereoscopic imaging and Motion analysis, implement Hough Transform and clustering based segmentation, Image Classification, Object detection and Recognition algorithms.	
UNIT – I	**IMAGE FORMATION AND MODELS**	**9 periods**
Image Formation: Geometric Primitives and transformations – Photometric Image Formation – Lighting and Shading - Local Shading Models - Global Shading Models. Color: Human Color Perception - Representing Color – Digital Camera: sampling and aliasing – calibration		
UNIT – II	**EARLY VISION-ONE IMAGE**	**9 periods**
Linear Filters: Linear Filters and Convolution - Shift invariant linear systems - Spatial Frequency and Fourier Transforms – Sampling and aliasing - Filters as Templates - Edge Detection: Estimating Derivatives with Finite Differences - Gradient-based Edge Detectors. Neighborhoods: Build and Description - Texture: Representing Texture - Synthesizing Textures for Rendering –Image Denoising - Shape from Texture.		
UNIT – III	**EARLY VISION-MULTIPLE IMAGES**	**9 periods**
Stereopsis: Binocular Geometry, Reconstruction - Binocular Fusion: Local and Global Methods - Structure and Motion: Euclidean Structure from Two Images and Multiple Images - Affine Structure from Motion - Affine Structure from Two Images and Multiple Images - Affine to Euclidean Images - Affine Motion Segmentation. Projective Structure From Motion: Projective Scene Reconstruction from Two Views - Motion Estimation from Two or Three Views - Motion Estimation from Multiple Views - From Projective to Euclidean Structure and Motion.		
UNIT – IV	**MID-LEVEL VISION**	**9 periods**
Segmentation Using Clustering Methods - Human vision: Grouping and Gestalt -Applications: Shot Boundary Detection, Background Subtraction and Skin Finding - Image Segmentation by Clustering - Segmentation by Graph - Fitting:The Hough Transform -Fitting Lines and planes - Fitting Curves - Fitting to the Outlines of Surfaces .Tracking: Tracking as an Abstract Inference -Linear Dynamic Models and the Kalman Filter - Non-Linear Dynamic Models -Particle Filtering - Data Association.		
UNIT – V	**HIGH-LEVEL VISION**	**9 periods**
Registration: Registering Rigid and Deformable Objects – Smooth surfaces: Elements – Contour Geometry – Range Data: Range data segmentation – Range Image registration - Linear Combinations of Models –Image Classification: Good Image Features – Image classification of single objects –Object Detection using sliding window approach – Recognition: Face Recognition – Category Recognition – context and scene understanding.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*David Forsyth and Jean Ponce* ***"Computer vision: a modern approach"*** *2nd edition, Pearson India Education Services Pvt. Ltd, 2015.*

REFERENCES :

1	*Richard Szeliski,* ***"Computer Vision- Algorithms and Applications",*** *2nd Edition, Springer Science & Business Media, 2022*
2	*Simon J.D. Prince,* ***"Computer Vision - Models, Learning and Inference",*** *Cambridge University Press, 2012.*
3	*ReinhardKlette,* ***"Concise Computer Vision: An Introduction into Theory and Algorithms",*** *Springer, 2014*
4	*E. R. Davies,* ***"Computer & Machine Vision, Fourth Edition",*** *Academic Press, 2012.*
5	*D. L. Baggio et al.,* ***"Mastering OpenCV with Practical Computer Vision Projects",*** *Packt Publishing, 2012*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze and apply low level transformation techniques to image formation and model.	K4
CO2	Apply Filters, Features, Texture and Edge detection techniques to enhance an image	K3
CO3	Analyze 3D Reconstruction and motion estimation techniques using multiple views object.	K4
CO4	Implement Hough Transform for geometric shapes and clustering based segmentation.	K3
CO5	Understand the proper use of shape related cue features for image classification, object detection and recognition.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1	2	1	-	-	-	-	-	-	2	2	2
CO2	2	3	2	2	1	-	-	-	-	-	-	2	2	1
CO3	2	3	2	2	1	-	-	-	-	-	-	2	2	1
CO4	3	3	2	3	1	-	-	-	-	-	-	2	2	1
CO5	2	3	3	3	1	-	-	-	-	-	-	2	2	1
22IPE$07	**2**	**3**	**2**	**2**	**1**	-	-	-	-	**-**	**-**	**2**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3, 2.2.2,2.2.3, 2,3,1, 2.3.2, 2.4.1, 2.4.4, 3.1.4, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 5.1.1, 12.1.1, 12.2.1, 12.2.2,
CO2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2,2.1.3, 2.2.1, 2.2.2,2.2.3, 2.2.4, 2,3,1, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.4, 5.1.1, 5.1.2, 12.1.1, 12.2.1, 12.2.2
CO3	1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.2,2.1.3, 2.2.1, 2.2.3, 2.2.4, 2,3,1, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 12.1.1, 12.2.1, 12.2.2
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2,3,1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 12.1.1, 12.2.1, 12.2.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3, 2.2.1, 2.2.3, 2.2.4, 2,3,1, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 12.1.1, 12.2.1, 12.2.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	30	30	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	30	30	20	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$08	CLOUD COMPUTING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Overview of computing Paradigm; Cloud Computing architecture and its service models; Representation of virtualization concepts; Intensive computation in Cloud computing; Applications and management of cloud computing.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Principles of Parallel and Distributed Computing - Eras of Computing - Parallel vs. Distributed Computing - Hardware Architectures for Parallel Processing - Approaches to Parallel Programming -Levels of Parallelism - Distributed System - Technologies for Distributed Computing – Remote Procedure Call - Distributed Object Frameworks - Service Oriented Computing Cloud Computing Reference Model - Historical Developments - Building Cloud Computing Environments - Application Development - Infrastructure and System Development - Computing Platforms and Technologies.		
UNIT – II	**CLOUD COMPUTING ARCHITECTURE**	**9 Periods**
Introduction - Cloud Reference Model – Architecture - Infrastructure / Hardware as a Service – Platform as a Service - Software as a Service- Types of Clouds - Public Clouds - Private Clouds - Hybrid Clouds - Community Clouds- Open Challenges - Cloud Definition - Cloud Interoperability and Standards -Scalability and Fault Tolerance - Security- Trust- and Privacy – Organizational Aspects.		
UNIT – III	**VIRTUALIZATION**	**9 Periods**
Introduction - Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques - Execution Virtualization - Other Types of Virtualization - Virtualization and Cloud Computing - Pros and Cons of Virtualization - Xen- Paravirtualization- VMware- Full Virtualization - Microsoft Hyper-V; Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.		
UNIT – IV	**DATA-INTENSIVE COMPUTING AND CLOUD PLATFORMS**	**9 Periods**
Characterizing Data-Intensive Computations - Challenges Ahead - Technologies for Data-Intensive Computing - Storage Systems - Programming - Introducing the MapReduce, Hadoop Programming Model- cloud Platforms in Industry - Amazon Web Services - Compute Services (GCP) - Storage Services - Communication Services -Google AppEngine - Microsoft Azure.		
UNIT – V	**APPLICATIONS AND MANAGEMENT OF CLOUD**	**9 Periods**
Scientific Applications- Business and Consumer Applications - Energy Efficiency in Clouds- Energy-Efficient and Green Cloud Computing Architecture- Market-Based Management of Clouds- Market-Oriented Cloud Computing- Reference Model for MOCC- Federated Clouds / Inter Cloud-Characterization and Definition- Cloud Federation Stack- Aspects of Interest- Technologies for Cloud Federations- Third Party Cloud Services.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "**Mastering Cloud Computing**", Tata Mcgraw Hill, 2013.*
2	*James Turnbull, "**The Docker Book**", O'Reilly Publishers, 2014.*

REFERENCES:

1	Rittinghouse, John W., and James F. Ransome, "**Cloud Computing: Implementation, Management and Security**", CRC Press, 2017.
2	*Lizhe Wang, Rajiv Ranjan, Jinjun Chen, and Boualem Benatallah , "**Cloud Computing: Methodology, Systems, and Applications**", CRC Press, 2017.*
3	*George Reese, "**Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)**", O'Reilly, 2009.*
4	*Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "**Distributed and Cloud Computing, From Parallel Processing to the Internet of Things**", Morgan Kaufmann Publishers, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the characteristics and properties of Cloud computing.	K1
CO2	Analyze the architecture of the Cloud computing stack.	K4
CO3	Differentiate between full and paravirtualization.	K2
CO4	Design map-reduce programming model.	K4
CO5	List the applications of the Cloud.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO2	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO3	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO4	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO5	2	1	2	2	1	1	2	-	-	-	-	1	2	1
22IPE$08	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPE$09	APP DEVELOPMENT (Common to CSE & IT)

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of the course the students will be familiar with the basic concepts of DART programming language, the development process of mobile application framework and able to develop simple mobile application using Flutter able to collect and analyze data from mobile applications, using tools such as Google Analytics and Firebase, and use the insights to improve the app's performance, usability, and user engagement, able to understand the major mobile platforms,deploy mobile applications to the target platform, following best practices for distribution, monetization, and app store optimization.	
UNIT – I	**PROGRAMMING DART**	**9 Periods**
Creating a DART project - main function – variables – data types – conditionals – loops – functions – object-oriented programming – objects – classes – constructors - inheritance – abstract class - DART project structure and libraries		
UNIT – II	**INTRODUCTION TO FLUTTER**	**9 Periods**
Flutter framework – Installing Android Studio – Installing and Configuring Flutter SDK – Run flutter app on android virtual device and mobile phone – Flutter widgets – Scaffold – Image – Container – Row and column – Card – Icon - Layouts – State management – Form validation - Data structures and Collections – Lists – Maps - Exception handling		
UNIT – III	**FLUTTER NAVIGATION AND ROUTING**	**9 Periods**
Button Widget – Types – App Structure and navigation – Navigate with Named routes – Navigate to new screen and back - Send and return data among screens – Animate a widget – WebView widget – Introduction to Material design – Elements - Scrolling – Inputs and Selections – Dialogs – Alerts – Panels – MVC pattern - Provider – Consumer - Selector		
UNIT – IV	**FIREBASE, GPS AND GOOGLE MAPS**	**9 Periods**
JSON – Adding firebase to app - Firebase authentication – signup and login to Flutter app – Configuring Firebase authentication – Firebase database – Real time database – cloud Firestore – Location aware apps – Adding Google maps to Flutter app – Google map marker		
UNIT – V	**APP TESTING AND PUBLISHING**	**9 Periods**
Debugging tools – Dart analyzer – Flutter performance and optimizing - profiling – best practices – Deployment – code obfuscation – Build and release Android app – Build and release iOS app – Continuous delivery		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Sanjib Sinha, **"Beginning Flutter with Dart"**, Lean publishing, First Edition, 2021*
2	*Thomas Bailey, Alessandro Biessek, **"Flutter for Beginners"**, Packt Publishing, Second Edition, 2021*

REFERENCES:

1	*Sufyan bin Uzayr, **"Mastering Flutter – A Beginner's Guide"**, Taylor and Francis, First Edition, 2022*
2	*Simone Alessandria, Brian Kayfitz, **"Flutter Cookbook"**, Packt Publishing, First Edition, 2021*
3	*Rap Payne, **"Beginning App Development with Flutter: Create cross platform mobile apps"**, Apress, First Edition, 2019*
4	*Marco L Napoli, **"Beginning Flutter – A hands on guide to App Development"**, John Wiley & Sons, First Edition, 2020*
5	*https://docs.flutter.dev/*

6	*https://firebase.google.com/*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Setup a new Material App using Android Studio and use pre-made Flutter widgets for User Interface Design	K1
CO2	Summarize the difference between Stateful and Stateless Widgets and Explore how Flutter widgets react to state changes	K2
CO3	Apply common mobile design patterns to structure flutter apps and navigation	K3
CO4	Design mobile applications with backend services, APIs and Create signup and login screens using Firebase Authentication and Cloud Firestore	K4
CO5	Analyze the mobile app usage data and user feedback, and use the insights to improve app performance, usability, and user engagement	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	3	2	-	-	-	2	1	2	1	2	1
CO2	2	3	3	3	2	-	-	-	2	1	2	1	2	1
CO3	2	3	3	3	2	-	-	-	2	1	2	1	2	1
CO4	2	3	3	3	2	-	-	-	2	1	2	1	2	1
CO5	2	3	3	3	2	-	-	-	2	1	2	1	2	1
22IPE$09	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**1**	**2**	**1**	**2**	**1**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.3.1,1.4.1,2.4.1,3.2.1,3.2.2,3.3.1, 3.4.1,3.4.2,4.1.3,4.3.2,8.1.1,8.1.2
CO2	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.2.1,2.2.3,2.2.4,2.4.4,3.1.1,3.1.3,3.4.1,4.3.1,4.3.2,4.3.4,7.1.1,11.1.1,11.2.1, 12.3.1
CO3	1.1.1,1.1.2,1.3.1,1.4.13.2.1,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.2,4.2.2,5.3.2,
CO4	1.1.1,1.1.2,1.3.1,1.4.1,2.1.1,2.1.2,2.2.22.2.3,2.2.4,2.3.12.4.2,2.4.4,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2, 3.4.1,3.4.2, 4.1.2,4.2.2,5.3.2,
CO5	1.1.1,1.1.2,1.3.1,1.4.1, 2.1.1,2.1.2,2.2.2,,2.2.3,2.2.4,2.3.1,,2.4.2,2.4.4,3.1.1,3.1.5,3.1.6,3.2.2, 3.2.3,3.3.1,3.4.1,4.1.2, 4.3.1,4.3.2,4.3.3, 4.3.4, 7.1.2, 8.1.1, 8.1.2, 10.3.1,10.3.2, 11.2.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	-	20	30	50	-	-	100
Assignment 2	-	20	30	50	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPE$10	CLOUD SERVICES MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Cloud Service Management terminology, definition and concepts; Compare and contrast cloud service management with traditional IT service management; Identify strategies to reduce risk and eliminate issues associated with the 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 Periods**
Enterprise Transformation, The Essential Characteristics, Cloud Service Models, Cloud Service Consumption, Cloud Service Deployment Models, Cloud ecosystem, Architecture, ITSM framework.		
UNIT – II	**CLOUD SERVICE DESIGN**	**9 Periods**
Introduction, Framework, processes, practices, service value system, value streams, process transformation, DevOps, Cloud Service Architecture, CSM reference model, value chain, value streams and service models, Cloud service Lifecycle, KPIs.		
UNIT – III	**CLOUD SERVICE OPERATION AND GOVERNANCE**	**9 Periods**
Operational tasks, Cloud Service capabilities, Cloud support model, Cloud governance context, ways of workings, principals, Framework, model, Lifecycle, Performance metrics, Center of Excellence, Cloud Management platforms.		
UNIT – IV	**CLOUD SERVICE MANAGEMENT AND SECURITY MECHANISMS**	**9 Periods**
Remote administration, Resource management, SLA management, Billing Management, Encryption, Hashing, Digital signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images.		
UNIT – V	**ADVANCED CLOUD SERVICE ARCHITECTURE AND SERVICE QUALITY METRICS**	**9 Periods**
Hypervisor Clustering, Load Balanced Virtual Server Instances, Non-Disruptive Service Relocation, Zero Downtime, Cloud Balancing, Resource Reservation, Dynamic Failure Detection and Recovery, Bare-Metal Provisioning, Rapid Provisioning, Storage Workload Management, Direct I/O Access, Direct LUN Access, Dynamic Data Normalization, Elastic Network Capacity, Cross-Storage Device Vertical Tiering, Intra-Storage Device Vertical Data Tiering, Load Balanced Virtual Switches, Multipath Resource Access, Persistent Virtual Network Configuration, Redundant Physical Connection for Virtual Servers, Storage Maintenance Window, Service Quality metrics: Service Availability, Reliability, Performance Metrics, Scalability, Resiliency.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*Enamul Haque, "**Cloud Service Management and Governance: Smart Service Management in Cloud Era**", Enel Publications, 1st edition, 2020*
2	*Thomas Erl, Ricardo Puttini, Zaigham Mohammad "**Cloud Computing: Concepts, Technology & Architecture**", Prentice hall, 1st edition, 2013.*

REFERENCES :

1	*Praveen Ayyappa, **"Economics of Cloud Computing"**, LAP Lambert Academic Publishing, 1st edition, 2022.*
2	*Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "**Mastering Cloud Computing**", Tata Mcgraw Hill, 2013.*
3	*AndreasWittigandMichaelWittig"**AmazonWebServicesinAction**", Manning Publications, 2nd edition,2018.*
4	*JeffBarr, "**HostYourWebSiteintheCloud:AmazonWebServicesMadeEasy**" ,Amazon Web Services, LLC, a Delaware limited liability company, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.	K4
CO2	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services	K3
CO3	Solve the real-world problems using Cloud services and technologies	K1
CO4	Understand the economics of Cloud services	K2
CO5	Apply Governance and value to Cloud services	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	1	1	1	-	-	-	2	1	3	2	2	1
CO2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO3	1	1	3	1	3	-	-	-	3	3	1	1	3	2
CO4	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO5	1	1	3	1	3	-	-	-	3	3	1	1	3	2
22IPE$10	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**1**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPE$11	UI AND UX DESIGN (Common to CSE & IT)

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The course is designed to teach the fundamentals of UI/UX design along with industry-standard design tools to evaluate and improve their designs for better user experience.	
UNIT – I	**INTRODUCTION TO UI DESIGN**	**9 Periods**
Basics of HCI - Design process- HCI in software process – Basics of interaction design - UI Design and Why it matters – UI disasters – Case studies – Design Process – Introduction – Usability Engineering – Task centered approaches – Use cases – Personas – Tasks – Scenarios –Design centered approaches – Psychology and human factors for UI Design – Fitts Law – Short-term – long-term – attention – perception – conceptual models – Design principles – visibility – feedback – mappings – constraints – High-level models – distributed cognition – activity theory – situated action		
UNIT – II	**USER RESEARCH**	**9 Periods**
UserCentered Approaches to Interaction Design -User Research methods – Interview and Focus groups – Observations – Contextual inquiry – Ethics and Consent – User Research Protocol – Log Analysis – Surveys and Questionnaires – Translating User Research to Support design – Qualitative analysis – Quantitative analysis – Examples - Implications for Design – From Research to Ideas – Ideation – Selection – Communicating to Stakeholders		
UNIT – III	**PROTOTYPING**	**9 Periods**
Interface Prototying techniques – Low fidelity – Paper prototype – Wireframing – Tool-based – Physical low fidelity prototyping – Introduction to Design principles and patterns – Layout – Color and consistency – Cultural factors – Interaction design patterns – Google Material design – Design critiques – eliciting and giving feedback		
UNIT – IV	**UNIVERSAL DESIGN**	**9 Periods**
Introduction – Sensory and Cognitive Impairments – Physical limitations – tools and standards – Design for older adults and children – Socio-economic differences – Design for different platforms and contexts – Mobile UI design – Wearable – Automotive User Interfaces – IoT and Physical Computing		
UNIT – V	**EVALUATING USER INTERFACES AND TOOLS**	**9 Periods**
Introduction to Evaluating User interfaces and Evaluation in UI Design process – Evaluation without users – Action Analysis – Cognitive Walkthroughs – Heuristic Evaluation – Nielsen's heuristics – Evaluation with Users – User Testing – Goals – Formative and Summative Evaluation – Ethics in evaluation – Tools – Adobe XD – Figma –Invision -Sketch		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Rex Hartson, Pardha S Pyla,* ***"The UX Book: Agile UX Design for a Quality User Experience"****, Morgan Kaufmann, Second Edition, 2018*
2	*Joel Marsh,* ***"UX for beginners"****, O'Reilly Media, 2015*

REFERENCES :

1	*Alan Cooper, Robert Riemann, David Cronin, Christopher Noessel,* ***"About Face: The Essentials of Interaction Design"****, Wiley, Fourth Edition, 2014*
2	*Ben Coleman, and Dan Goodwin,* ***"Designing UX: Prototyping: Because Modern Design is Never Static"****, SitePoint , 2017*
3	*Westley Knight,* ***"UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work"****, Apress, 2018*
4	https://in.coursera.org/specializations/user-interface-design

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Articulate UI/UXdesign principles and tools	K2
CO2	Conduct user research to gain insights into user needs and behaviors, and apply these insights to inform design decisions	K3
CO3	Create wireframes and prototypes using design software to communicate design ideas	K4
CO4	Design interfaces that adapt to different devices and screen sizes using responsive design principles	K4
CO5	Collaboratively design and evaluate interfaces for web and mobile applications using tools like Adobe XD, Figma ,Invision and Sketch.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	-	-	-	-	-	-	-	-	-	1	2	2	1
CO2	2	3	2	1	-	-	-	-	-	-	-	1	2	2	1
CO3	2	3	2	2	1	-	-	-	-	-	-	2	2	1	1
CO4	2	3	3	2	1	-	-	-	-	-	-	2	2	1	1
CO5	2	3	3	2	1	-	-	1	-	-	-	2	2	1	1
22IPE$11	**2**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**2**	**1**

b)CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1,12.3.1
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.2, 4.2.2, 4.3.1, 4.3.4,12.1.1,12.2.2
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.,2, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.4,5.2.2,12.1.1,12.1.2, 12.2.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 4.3.4,5.2.2,12.1.1,12.1.2, 12.2.2
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.3, 4.2.2, 4.3.1, 4.3.4, 5.1.2,5.2.2,8.2.2,12.1.1, 12.1.2,12.2.2

ASSESSMENTPATTERN –THEORY							
Test /Bloom's Category*	**Remembering (K1)%**	**Understanding (K2)%**	**Applying (K3)%**	**Analyzing (K4)%**	**Evaluating (K5)%**	**Creating (K6)%**	**Total %**
CAT1	-	40	40	20	-	-	100
CAT2	-	20	40	40	-	-	100
Individual Assessment 1 /CaseStudy1/ Seminar 1 /Project1	-	-	70	30	-	-	100
Individual Assessment 2 /CaseStudy2/ Seminar2 / Project2	-	-	50	50	-	-	100
ESE	-	30	40	30	-	-	100

22IPE$12	SOFTWARE TESTING AND AUTOMATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of the course the students will be familiar with the understanding of Software testing principles and methodologies, including black-box testing, white-box testing, and gray-box testing, Familiar with a range of testing tools and frameworks, such as Selenium, Appium, JUnit, TestNG, and Cucumber, able to understand different phases in test planning and management, including test plan creation, test case development, and test execution, performance testing principles and be able to use tools such as JMeter to conduct performance tests, also able to analyze test results, identify issues, and report on test findings to stakeholders	
UNIT – I	**INTRODUCTION**	**9 Periods**
Humans, Errors and Testing – Software quality – Requirements, Behavior and Correctness – Correctness vs Reliability – Testing and Debugging – Test metrics – Testing and Verification – Defect management – Test Generation strategies – Static testing – Model based testing and Model checking – Types of testing – Saturation effect – Principles of testing		
UNIT – II	**TEST GENERATION**	**9 Periods**
Domain partitioning – Test Selection Problem – Equivalence Partitioning – Boundary value analysis – Category partition method – Predicate Analysis – Domain testing – Cause-effect graphing – Tests using Predicate Syntax – Test generation from finite state models – Finite state machines – Conformance testing – Fault model – Characterization Set – W-method – Partial-W method – UIO-Sequence method – Test generation from Combinatorial Designs – Tools – AETG – ACTS		
UNIT – III	**CONTROL FLOW AND DATA FLOW TESTING**	**9 Periods**
Basics of test adequacy – Adequacy criteria based on control flow – Data flow concepts – Adequacy criteria based on data flow – Control flow vs Data flow – Subsumes relation – Structural and Functional testing – Scalability of coverage measurement – Test adequacy assessment using program mutation – Mutation operators for C and JAVA		
UNIT – IV	**PHASES OF TESTING**	**9 Periods**
Regression Testing Process – Test Selection – Dynamic Slicing – Test Minimization – Unit Testing – Tools – JUnit, PyUnit, SpartanUnit – Integration Testing – Dependence – OO vs Non-OO Programs – Integration Hierarchy – Finding Near-Optimal Test Order – Test Assessment – Tools – System Testing – Test cases – Coverage metrics – Non-functional system testing - Software Complexity – basics		
UNIT – V	**TESTING AUTOMATION**	**9 Periods**
API Testing with Postman – Performance Testing using JMeter – Codeless Test Automation using Selenium IDE – Test Automation using Katalon Studio – Robot Framework		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Aditya P Mathur,* ***"Foundations of Software Testing"****, Pearson Education, Second Edition, 2013*
2	*Gayathri Mohan,* ***"Full Stack Testing – A Practical Guide for Delivering High Quality Software"****, O'Reilly Media, 2022*

REFERENCES:

1	*Mauricio Aniche,* ***"Effective Software Testing – A Developer's Guide"****, Manning Publications, 2022*
2	*Paul C Jorgensen, Byron DeVries,* ***"Software Testing – A Craftsman's Approach"****, CRC Press, Fifth Edition, 2021*
3	*Paul Ammann, Jeff Offutt,* ***"Introduction to Software Testing"****, Cambridge University Press, Second Edition, 2017*
4	*Glenford J Myers, Corey Sandler, Tom Badgett,* ***"The Art of Software Testing"****, John Wiley & Sons, Third Edition, 2012*
5	*https://robotframework.org/*
6	*https://katalon.com/*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand software testing principles, methodologies, and terminology	K2
CO2	Develop test plan and test cases for different types of testing, including unit testing, integration testing, system testing, and acceptance testing	K3
CO3	Familiar with different types of testing, such as black-box testing, white-box testing, and gray-box testing, and understand how to apply them in practice	K3
CO4	Practice with different testing frameworks, such as JUnit, TestNG, and Selenium, and understand how to use them to conduct tests	K3
CO5	Understand test automation principles and practices, and be able to use testing tools to automate tests and report on test findings, and understand how to communicate test results to stakeholders	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	-	1	-	-	-	-	-	2	1
CO2	2	1	2	1	3	-	1	-	-	-	-	-	2	1
CO3	2	1	2	1	3	-	1	-	-	-	-	-	2	1
CO4	2	2	2	1	-	2	2	-	1	2	2	1	2	1
CO5	2	2	2	1	-	-	1	-	-	-	-	-	2	1
22IPE$12	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**1**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1, 4.3.1,5.1.2,7.1.1
CO2	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1, 5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,7.1.1
CO3	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1, 5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,7.1.1,
CO4	1.1.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1, 4.3.1,6.1.1,7.1.1,7.1.2,9.3.1,10.1.1,10.1.2,10.3.1,11.1.1,11.2.1,11.3.1,12.3.2
CO5	1.1.1,1.3.1,1.4.1,2.1.1,,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1, 4.3.1,7.1.1,

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPE$13	WEB APPLICATION SECURITY *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of the course the students will be familiar with the common security threats faced by web applications, such as SQL injection, cross-site scripting (XSS), cross-site request forgery (CSRF), and man-in-the-middle attacks, able to respond effectively to security threats and incidents, design secure web applications from the ground up, including secure authentication and authorization, secure communication protocols, firewalls, intrusion detection systems, also able to apply industry standards and regulations, such as OWASP Top 10, and PCI DSS, that outline best practices for web application security, able to .understand the principles of web security, browser security and database security and prevent security vulnerabilities.

UNIT – I	**INTRODUCTION**	**9 Periods**
Structure of a Modern Web Application – REST APIs – Javascript – SPA Frameworks – Web Servers – Sever side databases – Client-side data stores – Network Security vs Application Security – Thinking like a defender – OWASP Top Ten List – Security Fundamentals – Input Validation – Attack surface reduction – Classifying and Prioritizing threats		
UNIT – II	**WEB SECURITY PRINCIPLES**	**9 Periods**
Authentication – Two factor and Three factor authentication – Web application authentication – Securing Password based authentication – Best Practices – Authorization – Access Control – Session management fundamentals – Securing web application session management		
UNIT – III	**BROWSER SECURITY**	**9 Periods**
Same origin policy – Definition – Client-side vs Server-side - Exceptions – Cross site Scripting – XSS Discovery and Exploitation – Stored XSS – Reflected XSS – DOM-based XSS – Mutation-based XSS - Cross site Request Forgery – Query parameter tampering – Alternate GET payloads – CSRF against POST endpoints		
UNIT – IV	**DATABASE AND FILE SECURITY**	**9 Periods**
SQL Injection – Code injection – Command injection – Setting database permissions – Stored procedure security – Insecure direct object references – File Security principles – Keeping source code secure – Security through Obscurity – Forceful browsing – Directory traversal		
UNIT – V	**SECURE DEVELOPMENT AND DEPLOYMENT**	**9 Periods**
Securing modern web applications – Secure application architecture – Reviewing Code – Vulnerability discovery and management – Defending against XSS, CSRF, XXE, Injection and DoS attacks – Industry standards – Maturity models – Securing third party dependencies		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Andrew Hoffman,* ***"Web Application Security – Exploitation and Countermeasures for Modern Web Applications"****, O'Reilly, 2020*
2	*Bryan Sullivan, Vincent Liu,* ***"Web Application Security – A Beginner's Guide"****, McGraw Hill, 2012*

REFERENCES:

1	*Mike Shema,* ***"Hacking Web Apps – Detecting and Preventing Web Application Security Problems"****, Elsevier, 2012*
2	*Ron Lepofsky,* ***"The Manager's Guide to Web Application Security – A Concise guide to Web Application Security"****, Apress, 2014*
3	*Dafydd Stuttard, Marcus Pinto,* ***"The Web Application Hacker's Handbook – Finding and Exploiting Security flaws"****, John Wiley & Sons, Second Edition, 2011*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiar with secure coding best practices, such as OWASP Top 10	K2
CO2	Write secure code, including input validation, error handling, and password protection	K3
CO3	Comprehend the most common web security threats, such as cross-site scripting (XSS), cross-site request forgery (CSRF), SQL injection, and others	K2
CO4	Implement and manage web security policies and procedures, including incident response planning and management, security auditing, and security monitoring	K3
CO5	Identify and prioritize potential security threats to web applications and develop effective strategies for mitigating those threats	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2	2	1	1	-	1	-	-	-	-	-	2	1
CO2	2	1	2	1	3	-	1	-	-	-	-	-	2	1
CO3	2	1	2	1	3	-	1	-	-	-	-	-	2	1
CO4	2	2	2	1	-	2	2	-	1	2	2	1	2	1
CO5	2	2	2	1	-	-	1	-	-	-	-	-	2	1
22IPE$13	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**1**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1, 5.1.2,7.1.1
CO2	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1,5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,7.1.1
CO3	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1, 3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1,5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,7.1.1,
CO4	1.1.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,63.1.1, 7.1.1,7.1.2,9.3.1,10.1.1,10.1.2,10.3.1,11.1.1,11.2.1,11.3.1,12.3.2
CO5	1.1.1,1.3.1,1.4.1,2.1.1,,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,7.1.1,

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPE$14	DEV-OPS *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to make the students understand about the concepts of DevOps principles, agile development methodologies, DevOps tools and technologies, orchestrate containers using Docker and Kubernetes, script writing to automate tasks and create pipelines for CI/CD, monitoring and Logging tools.	
UNIT – I	**INTRODUCTION**	**9 Periods**
What is DevOps – Roles and responsibilities of DevOps engineer – DevOps and SDLC – Virtualization – Shell scripting – SSH – Git for DevOps – Branches – Merge requests – Commits – Resolving Conflicts – Deletions – Build tools and Package managers – Artifact Repository manager		
UNIT – II	**CONTAINERS**	**9 Periods**
What is container – Docker components and architecture – Docker vs. Virtual machine – Main docker commands – Docker compose – running multiple services – Dockerfile – Building a docker image - Deploy containerized app – Docker volumes		
UNIT – III	**ORCHESTRATION**	**9 Periods**
What is Container orchestration - Introduction to Kubernetes – Components – Architecture – Commands – YAML configuration – Namespaces – Service types – Persisting data – Deploying Kubernetes Cluster – Stateful app deployment using Helm		
UNIT – IV	**CI/CD PIPELINE**	**9 Periods**
What is Build Automation – Continuous Integration and Continuous Delivery Principles - Introduction to Jenkins – Install Jenkins on Cloud Server – Plugins – Build tools – Docker in Jenkins – Configuring Jenkins pipeline – Multi-branch pipeline Job - Webhooks		
UNIT – V	**MONITORING**	**9 Periods**
Docker container monitoring – statistics – metrics – events – Performance monitoring – Container monitoring – Container administration – Auditing and Analyzing Vulnerabilities in Kubernetes – Enhancing observability and monitoring in Kubernetes with Prometheus and Grafana		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	Mikael Krief, "Learning DevOps - The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps", Packt Publishing, 2019
2	Jose Manuel Ortega Candel, "Implementing DevSecOps with Docker and Kubernetes", BPB Publications, First Edition, 2022

REFERENCES:

1	Joakim Verona, **"Practical DevOps"**, Packt Publishing, 2016
2	Len Brass, Ingo Weber, Liming Zhu, **"DevOps – A Software Architect's Perspective"**, Pearson Education, 2015
3	Gene Kim, Jez Humble, Patrick Debois, John Willis, **"The DevOps Handbook – How to create world-class agility, reliability and security in technology organizations"**, IT Revolution, Second edition, 2016
4	Jennifer Davis, Katherine Daniels, **"Effective DevOps"**, O'Reilley Media, 2015
5	https://github.com/milanm/DevOps-Roadmap
6	https://github.com/annfelix/DEVOPS-WORLD

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the DevOps principles and practices, such as continuous integration, continuous delivery, infrastructure as code, and collaboration between development and operations teams	K2
CO2	Implement containerization and container orchestration using tools such as Docker and Kubernetes	K3
CO3	Create and manage infrastructure on public and private cloud platforms such as AWS, Azure, and GCP using tools such as Terraform and CloudFormation	K4
CO4	Write scripts to automate tasks and create pipelines for continuous integration and continuous delivery	K3
CO5	Understand the purpose of monitoring and logging tools such as Prometheus and Grafana and be able to use them to monitor and analyze system performance	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**
CO1	1	1	2	2	1	-	-	-	1	-	-	2	3	1
CO2	1	2	2	1	2	-	-	-	-	-	1	1	3	1
CO3	1	2	2	2	2	-	-	-	-	-	1	1	3	1
CO4	1	3	2	3	2	-	-	-	1	-	-	2	3	1
CO5	1	3	3	3	2	-	-	-	1	-	2	2	3	1
22IPE$14	1	2	2	2	2	-	-	-	1	-	1	2	3	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 2.1.2, 2.2.2,2.2.4, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 12.1.1, 12.1.2, 12.2.2
CO2	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2,2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 11.2.1, 12.1.1, 12.2.2
CO3	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2,2.2.3, 2.2.4, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 11.2.1, 12.1.1, 12.2.2
CO4	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2,2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2,4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 9.1.2, 12.1.1, 12.1.2, 12.2.2, 12.3.2
CO5	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2,2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 9.1.1, 9.1.2, 11.2.1, 12.1.1, 12.1.2, 12.2.2, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	30	30	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	30	30	20	-	-	100
ESE	20	30	30	20	-	-	100

22IPE$15	PRINCIPLES OF PROGRAMMING LANGUAGES *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of the course the students will be familiar with the syntax and semantics of programming languages, call-return architecture and ways of implementing them also able to analyze and evaluate the different programming paradigms, Practice Functional and Concurrent programming with Haskell, also able to explain the design concepts and issues behind programming languages like C, Java, Scala, Lisp, Prolog, or any new language	
UNIT – I	**FOUNDATIONS**	**9 Periods**
Evolution of Major Programming Languages –Overview of Compilation – Describing Syntax and Semantics – Lexical and Syntax analysis - Names, Scopes and Bindings – Data Types – Expressions and Assignment Statements –Type Systems		
UNIT – II	**CORE ISSUES IN LANGUAGE DESIGN**	**9 Periods**
Control Flow – Structured and Unstructured Flow – Sequencing – Selection – Iteration – Recursion – Subroutines and Control Abstraction – Stack layout – Calling Sequences – Parameter Passing – Blocks – Dynamic Scoping - Exception Handling – Coroutines – Events		
UNIT – III	**OBJECT ORIENTED PARADIGM**	**9 Periods**
Abstract Data Types and Encapsulation Concepts – Design Issues – Namespaces - Inheritance - Inner Classes – Type Extensions – Dynamic Method Binding – Mix-in Inheritance – True Multiple Inheritance - Examples – Object Models – Smalltalk, C++, Java, Scala		
UNIT – IV	**FUNCTIONAL AND LOGIC PROGRAMMING**	**9 Periods**
Functional Programming – Programs as Functions – Delayed Evaluation – Lambda Calculus – Examples from Lisp - Introduction to Haskell Programming – Comparison of Functional and Imperative languages – Logic Programming - Predicate Calculus – Proving theorems – Resolution and Unification - Elements of Prolog – Applications		
UNIT – V	**CONCURRENT PROGRAMMING**	**9 Periods**
Parallel Processing and Programming Languages – Threads – Semaphores – Monitors – Message Passing – Parallelism in Non-Imperative Languages – Java threads – Haskell concurrency primitives and abstractions		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Robert W. Sebesta,* ***"Concepts of Programming Languages"****, Pearson Education, Twelfth Edition, 2019*
2	*Michael L. Scott,* ***"Programming Language Pragmatics"****, Morgan Kauffman, Fourth Edition, 2016*

REFERENCES:

1	*Kenneth C. Louden, Kenneth A. Lambert,* ***"Programming Languages – Principles and Practice"****, Course Technology, Cengage Learning, Third Edition, 2011*
2	*Daniel P. Friedman, Mitchell Wand,* ***"Essentials of Programming Languages"****, MIT Press, Third Edition, 2008*
3	*Carlo Ghezzi, Mehdi Jazayeri,* ***"Programming Language Concepts"****, John Wiley & Sons, Third Edition, 2008*
4	*Peter Sestoft,* ***"Programming Language Concepts"****, Springer-Verlag, Second Edition, 2017*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Summarize the key concepts and theories behind programming languages, including syntax, semantics, grammar, and parsing	K2
CO2	Compare the different programming language paradigms and be able to choose the appropriate paradigm for different types of software	K3
CO3	Explain the core issues in procedural and object-oriented programming language design	K2
CO4	Apply functional programming concepts and logic programming concepts and be able to write functional code using languages such as Lisp or Prolog or Haskell or Scheme	K3
CO5	Describe the principles of concurrent and parallel programming, including threads, locks, and semaphores, and be able to write concurrent and parallel code using languages Java or Haskell	K3

COURSE ARTICULATION MATRIX :														
a) CO and PO Mapping														
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1		1						2	1
CO2	2	1	2	1	3		1						2	1
CO3	2	1	2	1	3		1						2	1
CO4	2	2	2	1		2	2		1	2	2	1	2	1
CO5	2	2	2	1			1						2	1
22IPE$15	2	2	2	1	1		1						2	1
1– Slight, 2 – Moderate, 3 – Substantial														
b) CO and Key Performance Indicators Mapping														
CO1	1.1.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.2,7.1.1													
CO2	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,7.1.1													
CO3	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1, 3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1,5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,7.1.1,													
CO4	1.1.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,6.1.1,7.1.1,7.1.2,9.3.1,10.1.1,10.1.2,10.3.1,11.1.1,11.2.1,11.3.1,12.3.2													
CO5	1.1.1,1.3.1,1.4.1,2.1.1,,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,7.1.1,													

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPE$08	CLOUD COMPUTING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Overview of computing Paradigm; Cloud Computing architecture and its service models; Representation of virtualization concepts; Intensive computation in Cloud computing; Applications and management of cloud computing.

UNIT – I	**INTRODUCTION**	**9 Periods**

Principles of Parallel and Distributed Computing - Eras of Computing - Parallel vs. Distributed Computing - Hardware Architectures for Parallel Processing - Approaches to Parallel Programming -Levels of Parallelism - Distributed System - Technologies for Distributed Computing – Remote Procedure Call - Distributed Object Frameworks - Service Oriented Computing Cloud Computing Reference Model - Historical Developments - Building Cloud Computing Environments - Application Development - Infrastructure and System Development - Computing Platforms and Technologies.

UNIT – II	**CLOUD COMPUTING ARCHITECTURE**	**9 Periods**

Introduction - Cloud Reference Model – Architecture - Infrastructure / Hardware as a Service – Platform as a Service - Software as a Service- Types of Clouds - Public Clouds - Private Clouds - Hybrid Clouds - Community Clouds- Open Challenges - Cloud Definition - Cloud Interoperability and Standards -Scalability and Fault Tolerance - Security- Trust- and Privacy – Organizational Aspects.

UNIT – III	**VIRTUALIZATION**	**9 Periods**

Introduction - Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques - Execution Virtualization - Other Types of Virtualization - Virtualization and Cloud Computing - Pros and Cons of Virtualization - Xen- Paravirtualization- VMware- Full Virtualization - Microsoft Hyper-V; Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

UNIT – IV	**DATA-INTENSIVE COMPUTING AND CLOUD PLATFORMS**	**9 Periods**

Characterizing Data-Intensive Computations - Challenges Ahead - Technologies for Data-Intensive Computing - Storage Systems - Programming - Introducing the MapReduce, Hadoop Programming Model- cloud Platforms in Industry - Amazon Web Services - Compute Services (GCP) - Storage Services - Communication Services -Google AppEngine - Microsoft Azure.

UNIT – V	**APPLICATIONS AND MANAGEMENT OF CLOUD**	**9 Periods**

Scientific Applications- Business and Consumer Applications - Energy Efficiency in Clouds- Energy-Efficient and Green Cloud Computing Architecture- Market-Based Management of Clouds- Market-Oriented Cloud Computing- Reference Model for MOCC- Federated Clouds / Inter Cloud-Characterization and Definition- Cloud Federation Stack- Aspects of Interest- Technologies for Cloud Federations- Third Party Cloud Services.

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOK :

1	*Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "**Mastering Cloud Computing**", Tata Mcgraw Hill, 2013.*
2	*James Turnbull, "**The Docker Book**", O'Reilly Publishers, 2014.*

REFERENCES:

1	Rittinghouse, John W., and James F. Ransome, "**Cloud Computing: Implementation, Management and Security**", CRC Press, 2017.
2	*Lizhe Wang, Rajiv Ranjan, Jinjun Chen, and Boualem Benatallah , "**Cloud Computing: Methodology, Systems, and Applications**", CRC Press, 2017.*
3	*George Reese, "**Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)**", O'Reilly, 2009.*
4	*Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "**Distributed and Cloud Computing, From Parallel Processing to the Internet of Things**", Morgan Kaufmann Publishers, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the characteristics and properties of Cloud computing.	K1
CO2	Analyze the architecture of the Cloud computing stack.	K4
CO3	Differentiate between full and paravirtualization.	K2
CO4	Design map-reduce programming model.	K4
CO5	List the applications of the Cloud.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO2	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO3	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO4	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO5	2	1	2	2	1	1	2	-	-	-	-	1	2	1
22IPE$08	2	1	2	2	1	1	2	-	-	-	-	1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPE$16	VIRTUALIZATION TECHNIQUES

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Virtualization concepts, Virtualized infrastructure design, Operating system virtualization, Storage virtualization, Network virtualization.	
UNIT– I	**INTRODUCTION**	**9 Periods**
Architect for virtualization- virtualization – five-step process – Discovery – Virtualization – Hardware maximization– Architectures–manage virtualization.		
UNIT– II	**VIRTUALIZATIONINFRASTRUCTURE**	**9 Periods**
Build the resource pool – planning and preparation – network layer – storage – host servers - testinglevels-lab requirement –reuse oflabdeliverables–managementpractices.		
UNIT– III	**OSVIRTUALIZATION**	**9 Periods**
Hardware-levelvirtualization–OSlevelVirtualization–InterceptionTechniqueonWindows– Featherweight Virtual Machine- FVM states- operations – Design of virtualization layer – Implementation – System calllloganalysis– Limitations of FVM.		
UNIT– IV	**STORAGEVIRTUALIZATION**	**9 Periods**
Storage virtualization – Enhanced Storage and Data Services – Implementation – High Availability –Performance –Capacity –SNIAstoragemanagement– Policy-basedservicelevelmanagement– Futureofstoragevirtualization.		
UNIT– V	**NETWORKVIRTUALIZATION**	**9 Periods**
KeyConcepts-Architecture–VirtualizednetworkComponents-LogicalNetworks-LogicalNetwork Design-Naming Conventions -Port profiles-uplink port profiles –network adapter port profiles –Logical switches-planninglogical switchdesign-deployment –Operations.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*Matthew portnoy, "**Virtualization Essentials**", SYBEX (Wiley Brand) 2 nd Edition, 2016*
2	*David Marshall, Wade A. Reynolds, "**Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual DataCenter**", Auerbach Publications, 2006.*

REFERENCES :

1	*Danielle Ruest, Nelson Ruest, "**Virtualization: A Beginner's Guide**", McGraw-Hill, 2009.*
2	*Frank Bunn, Nik Simpson, Robert Peglar, Gene Nagle, "**Technical Tutorial – Storage Virtualization**", Storage Networking Association (SNIA), 2004.*
3	*Matthew Portney, "**Virtualization Essentials**", John Wiley & Sons, 2012.*
4	*Tim cerfing, Jeff buller, ChuckEnstall, Richard Ruiz, "**Mastering MicrosoftVirtualization**", Wiley Publication, 2010.*
5	*William Von Hagen ,"**Professional Xen Virtualization**", Wiley publication, 2008.*
6	*Cody Bunch, "**Automating vSphere with VMware vCenter Orchestrator: TechnologyHands-on**", Pearson Education, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze the virtualization concepts and Hypervisor	K4
CO2	Apply the Virtualization for real-world applications	K3
CO3	Install &Configure the different VM platforms	K1
CO4	Experiment with the VM with various software	K2
CO5	Experiment with various VM tools	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO2	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO3	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO4	2	1	2	2	1	1	2	-	-	-	-	1	2	1
CO5	2	1	2	2	1	1	2	-	-	-	-	1	2	1
22IPE$16	**2**	**1**	**2**	**2**	**1**	**1**	**2**	-	-	**-**	**-**	**1**	**2**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPE$10	CLOUD SERVICES MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Cloud Service Management terminology, definition and concepts; Compare and contrast cloud service management with traditional IT service management; Identify strategies to reduce risk and eliminate issues associated with the 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 Periods**
Enterprise Transformation, The Essential Characteristics, Cloud Service Models, Cloud Service Consumption, Cloud Service Deployment Models, Cloud ecosystem, Architecture, ITSM framework.		
UNIT – II	**CLOUD SERVICE DESIGN**	**9 Periods**
Introduction, Framework, processes, practices, service value system, value streams, process transformation, DevOps, Cloud Service Architecture, CSM reference model, value chain, value streams and service models, Cloud service Lifecycle, KPIs.		
UNIT – III	**CLOUD SERVICE OPERATION AND GOVERNANCE**	**9 Periods**
Operational tasks, Cloud Service capabilities, Cloud support model, Cloud governance context, ways of workings, principals, Framework, model, Lifecycle, Performance metrics, Center of Excellence, Cloud Management platforms.		
UNIT – IV	**CLOUD SERVICE MANAGEMENT AND SECURITY MECHANISMS**	**9 Periods**
Remote administration, Resource management, SLA management, Billing Management, Encryption, Hashing, Digital signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images.		
UNIT – V	**ADVANCED CLOUD SERVICE ARCHITECTURE AND SERVICE QUALITY METRICS**	**9 Periods**
Hypervisor Clustering, Load Balanced Virtual Server Instances, Non-Disruptive Service Relocation, Zero Downtime, Cloud Balancing, Resource Reservation, Dynamic Failure Detection and Recovery, Bare-Metal Provisioning, Rapid Provisioning, Storage Workload Management, Direct I/O Access, Direct LUN Access, Dynamic Data Normalization, Elastic Network Capacity, Cross-Storage Device Vertical Tiering, Intra-Storage Device Vertical Data Tiering, Load Balanced Virtual Switches, Multipath Resource Access, Persistent Virtual Network Configuration, Redundant Physical Connection for Virtual Servers, Storage Maintenance Window, Service Quality metrics: Service Availability, Reliability, Performance Metrics, Scalability, Resiliency.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*Enamul Haque, "**Cloud Service Management and Governance: Smart Service Management in Cloud Era**", Enel Publications, 1st edition, 2020*
2	*Thomas Erl, Ricardo Puttini, Zaigham Mohammad "**Cloud Computing: Concepts, Technology & Architecture**", Prentice hall, 1st edition, 2013.*

REFERENCES :

1	*Praveen Ayyappa, **"Economics of Cloud Computing"**, LAP Lambert Academic Publishing, 1st edition, 2022.*
2	*Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "**Mastering Cloud Computing**", Tata Mcgraw Hill, 2013.*
3	*AndreasWittigandMichaelWittig"**AmazonWebServicesinAction**", Manning Publications, 2nd edition, 2018.*
4	*JeffBarr, "**HostYourWebSiteintheCloud:AmazonWebServicesMadeEasy**" ,Amazon Web Services, LLC, a Delaware limited liability company, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.	K4
CO2	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services	K3
CO3	Solve the real-world problems using Cloud services and technologies	K1
CO4	Understand the economics of Cloud services	K2
CO5	Apply Governance and value to Cloud services	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	1	1	1	-	-	-	2	1	3	2	2	1
CO2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO3	1	1	3	1	3	-	-	-	3	3	1	1	3	2
CO4	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO5	1	1	3	1	3	-	-	-	3	3	1	1	3	2
22IPE$10	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**1**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPE$17	DATA WAREHOUSING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To learn and understand the concepts and techniques about architecture and infrastructure of warehouses, data modelling, data extraction, transformation, information access and delivery, physical storage implementation and maintenance.	
UNIT – I	**CONCEPTS, PLANNING AND REQUIREMENTS**	**9 periods**
The need for Data warehousing – Data warehousing defined – Milestones and challenges – Defining features – data warehouses vs data marts – Architectural types – components – significant trends – planning data warehouse – development phases – Dimensional analysis – requirement gathering methods – data design – architectural plan – storage specification.		
UNIT – II	**ARCHITECTURE AND INFRASTRUCTURE**	**9 periods**
Architectural components – infrastructure as the foundation for data warehousing – Significant role of metadata: importance, types by functional area, business meta data, technical metadata, providing metadata.		
UNIT – III	**DATA DESIGN AND PREPARATION**	**9 periods**
Dimensional modelling: basics, the star schema, star schema keys and advantages – snowflake schema – aggregate fact tables – Data Extraction – Data Transformation – Data Loading - Importance of data quality – data quality challenges and tools.		
UNIT – IV	**INFORMATION ACCESS AND DELIVERY**	**9 periods**
Information delivery and tools – OLAP: need for OLAP, Major features and functions, Models – Web enabled data warehouse and delivery – Data mining techniques and applications.		
UNIT – V	**IMPLEMENTATION AND MAINTENANCE**	**9 periods**
Physical design steps and considerations – Physical storage – indexing – Techniques for enhancing the performance – testing – Major development activities – security – Backup and recovery – Monitoring the data warehouse – user training and support – managing the data warehouse.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Paulraj Ponnaiah, "**Data warehousing Fundamentals for IT professionals**", wiley, 2nd edition, 2010.*

REFERENCES :

1	*Parteekbhatia,"**Data Mining and Data Warehousing: Principles and Practical Techniques**", Cambridge University Press, 2019*
2	Thomas C. Hammergren, Alan R.Simon, "**Data Warehousing: For dummies**", For dummies, 2nd edition, 2019.
3	*Jiaweihan, Michelinekamber, Jianpei, "**Data mining concepts and techniques**", 3rd Edition, Morgan Kaufmann publishers, 2012.*
4	***Herbert Jones, "**Data Science: The Ultimate Guide to Data Analytics, Data Mining, Data Warehousing, Data Visualization, Regression Analysis, Database Querying, Big Data for Business and Machine Learning for Beginners**", Bravex, 2020.***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the basic concepts, planning and requirements for data warehousing.	K2
CO2	Understand the architecture and infrastructure of warehouses	K2
CO3	Apply various techniques for data modelling, extraction, transformation and Loading	K3
CO4	Demonstrate information access and delivery in data warehouses..	K3
CO5	Apply various techniques for physical storage implementation and maintenance.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	1	1	-	-	-	-	-	-	-	2	1
CO2	2	1	1	1	1	-	-	-	-	-	-	-	2	1
CO3	1	1	2	2	-	-	-	-	-	-	-	-	1	1
CO4	1	1	2	2	-	-	-	-	-	-	-	-	1	1
CO5	1	1	1	2	-	-	-	-	-	-	-	-	1	1
22IPE$17	2	1	2	2	1	-	-	-	-	-	-	-	2	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1,2.1.1,2.2.3,3.1.1,3.1.2,3.1.6,4.1.1,4.2.2,4.3.1,5.1.1
CO2	1.3.1,1.4.1,2.1.1,2.2.3,3.1.1,3.1.2,3.1.6,4.1.1,4.2.2,4.3.1,5.1.1
CO3	1.4.1,2.2.1,2.2.4,2.4.1,2.4.2,3.1.1,3.2.1,3.2.3,3.4.1,3.4.2,4.1.2,4.1.3,4.2.2,4.3.3
CO4	1.4.1,2.2.1,2.2.4,2.4.1,2.4.2,3.1.1,3.2.1,3.2.3,3.4.1,3.4.2,4.1.2,4.1.3,4.2.2,4.3.3
CO5	1.4.1,2.2.1,2.4.2,3.2.1,3.4.1,4.1.4,4.2.2,4.3.3,4.3.4

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	40	30	-	-	-	100
ESE	30	40	30	-	-	-	100

22IPE$18	STORAGE TECHNOLOGIES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, the functionalities of logical and physical components of storage; Various storage networking technologies; Different storage virtualization technologies; The different backup and recovery strategies; Understand common storage management activities and solutions	
UNIT – I	**STORAGE SYSTEMS**	**9 Periods**
Introduction to Information Storage and Management: Information storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of a Storage System Environment, Disk Drive Components, Disk Drive Performance, Logical Components of the Host. Data Protection: Implementation of RAID, RAID Array Components, RAID Levels.		
UNIT – II	**INTELLIGENT STORAGE SYSTEMS AND SCSI**	**9 Periods**
Components of an intelligent storage system, Intelligent Storage Array, case study - EMC CLARiiON and Symmetrix, Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Introduction to Parallel SCSI, SCSI Command Model.		
UNIT – III	**STORAGE AREA NETWORK AND NETWORK ATTACHED STORAGE**	**9 Periods**
Fibre Channel, The SAN and Its Evolution, Components of SAN, FC Connectivity, Fibre Channel Ports, Fibre Channel Architecture, Zoning, Fibre Channel Login Types, FC Topologies, General-Purpose Servers vs. NAS Devices, Benefits of NAS, NAS File I/O, Components of NAS, NAS Implementations, NAS File-Sharing Protocols, NAS I/O Operations, Factors Affecting NAS Performance and Availability, case study - EMC Celerra.		
UNIT – IV	**STORAGE VIRTUALIZATION AND BUSINESS CONTINUITY**	**9 Periods**
Content-Addressed Storage: Fixed Content and Archives, Types, Features and Benefits, Architecture, Object Storage and Retrieval in CAS, Storage Virtualization: Forms of Virtualization, SNIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types, Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, BC Technology Solutions.		
UNIT – V	**BACKUP, RECOVERY AND REPLICATION**	**9 Periods**
Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies, Local Replication: Source and Target, Uses, Data Consistency, Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface, Remote Replication: Modes, Technologies, Network Infrastructure.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*G. SomasundaramAlok Shrivastava, EMC Corporation, "**Information Storage and Management**", Wiley, India, 2009.*
2	*Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel, and Libor Miklas, "**Introduction to Storage Area Networks, Ninth Edition**", IBM -Redbooks, December 2017*

REFERENCES :

1	*Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein , "**Storage Networks Explained**", Second Edition, Wiley, 2009.*
2	*Silvangai,RogerAndersson,DiegoCrupnicoffandVipinJain, "**Buildingafuture-proofcloudinfrastructure:AunifiedArchforNetwork,SecurityandStorageServices**",PearsonAddison–Wesley, 2020*
3	*https://www.udemy.com/topic/data-storage/*
4	*https://www.coursera.org/courses?query=data%20storage*

COURSE OUTCOMES:	Bloom's Taxonomy

Upon completion of the course, the students will be able to:		Mapped
CO1	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment	K1
CO2	Illustrate the usage of advanced intelligent storage systems and RAID	K2
CO3	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization	K2
CO4	Examine the different roles in providing disaster recovery and remote replication technologies	K4
CO5	Infer the security needs and security measures to be employed in information storage management	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping													
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	1	2	1	3	3	-	-	-	1	1	1	3	1	2
CO2	3	1	2	3	3	-	-	-	3	2	3	2	2	3
CO3	1	1	3	2	2	-	-	-	3	1	1	2	2	3
CO4	3	2	1	2	2	-	-	-	1	1	3	1	3	2
CO5	1	3	2	1	2	-	-	-	1	2	3	1	3	2
22IPE$18	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														
b) CO and Key Performance Indicators Mapping														
CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2													
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2													
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2													
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2													
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2													

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPE$19	SOFTWARE DEFINED NETWORKS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of the course, the students will be familiar with the fundamental concepts of Software Defined Networks,Separation of the data Plane and Control Plane,Principles of Software Defined Network Programming and various Applications of Software Defined Networks.	
UNIT – I	**INTRODUCTION TO SDN**	**9 Periods**
Evolution of Software Defined Networking (SDN) – Modern Data Centre – Traditional Switch Architecture – Need for SDN – Evolution of SDN –Working of SDN – Centralized and Distributed Control Plane and Data Plane.		
UNIT – II	**OPEN FLOW & SDN CONTROLLERS**	**9 Periods**
OpenFlow specification - Drawbacks of Open SDN – SDN via APIs – SDN via Hypervisor-Based Overlays - SDN via Opening up the device – Network Function Virtualization – Alternatives Overlap and ranking – SDN protocol models – SDN controller Models – Application Models – Approaches to SDN security.		
UNIT – III	**DATA CENTERS AND OTHER ENVIRONMENTS**	**9 Periods**
Data centre: Demands – Tunneling technology – Path technology – Ethernet Fabrics – SDN use Cases – Consistency Policy Configuration – Wide Area Networks – Service Providers - Campus Networks - Hospitality Networks and Mobile Networks		
UNIT – IV	**SDN PROGRAMMING AND APPLICATIONS**	**9 Periods**
Network Function Virtualization – SDN players – Types of Applications - SDN Controllers - Controller Considerations - Device Considerations – Creating Network Virtualization Tunnels – Offloading flows in Data centre – Access Control for campus – Traffic Engineering for service Providers.		
UNIT – V	**SDN OPEN SOURCE**	**9 Periods**
OpenFlow – Switch Implementation – Controller Implementation – Orchestration and Network Virtualization – Simulation, Testing and Tools – Open Source Cloud Software: OpenStack, CloudStack – Juniper SDN framework – IETF SDN framework – Open Daylight controller.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2	Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, OReilly Media, 2013.

REFERENCES :

1	Siamak Azodolmolky, Software Defined Networking with Open Flow, Packet Publishing, 2013
2	Vivek Tiwari, SDN and Open Flow for Beginnersll, Amazon Digital Services, Inc., 2013.
3	Fei Hu, Editor, Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014
4	Larry Peterson, Carmelo Cascone, Bruce Davie,"Software-Defined Networks: A Systems Approach, Systems Approach, LLC,2021

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze the evolution of software defined networks	K3
CO2	Express the various components of SDN and their uses	K2
CO3	Explain the use of SDN in the current networking scenario	K1
CO4	Design and develop various applications of SDN.	K2
CO5	Demonstrate the SDN open source framework and software.	K2

COURSE ARTICULATION MATRIX														
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2	2	2	1	1	-	1	-	-	-	-	-	2	1
CO2	2	1	2	1	3	-	1	-	-	-	-	-	2	1
CO3	2	1	2	1	3	-	1	-	-	-	-	-	2	1
CO4	2	2	2	1	-	2	2	-	1	2	2	1	2	1
CO5	2	2	2	1	-	-	1	-	-	-	-	-	2	1
22IPE$19	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**1**
1– Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1, 4.3.1,5.1.2,7.1.1
CO2	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1, 5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,7.1.1
CO3	1.1.1,1.3.1,1.4.1,2.1.1,2.2.3,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1,4.3.1,5.1.1, 5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,7.1.1,
CO4	1.1.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1, 4.3.1,6.1.1,7.1.1,7.1.2,9.3.1,10.1.1,10.1.2,10.3.1,11.1.1,11.2.1,11.3.1,12.3.2
CO5	1.1.1,1.3.1,1.4.1,2.1.1,,2.1.2,2.2.3,2.3.1,2.4.1,3.1.1,3.1.6,3.2.1,3.3.1,3.3.2,4.1.1,4.2.1, 4.3.1,7.1.1,

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPE$20	STREAM PROCESSING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, data Processing terminology, definition & concepts; Different types of Data Processing; The concepts of Real-time Data processing; Selecting appropriate structures for designing and running real-time data services in a business environment. The benefits and drive the adoption of real-time data services to solve real-world problems	
UNIT– I	**FUNDAMENTALS OF STREAM PROCESSING**	**9 Periods**
Continuous data processing, Stream processing foundations- data management technology, parallel and distributed systems, signal processing, statistics and data mining, optimization theory, stream processing, Introduction to stream processing – Stream processing applications, information flow processing technologies.		
UNIT – II	**REAL-TIME DATA PROCESSING**	**9 Periods**
Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing, Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage		
UNIT – III	**DATA MODELS AND QUERY LANGUAGES**	**9 Periods**
Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many-to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL.		
UNIT – IV	**EVENT PROCESSING WITH APACHE KAFKA**	**9 Periods**
Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API.		
UNIT – V	**REAL-TIME PROCESSING USING SPARK STREAMING**	**9 Periods**
Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*Henrique C.M.Andrade,BugraGedikandDeepakS.Turaga "**FundamentalsofStreamProcessing:ApplicationDesign,SystemsandAnalytics**" , CambridgeUniversitypress, 1st edition, 2014.*
2	*Shilpi Saxena, Saurabh Gupta, "**Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka**", Packt Publishing, 1st edition, 2017*

REFERENCES :

1	*Martin Kleppmann, "**Designing Data-Intensive Applications**", O'Reilly Media, 2017*
2	TylerAkidan, SlavaChernyakandReuvenLax,"**StreamingSystems**",O'ReillyMedia,Inc,2nd Edition, 2019.
3	*Tyler Akidau, Slava Chemyak, Reuven Lax, "**Streaming Systems: The What, Where, When and How of Large-Scale Data Processing**", O'Reilly publication, 2018*
4	*https://spark.apache.org/docs/latest/streaming-programming-guide.html*
5	*Kafka.apache.org*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the applicability and utility of different streaming algorithms.	K2
CO2	Describe and apply current research trends in data-stream processing.	K3
CO3	Analyze the suitability of stream mining algorithms for data stream systems.	K4
CO4	Program and build stream processing systems, services, and applications.	K2
CO5	Solve problems in real-world applications that process data streams.	K1

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	3	1	-	-	-	2	3	1	2	1	3
CO2	2	1	1	2	2	-	-	-	3	2	2	3	1	2
CO3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO4	2	1	3	3	3	-	-	-	3	3	1	1	1	2
CO5	3	3	1	2	2	-	-	-	3	3	2	3	3	2
22IPE$20	**3**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**3**	**3**	**1**	**2**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO2	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO3	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO4	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2
CO5	1.3.1,1.4.1, 2.1.1, 2.2.2, 2.2.4, 3.1.4, 3.1.6, 4.3.4, 5.1.2, 5.2.1, 9.3.1, 10.1.1, 10.3.2, 11.2.1, 11.3.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	20	-	20	20	-	100
CAT2	40	20	-	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	20	20	20	20	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	20	20	20	20	10	100
ESE	40	40	-	20	-	-	100

22IPE$21	SECURITY AND PRIVACY IN CLOUD *(Common to CSE $ IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to develop proficiency in securing cloud environments while safeguarding data privacy and ensuring regulatory compliance.	
UNIT – I	**INTRODUCTION AND SECURITY LEVELS**	**9 Periods**
The Evolution of Cloud Computing, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud Barriers to Cloud Computing Adoption in the Enterprise. Infrastructure Security - The Network Level, The Host Level, The Application Level.		
UNIT – II	**DATA SECURITY AND STORAGE**	**9 Periods**
Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security Identity and Access Management- Trust Boundaries and IAM, IAM Challenges, IAM Definitions, IAM Architecture and Practice, IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management, Cloud Service Provider IAM Practice		
UNIT – III	**SECURITY MANAGEMENT IN THE CLOUD**	**9 Periods**
Security Management Standards, Security Management in the Cloud - Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management, Access Control - Security Vulnerability, Patch, and Configuration Management.		
UNIT – IV	**PRIVACY**	**9 Periods**
Privacy, Data Life Cycle, Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications		
UNIT – V	**AUDIT AND COMPLIANCE**	**9 Periods**
Internal Policy Compliance - Governance, Risk, and Compliance (GRC), Illustrative Control Objectives for Cloud Computing, Incremental CSP-Specific Control Objectives, Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements, Cloud Security Alliance, Auditing the Cloud for Compliance.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Tim Mather, Subra Kumaraswamy, and Shahed Latif,* ***"Cloud Security and Privacy:An Enterprise Perspective on Risks and Compliance"****, O'Reilly Media, 2011*

REFERENCES:

1	*John R. Vacca,* ***"Cloud Computing Security Foundations and Challenges"****, CRC Press,2nd Edition,2020.*
2	*Siani Pearson, George Yee* ***"Privacy and Security for Cloud Computing"*** *Computer Communications and Networks, Springer, 2013.*
3	*Ronald L. Krutz, Russell Dean Vines,* ***"Cloud Security: A Comprehensive Guide to Secure Cloud Computing"****, Wiley Publishing, 2010*
4	*Ben Halper,* ***"Auditing Cloud Computing: A Security and Privacy Guide"*** *John Wiley & Sons, Inc. Publications, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the threats, challenges, and security levels associated with infrastructure security.	K2
CO2	Examine the current state of data security and storage in the cloud. Explain the identity and access management (IAM) practice in the cloud.	K3
CO3	Define and use appropriate security management frameworks and standards for the cloud.	K2
CO4	Understand the significance of privacy in the cloud.	K3
CO5	Enumerate the importance of audit and compliance functions within the cloud.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping													
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	3	3	1	2	-	-	-	1	1	1	3	3	2
CO2	1	3	2	3	1	-	-	-	2	2	3	2	3	1
CO3	3	2	2	3	2	-	-	-	3	1	1	2	2	3
CO4	2	1	2	3	3	-	-	-	3	2	3	3	1	1
CO5	1	3	3	1	1	-	-	-	2	3	3	2	2	3
22IPE$21	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,3.1.2,10.1.1,10.1.2,10.1.3,12.1.1,12.1.2,12.2.1, 12.2.2,12.3.1,12.3.2
CO2	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,9.1.1, 10.1.1,10.1.2,10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO3	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,3.1.2,4.1.1,4.1.2,4.1.3,4.1.4,9.1.1,10.1.1,10.1.2, 10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO4	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,2.4.4, 3.1.1,3.1.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4, 9.1.1, 10.1.1,10.1.2,10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO5	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,3.1.2,4.1.1,4.1.2,4.1.3,4.1.4,1,9.1.1,10.1.1,10.1.2, 10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$22	ETHICAL HACKING *(Common to CSE & IT)*

PREREQUISITE	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to make the students to explore the tools that gather information on potential target, protect against the hackers, identify vulnerabilities and attacks in network systems & web application.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Introduction to Hacking –Important Terminologies – Hacktivism – Computer Crimes and Implications. Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement–Penetration Testing Methodologies: OSSTMM–NIST –OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports.		
UNIT – II	**INFORMATION GATHERING AND SCANNING**	**9 Periods**
Information Gathering Techniques: Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute: ICMP, TCP and UDP Traceroute – Enumerating and Fingerprinting the Webservers – Google Hacking – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.		
UNIT – III	**NETWORK ATTACKS**	**9 Periods**
Network Sniffing – Types of Sniffing – Promiscuous versus Non promiscuous Mode – MITM Attacks – ARP Attacks –MAC flooding - Denial of Service Attacks – Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic –DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation –Attacking Network Remote Services – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.		
UNIT – IV	**EXPLOITATION**	**9 Periods**
Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E–Mails with Malicious Attachments – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Cracking the Hashes: Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.		
UNIT – V	**WIRELESS AND WEB HACKING**	**9 Periods**
Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircracking – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Log-In Protection Mechanisms – Captcha Validation Flaw – Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability– Session Attacks – SQL Injection Attacks.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*RafayBaloch, **"Ethical Hacking and Penetration Testing Guide"**, CRC Press, 2017.*

REFERENCES:

1	*Kevin Beaver, **"Hacking for Dummies"**, Sixth Edition, Wiley, 2022.*
2	*Kimberly Graves, "**Certified Ethical Hacker STUDY GUIDE"**, Wiley publication, 2010.*
3	*Michael Gregg, "**Certified Ethical Hacker"**, Pearson publication, 2014.*
4	*Matt Walker, "**All-in-one Certified Ethical Hacker Exam Guide"**, McGraw Hill Edition, 2012.*
5	*Jon Erickson, **"Hacking: The Art of Exploitation"**, Second Edition, Rogunix, 2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Use the various security tools to assess and to predict the vulnerabilities across any computing system using penetration testing.	K1
CO2	Identify prediction mechanism to prevent any kind of attacks using information gathering mechanisms.	K2
CO3	Protect the system using scanning techniques from malicious software and worms.	K2
CO4	Evaluate the wireless network flaws and able to apply security patches with different exploitations.	K3
CO5	Analyze the risk and support the organization for effective security measures.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2	2	2	3	-	-	1	1	1	-	-	2	1
CO2	2	2	2	2	3	-	-	1	1	1	-	-	2	1
CO3	2	1	2	2	3	-	-	1	1	1	-	-	2	1
CO4	2	1	2	2	3	-	-	1	1	1	-	-	1	1
CO5	2	2	2	2	3	-	-	1	1	1	-	-	2	1
22IPE$22	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,8.1.1,9.2.1,10.1.1
CO2	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,8.1.1,9.2.1,10.1.1
CO3	1.3.1,1.4.1,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,8.1.1,9.2.1,10.1.1
CO4	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,8.1.1,9.2.1,10.1.1
CO5	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,8.1.1,9.2.1,10.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$23	DIGITAL AND MOBILE FORENSICS *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to interpret the principles of digital evidences, duties of cybercrime experts and role of internet in cybercrime investigation and to choose appropriate software for digital forensics investigation.	
UNIT – I	**DIGITAL EVIDENCE**	**9 Periods**
Digital Evidence- Increasing Awareness of Digital Evidence- Principles of Digital Forensics-Challenging Aspects of Digital Evidence- Following the Cybertrail- Language of Computer CrimeInvestigation - Role of Computers in Crime.		
UNIT – II	**CYBER CRIME AND LAWS**	**9 Periods**
Duty of Experts- Admissibility - Levels of Certainty in Digital Forensics- Direct versusCircumstantial Evidence- Scientific Evidence- Presenting Digital Evidence- Federal CybercrimeLaw- Constitutional Law- Specific Cybercrime Offenses – Computer-Integrity Crimes – Computer-Assisted Crimes- Content-Related Cybercrimes.		
UNIT – III	**DIGITAL INVESTIGATIONS**	**9 Periods**
Digital Investigation Process Models – Scaffolding- Applying the Scientific Method- Guidelines forHandling Digital Crime Scenes- Fundamental Principles – Authorization- Digital Crime Scene:Preparing to Handle, Surveying, Preserving- Equivocal Forensic Analysis- Crime Scene Characteristics - Threshold Assessments- Modus Operandi-Motive and Technology.		
UNIT – IV	**COMPUTER AND MOBILE FORENSICS**	**9 Periods**
Representation of Data- Storage Media and Data Hiding- File Systems and Location of Data-Dealing with Password Protection and Encryption- Applying Forensic Science to Computers-Digital Evidence: Windows Systems, UNIX Systems, Macintosh Systems- Understanding MobileDevice Security - Analyzing SIM Cards - Analyzing Android, BlackBerry and iOS devices.		
UNIT – V	**NETWORK FORENSICS**	**9 Periods**
Role of the Internet in Criminal Investigations- Connecting Networks Using Internet Protocols-Legitimate versus Criminal Uses- Using the Internet as an Investigative Tool- Online Anonymityand Self-Protection- Forgery and Tracking: E-mail, Usenet- Linking the Data-Link and NetworkLayers: Encapsulation- Documentation, Collection, and Preservation- Analysis Tools andTechniques- TCP/IP-Related Digital Evidence.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*Eoghan Casey, **"Digital Evidence** and Computer Crime: Forensic Science**, Computers and the Internet"**, Elsevier, Third Edition, 2011. (Unit - I, II, III, V)*
2	*Reiber Lee, **"Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation"**, McGraw Hill LLC, Second Edition, 2018. (Unit - IV)*

REFERENCES

1	*Soufiane Tahiri, **"Mastering Mobile Forensics"**, Packt Publishing, 2016.*
2	*Oleg Afonin, **"Mobile Forensics – Advanced Investigative Strategies"**, Packt Publishing, 2016.*
3	*Filipo Sharevski, **"Mobile Network Forensics Emerging Research and Opportunities"**, IGI Global, 2018.*
4	*Ali Dehghantanha, Kim-Kwang Raymond Choo, **"Investigations of Cloud and Mobile Applications"**, Elsevier Science, 2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Define the terminologies involved in digital evidence and different aspects of computer crime investigations.	K1
CO2	Summarize the legal issues that arise in computer-related investigations and cyber laws.	K2
CO3	Illustrate the usage of digital evidence in reconstructing a crime or incident, identify suspects and understand criminal motivations.	K4
CO4	Articulate the role of computers and digital devices in crime investigations.	K3
CO5	Exemplify the underlying complexity of computer networks in digital investigation mechanism.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2	3	-	-	-	1	1	-	-	2	1
CO2	2	2	2	2	3	-	-	-	1	1	-	-	2	1
CO3	2	1	2	2	3	-	-	-	1	1	-	-	2	1
CO4	2	1	2	2	3	-	-	-	1	1	-	-	2	1
CO5	2	2	2	2	3	-	-	-	1	1	-	-	2	1
22IPE$23	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1, 12.1.2.
CO2	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1, 12.1.2.
CO3	1.3.1,1.4.1,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1, 12.1.2.
CO4	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1, 12.1.2.
CO5	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1, 12.1.2.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	30	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	40	30	30	-	-	100
ESE	40	30	30	-	-	-	100

22IPE$24	SOCIAL NETWORK SECURITY *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of the course is to understand the importance and need for securing the online social networks and handle attacks and threats effectively in social media platform.	
UNIT – I	**OVERVIEW OF ONLINE SOCIAL NETWORKS AND THEIR IMPACTS ON USERS**	**9 Periods**
Online Social Network vulnerabilities - Functional parameters - Statistical analysis based on usage - Usage of social network based on requirements - online social networks issues and impacts - difficulties in detection and mitigation of attacks.		
UNIT – II	**SECURITY CHALLENGES IN SOCIAL NETWORKING**	**9 Periods**
Advanced Persistent threats, Classical threats, Social threats – Inbuilt security solutions, Third party software solutions, Other security solutions against online social network attacks. Branding - Building of social authority in social platform – COBRAS – Hashtag – Collective intelligence.		
UNIT – III	**DETECTING ATTACKS IN ONLINE SOCIAL NETWORKS**	**9 Periods**
Fake Account detection – Characteristics analysis of twitter accounts – Selection of features and computing feature set – Petri net based analyzers – Simulation of Petri net in PN2 environment – Evaluation using SPIN model checker – Evaluation and performance analysis.		
UNIT – IV	**VARIOUS THREATS AND THREAT HANDLING TOOLS**	**9 Periods**
Attackers in social media platform – categorizes of attacks based on account types - cyber security tools to protect user account and information. Open issues and challenges in existing security solutions – Principles and best practices to protect user accounts in social platform.		
UNIT – V	**DATA THEFT - A CASE STUDY IN FACEBOOK**	**9 Periods**
Facebook data breaker in Indonesia – Expert opinions, Comments, Counter measures - Violating of rights to privacy (Singapore case related to Facebook) – Data protection based on International and National law		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Brij Gupta, Somya Ranjan Sahoo, "**Online Social Network Security – Principles, Algorithms, Applications and Perspectives**" , CRC Press, 2021.*
2	*Micheal Cross, "**Social Media Security**", O'Reilly Syngress , 2017.*

REFERENCES:

1	*Borko Furht, "**Handbook of Social Network Technologies and Application",** Springer, 2016.*
2	*Dion Goh and Schubert Foo, "**Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively**", IGI Global Snippet, 2008.*
3	*Xiaohui Liang , Rongxing Lu , Xiaodong Lin , Xuemin Shen"**Security and Privacy in Mobile Social Networks**, Springer, 2013*
4	*Al-Sakib Khan Pathan, "**Securing Social Networks in Cyberspace**", CRC Press, 2021*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the impact of users in online social platforms.	K2
CO2	Analyze security challenges in online social networks.	K4
CO3	Apply Petri net models to detect attacks in online social platforms.	K4
CO4	Use appropriate tools for handling threats in online social networks.	K3
CO5	Argue the real time data thefts in Facebook and devise countermeasures.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3	2	1	2	1	-	-	-	-	-	-	1	-
CO2	2	3	2	1	2	1	-	-	-	-	-	1	1	1
CO3	2	3	2	2	2	1	-	-	-	-	-	-	1	-
CO4	2	3	2	2	2	1	-	-	-	-	-	2	1	1
CO5	2	3	2	2	2	1	-	-	-	-	-	2	1	1
22IPE$24	2	3	2	2	2	1	-	-	-	-	-	1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.4.4, 3.1.2, 3.1.5, 3.2.1, 3.4.1, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1.
CO2	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.2, 3.1.5, 3.2.1, 3.4.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 12.1.2, 12.2.2.
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.2, 3.1.5, 3.2.1, 3.4.1, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1.
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.2, 3.1.5, 3.2.1, 3.4.1, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.2.1, 12.1.1, 12.2.2, 12.3.2.
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.2, 3.1.5, 3.2.1, 3.4.1, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 12.2.1, 12.2.2, 12.3.2.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	35	35	-	-	-	100
CAT2	-	35	35	30	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	50	50	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	50	50	-	-	100
ESE	10	20	30	40	-	-	100

22IPE$25	MODERN CRYPTOGRAPHY *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to make the students to understand the basic concepts of modern cryptography, private key & public key cryptographic algorithms, Identity based encryption mechanism and Post quantum cryptographic algorithms.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Cryptography and Modern Cryptography- Basic Principles of Modern Cryptography - Perfectly-Secret Encryption - Computational Complexity - Zero-knowledge Properties - Zero-knowledge Argument - Protocols with Two-sided-error - Round Efficiency - Non-interactive Zero-knowledge.		
UNIT – II	**SYMMETRIC CRYPTOGRAPHY**	**9 Periods**
Computational Approach to Cryptography - Defining Computationally-Secure Encryption – Secure Communication and Message Integrity-Collision-Resistant Hash Functions - NMAC and HMAC -One-Way Functions -Limitations of Private-Key Cryptography.		
UNIT – III	**ASYMMETRIC CRYPTOGRAPHY**	**9 Periods**
Primes and Divisibility - Modular Arithmetic - Cyclic Groups - Algorithms for Factoring -, Computing Discrete Logarithms - Goldwasser-Micali Encryption Scheme - Rabin Encryption Scheme - Paillier Encryption Scheme - Digital Signature Schemes - Lamport's One-Time Signature Scheme - Signatures from Collision-Resistant Hashing.		
UNIT – IV	**IDENTITY BASED ENCRYPTION**	**9 Periods**
Bilinear map – Security Model- Hardness Assumptions - Boneh-Franklin Identity based Encryption (IBE) – Gentry's IBE- Dual System Encryption – Waters' IBE - Boneh-Boyen IBE – Security Model for Hierarchical IBE - Waters' Realization – Generic Group Model.		
UNIT – V	**POST QUANTUM CRYPTOGRAPHY**	**9 Periods**
Lattice Problems – NTRU Cryptosystem - Lattice-Based Cryptography – Ring Variants of Learning with Errors (LWE) & Learning with Rounding (LWR) - (LWE+LWR)-Based Public-Key Encryption – Ring Variant of Lizard-Code based Cryptography: McEliece&Niederreiter Cryptosystem, Security Analysis.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Jonathan Katz and Yehuda Lindell,* ***"Introduction to Modern Cryptography",*** *CRC press, 2020.. (Unit - I, II, III)*
2	*Intae Kim, Wai Kong Lee, Seong Oun Hwang,* ***"Modern Cryptography with Proof Techniques and Implementations",*** *CRC press, 2021.(Unit IV, V)*

REFERENCES :

1	*William Stallings,* ***"Cryptography and Network security Principles and Practices",*** *Pearson/PHI, 2016.*
2	*Wade Trappe, Lawrence C Washington,* ***"Introduction to Cryptography with coding theory"****, Pearson, 2020.*
3	*W. Mao,* ***"Modern Cryptography – Theory and Practice"****, Pearson Education, 2003.*
4	*Song Y. Yan ,* ***"Computational Number Theory and Modern Cryptography"****, Wiley, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Realize the modern cryptographic principles and concepts.	K2
CO2	Apply a symmetric cryptography mechanism for encryption using hash functions.	K3
CO3	Apply asymmetric cryptography mechanism for public key encryption.	K3
CO3	Determine identity based encryption using hardness assumption and security models.	K3
CO5	Exemplify post-quantum standardization algorithms.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2	-	-	-	-	-	-	-	1	3	1
CO2	2	2	2	2	-	-	-	-	-	-	-	1	3	1
CO3	2	2	2	2	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	3	-	-	-	-	-	-	-	1	3	1
CO5	2	2	2	3	-	-	-	-	-	-	-	1	3	1
22IPE$25	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2,2.1.3, 2.2.3, 2.2.4, 2.4.1, 3.1.1, 3.1.6, 3.2.2, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 12.1.1
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2,2.1.3, 2.2.3, 2.2.4, 2.4.1, 2.4.3, 3.1.1, 3.1.6, 3.2.2, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 12.1.1
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2,2.1.3, 2.2.3, 2.2.4, 2.4.1, 2.4.3, 3.1.1, 3.1.6, 3.2.2, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 12.1.1
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2,2.1.3, 2.2.3, 2.2.4, 2.4.1, 2.4.3, 3.1.1, 3.1.6, 3.2.2, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 12.1.1
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2,2.1.3, 2.2.3, 2.2.4, 2.4.1, 2.4.3, 3.1.1, 3.1.6, 3.2.2, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 12.1.1

,

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	20	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	30	40	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	30	40	30	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$26	ENGINEERING SECURE SOFTWARE SYSTEMS *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to make the students understand about the development of robust software solutions while integrating security principles and practices throughout the software development lifecycle.	
UNIT – I	**FUNDAMENTALS OF SOFTWARE SECURITY**	**9 Periods**
Introduction - Software Assurance and Software Security - Threats to software security – Sources of software insecurity – Benefits of Detecting Software Security Defects Early – Managing Secure Software Development– Properties of Secure Software – Influence the Security Properties of Software- Assert and Specify Desired Security Properties.		
UNIT – II	**SECURE SOFTWARE REQUIREMENT ENGINEERING, ARCHITECTURE AND DESIGN**	**9 Periods**
Importance of Requirements Engineering – Quality Requirements – Security Requirements Engineering - SQUARE process Model – Requirements Elicitation - Requirements Prioritization – Critical Role of Architecture and Design – Issues and Challenges – Software Security Practices for Architecture and Design: Architectural Risk Analysis - Software Security Knowledge for Architecture and Design: Security Principles, Guidelines and Attack Patterns.		
UNIT – III	**SECURE CODING AND TESTING**	**9 Periods**
Code Analysis - Coding Practices – Software Security Testing – Security Testing Considerations Throughout the SDLC – Security and Complexity: System Assembly Challenges.		
UNIT – IV	**RISK MANAGEMENT**	**9 Periods**
Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques.		
UNIT – V	**GOVERNANCE AND MANAGING SECURE SOFTWARE**	**9 Periods**
Introduction - Governance and Security – Adopting an Enterprise Software Security Framework – Security and Project Management – Maturity of Practice.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Julia H. Allen,* ***"Software Security Engineering",*** *Pearson Education, 2008.*
2	*Evan Wheeler,* ***"Security Risk Management: Building an Information Security Risk Management Program from the Ground Up"****, First edition, Syngress Publishing, 2011.*

REFERENCES :

1	*McGraw, Gary,* ***"Software Security: Building Security In"****, Addison-Wesley, 2006.*
2	*John Viega, Gary McGraw ,* ***"Building Secure Software: How to Avoid Security Problems the Right Way"****, Addison-Wesley, 2011*
3	*Raimundas Matulevicius,* ***"Fundamentals of Secure System Modelling"****, Springer International Publishing, 2017.*
4	*Charles Antony Richard Hoare ,* ***"Software System Reliability and Security"****, IOS Press , 2007.*
5	*Heather Adkins, Betsy Beyer, Paul Blankinship, Piotr Lewandowski, Ana Oprea, Adam Stubblefield,* ***"Building Secure and Reliable Systems Best Practices for Designing, Implementing, and Maintaining Systems"****, O'Reilly Media, 2020.*
6	*Erik Fretheim, Marie Deschene,* ***"Secure Software Systems"****, Jones & Bartlett Learning, 2023.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Infer the fundamentals of software security.	K2
CO2	Apply security principles in software development.	K3
CO3	Integrate the appropriate security practices while coding and performing different types of testing.	K3
CO4	Identify, assess, mitigate and communicate security risks effectively in building secure software systems.	K4
CO5	Understand the importance of software security considerations as part of Governance and Project Management	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping													
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2	2	1	-	-	-	-	-	-	-	2	1
CO2	2	2	2	2	1	-	-	-	2	1	-	-	2	1
CO3	2	1	2	2	1	-	-	-	2	1	-	-	2	1
CO4	2	1	2	2	1	-	-	-	2	1	-	-	1	1
CO5	2	2	2	2	1	-	-	-	-	1	-	-	2	1
22IPE$26	**2**	**2**	**2**	**2**	**1**	-	-	-	**2**	**1**	-	-	**2**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														
b) CO and Key Performance Indicators Mapping														
CO1	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2, 4.3.3,5.1.1,10.1.1, 11.2.1													
CO2	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2, 4.3.3,5.1.1,5.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4,10.1.1, 11.3.1													
CO3	1.3.1,1.4.1,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.2,4.3.3,5.1.1,5.2.1, 9.1.1, 9.1.2, 9.2.1,9.2.2, 9.2.3, 9.2.4, 10.1.1, 11.3.1													
CO4	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3, 5.1.1,5.2.1, 9.1.1, 9.1.2, 9.2.1,9.2.2, 9.2.3, 9.2.4,10.1.1,11.1.2													
CO5	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2, 4.3.3,5.1.1,5.2.1,10.1.1, 11.3.2													

,

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	30	30	20	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$27	CRYPTO - CURRENCY AND BLOCKCHAIN TECHNOLOGIES *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to make the students to learn the basics of cryptography primitives used in block chain, networks in Block chain, Crypto currencies and applications of Block chain in various sectors.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Blockchain definitions- Database vs. blockchain- History, motivations & Characteristics - Background of DLT- Different types of blockchain- Overview of blocks - Moore's Law and Blockchain - Cryptography in blockchain- Cryptographic hashing- Digital signatures in blockchain.		
UNIT – II	**NETWORKS IN BLOCKCHAIN**	**9 Periods**
P2P networking architecture- Network discovery - Block synchronization - Building a simple blockchain in a P2P network - Blockchain structure - Blockchain networks - Bitcoin hard forks and altcoins – crypto currency application.		
UNIT – III	**BITCOIN AND CRYPTO CURRENCY**	**9 Periods**
Crypto currency - Bitcoin basics - Keys and addresses – Transactions - Mining and consensus – Bitcoin Network and Payments- Bitcoin Clients and APIs - Alternative Coins- MultiChain platform - Setting up a blockchain environment.		
UNIT – IV	**SMART CONTRACTS AND ETHEREUM**	**9 Periods**
Proof of Existence architecture - Building the Proof of Existence application - Digital assets and identity - Proof of ownership- Smart contracts- NEO blockchain - Choosing the smart contract platform –Ethereum network - Components of the Ethereum ecosystem- Test networks –Setting and Starting up a private network.		
UNIT – V	**BLOCKCHAIN APPLICATIONS**	**9 Periods**
Financial blockchain projects - Non-financial blockchain projects- Blockchain optimizations - Blockchain enhancements - Transaction security model- Decentralized security model - Attacks on the blockchain–Block in Financial system and crowdfunding.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Koshik Raj, "**Foundations of Blockchain: The pathway to cryptocurrencies and decentralized blockchain applications**", Packt publisher, 2019.*

REFERENCES:

1	*Bashir Imran, "**Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained**"Packt publisher, 2017.*
2	*Antony Lewis*, ***"The Basics of Bitcoins and Blockchains"***, *Mango Publising, 2018.*
3	*Chris Dannen, **"Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners"**,Apresspublisher, 2017.*
4	*S Shukla, M. Dhawan, S. Sharma and S. Venkatesan, **"Blockchain Technology: Cryptocurrency and Applications"**, Oxford University Press, 2019.*

COURSE ARTICULATION MATRIX:														
a) CO and PO Mapping														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	1	1	2	3	-	-	-	1	1	-	-	2	2
CO2	2	1	1	2	3	-	-	-	1	1	-	-	2	1
CO3	2	1	1	2	3	-	-	-	1	1	-	-	2	1
CO4	2	1	1	2	3	-	-	-	1	1	-	-	1	1
CO5	2	1	1	2	3	-	-	-	1	1	-	-	2	1
22IPE$27	2	1	1	2	3	-	-	-	1	1	-	-	2	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.1.2,1.3.1,1.4.1,2.1.3,2.2.3,2.4.2,3.3.2,4.1.1,4.1.2,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1
CO2	1.3.1,1.4.1,2.1.3,2.4.2,3.3.2,4.1.1,4.1.2,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1
CO3	1.3.1,1.4.1,2.1.3,2.4.2,3.3.2,4.1.1,4.1.2,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1
CO4	1.3.1,1.4.1,2.1.3,2.2.3,2.4.2,3.3.2,4.1.1,4.1.2,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1
CO5	1.3.1,1.4.1,2.1.3,2.4.2,3.3.2,4.1.1,4.1.2,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2,9.2.1,10.1.1

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$28	NETWORK SECURITY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To understand fundamentals of cryptography, key management techniques & authentication approaches, the network and transport layer security techniques, the application layer security standards and real time security practices.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Basics of cryptography, conventional and public-key cryptography, hash functions, authentication and digital signatures.		
UNIT – II	**KEY MANAGEMENT AND AUTHENTICATION**	**9 Periods**
Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.		
UNIT – III	**ACCESS CONTROL AND SECURITY**	**9 Periods**
Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application.		
UNIT – IV	**APPLICATION LAYER SECURITY**	**9 Periods**
Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain Keys Identified Mail, Wireless Network Security: Mobile Device Security.		
UNIT – V	**SECURITY PRACTICES**	**9 Periods**
Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*William Stallings, "**Cryptography and Network Security: Principles and Practice"**, 6th Edition, 2014, Pearson, ISBN 13:9780133354690.*

REFERENCES :

1	*M. Speciner, R. Perlman, C. Kaufman, **"Network Security: Private Communications in a Public World"**, Prentice Hall, 2002.*
2	*Gregor N. Purdy, **"Linux iptables Pocket Reference"**, O'Reilly, 2004.*
3	*Michael Rash, **"Linux Firewall: No Starch Press"**, October 2007.*
4	*J. Michael Stewart, Jones & Bartlett Learning, **"Network Security, Firewalls And VPNs"**, 2013.*
5	*Michael Gregg, **"The Network Security Test Lab: A Step-By-Step Guide"**, Dreamtech Press, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Classify the encryption techniques.	K2
CO2	Illustrate the key management technique and authentication.	K2
CO3	Evaluate the security techniques applied to network and transport layer.	K3
CO4	Discuss the application layer security standards.	K2
CO5	Apply security practices for real time applications.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	2	2	2	3	-	-	-	-	-	-	-	2	-
CO2	2	2	2	2	3	-	-	-	-	-	-	-	2	-
CO3	2	1	2	2	3	-	-	-	-	-	-	-	2	-
CO4	2	1	2	2	3	-	-	-	-	-	-	-	1	-
CO5	2	2	2	2	3	-	-	-	-	-	-	-	2	-
22IPE$28	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2.
CO2	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2.
CO3	1.3.1,1.4.1,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2.
CO4	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2.
CO5	1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.4.2,3.1.1,3.1.5,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,5.1.1,5.1.2,5.2.1,5.3.1,5.3.2.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	30	40	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	30	40	30	-	-	100
ESE	20	30	30	20	-	-	100

22IPE$21	SECURITY AND PRIVACY IN CLOUD *(Common to CSE $ IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of this course is to develop proficiency in securing cloud environments while safeguarding data privacy and ensuring regulatory compliance.	
UNIT – I	**INTRODUCTION AND SECURITY LEVELS**	**9 Periods**
The Evolution of Cloud Computing, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud Barriers to Cloud Computing Adoption in the Enterprise. Infrastructure Security - The Network Level, The Host Level, The Application Level.		
UNIT – II	**DATA SECURITY AND STORAGE**	**9 Periods**
Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security Identity and Access Management- Trust Boundaries and IAM, IAM Challenges, IAM Definitions, IAM Architecture and Practice, IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management, Cloud Service Provider IAM Practice		
UNIT – III	**SECURITY MANAGEMENT IN THE CLOUD**	**9 Periods**
Security Management Standards, Security Management in the Cloud - Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management, Access Control - Security Vulnerability, Patch, and Configuration Management.		
UNIT – IV	**PRIVACY**	**9 Periods**
Privacy, Data Life Cycle, Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications		
UNIT – V	**AUDIT AND COMPLIANCE**	**9 Periods**
Internal Policy Compliance - Governance, Risk, and Compliance (GRC), Illustrative Control Objectives for Cloud Computing, Incremental CSP-Specific Control Objectives, Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements, Cloud Security Alliance, Auditing the Cloud for Compliance.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*Tim Mather, Subra Kumaraswamy, and Shahed Latif,* ***"Cloud Security and Privacy:An Enterprise Perspective on Risks and Compliance"****, O'Reilly Media, 2011*

REFERENCES:

1	*John R. Vacca,* ***"Cloud Computing Security Foundations and Challenges"****, CRC Press,2nd Edition,2020.*
2	*Siani Pearson, George Yee* ***"Privacy and Security for Cloud Computing"*** *Computer Communications and Networks, Springer, 2013.*
3	*Ronald L. Krutz, Russell Dean Vines,* ***"Cloud Security: A Comprehensive Guide to Secure Cloud Computing"****, Wiley Publishing, 2010*
4	*Ben Halper,* ***"Auditing Cloud Computing: A Security and Privacy Guide"*** *John Wiley & Sons, Inc. Publications, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the threats, challenges, and security levels associated with infrastructure security.	K2
CO2	Examine the current state of data security and storage in the cloud. Explain the identity and access management (IAM) practice in the cloud.	K3
CO3	Define and use appropriate security management frameworks and standards for the cloud.	K2
CO4	Understand the significance of privacy in the cloud.	K3
CO5	Enumerate the importance of audit and compliance functions within the cloud.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	1	2	-	-	-	1	1	1	3	3	2
CO2	1	3	2	3	1	-	-	-	2	2	3	2	3	1
CO3	3	2	2	3	2	-	-	-	3	1	1	2	2	3
CO4	2	1	2	3	3	-	-	-	3	2	3	3	1	1
CO5	1	3	3	1	1	-	-	-	2	3	3	2	2	3
22IPE$21	**2**	**2**	**2**	**2**	**2**	-	-	-	**2**	**2**	**2**	**2**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,3.1.2,10.1.1,10.1.2,10.1.3,12.1.1,12.1.2,12.2.1, 12.2.2,12.3.1,12.3.2
CO2	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,9.1.1, 10.1.1,10.1.2,10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO3	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,3.1.2,4.1.1,4.1.2,4.1.3,4.1.4,9.1.1,10.1.1,10.1.2, 10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO4	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,2.4.4, 3.1.1,3.1.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4, 9.1.1, 10.1.1,10.1.2,10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO5	1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,3.1.2,4.1.1,4.1.2,4.1.3,4.1.4,1,9.1.1,10.1.1,10.1.2, 10.1.3, 12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$29	KNOWLEDGE ENGINEERING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To understand the basics of Knowledge Engineering, discuss methodologies and modeling for Agent Design and Development, design and develop ontologies and apply reasoning with ontologies and rules.	
UNIT – I	**REASONING UNDER UNCERTAINTY**	**9 Periods**
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 Periods**
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 Periods**
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 Periods**
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 LEARNING**	**9 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*GHEORGHE TECUCI,George Mason University,DORINMARCU,George Mason University,MIHAIBOICU,George Mason University,,DAVID A. SCHUM,,George Mason University,**"Building Cognitive Assistants for Evidence-Based Reasoning"**,Cambridge university press, 2016*

REFERENCES :

1	*Ronald J. Brachman, Hector J. Levesque, **"knowledge representation and Reasoning"** c 2004 by Elsevier, Inc*
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.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the basics of Knowledge Engineering.	K2
CO2	Apply methodologies and modelling for Agent Design and Development.	K3
CO3	Design and develop ontologies.	K3
CO4	Apply reasoning with ontologies and rules.	K3
CO5	Understand learning and rule learning.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO2	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO3	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO4	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO5	3	3	3	3	2	2	-	-	-	-	-	2	3	1
22IPE$29	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, .3.2, .4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, .4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	50	50	-	-	-	100
CAT2	-	50	50	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	-	50	50	-	-	-	100

22IPE$30	SOFT COMPUTING *(Common to CSE $ IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Understand fundamentals of Neural Network, Fuzzy logic and GeniticAlgoritms	
UNIT – I	**FUNDAMENTALS OF NEURAL NETWORKS**	**9 Periods**
Basic Concepts of Neural Networks–Human Brain–Model of an Artificial Neuron-Neural Network Architecture–characteristics of Neural Network–Learning Methods–Taxonomy of Neural Network Architectures=Early Neural Network Architectures.		
UNIT – II	**FUZZY SET THEORY**	**9 Periods**
Fuzzy vs Crisp–Crisp sets–Fuzzy sets–Crisp Relations–Fuzzy Relations.		
UNIT – III	**FUZZY SYSTEMS**	**9 Periods**
Crips Logic–Predictive Logic–Fuzzy Logic–Fuzzy Rule Based System–Defuzzification Methods–Applications		
UNIT – IV	**FUNDAMENTALS OF GENETIC ALGORITHMS**	**9 Periods**
Genetic Algorithm: History–Basic Concepts–Creation of Offsprings –Working Principle–Encoding–Fitness Function–Reproduction - Exploratory algorithm		
UNIT – V	**GENETIC MODELLING**	**9 Periods**
Inheritance Operations– Cross-Over–Inversion and Deletion –Mutation Operation–Bitwise Operators–Bitwise Operator used in GA=Generational Cycle –Conversion of Genetic Algorithm=Applications–Multilevel Optimization–Real Life Problems, Differences and Similarities between GA and Other Traditional methods.		
Contact Periods: **Lecture: 9 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 9 Periods**		

TEXT BOOK:

1	S. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India, 2010.
2	J.S.R. Jang, C.T. Sun, E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education, 2004.

REFERENCES :

1	S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Second Edition, Wiley-India, 2007.
2	Siman Haykin, "Neural Networks", Prentice Hall of India, 1999.
3	Timothy Ross, "Fuzzy Logic with Engineering Applications", Wiley Publications, 2016.
4	David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 2008.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	understand fuzzy sets Theory	K2
CO2	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.	K3
CO3	Design and analyzing neural networks for pattern classification and regression problems	K4
CO4	Understand fundamentals of Genetic Algorithms	K2
CO5	Apply genetic algorithms to optimization problems.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping													
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**
CO1	3	3	3	3	2	2	-	-	-	-	-	2	1	3
CO2	3	3	3	3	2	2	-	-	-	-	-	2	1	3
CO3	3	3	3	3	2	2	-	-	-	-	-	2	1	3
CO4	3	3	3	3	2	2	-	-	-	-	-	2	1	3
CO5	3	3	3	3	2	2	-	-	-	-	-	2	1	3
22IPE$30	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	10	20	30	20	20	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	50	50	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	-	50	50	-	100
ESE	10	20	35	35	-	-	100

22IPE$03	DEEP LEARING *(Common to CSE $ IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The Objective of this course is to make the students familiar with Perceptron Learning Algorithms,Feedforward Neural Networks, Deep Neural Networks, Convolution Neural Networks, Recurrent Neural Networks	
UNIT – I	**INTRODUCTON TO DEEP LEARNING**	**9 Periods**
Basics: Biological Neuron, Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.		
UNIT – II	**FEEDFORWARD NETWORKS**	**9 Periods**
Representation Power of Feedforward Neural Networks, Backpropagation, Empirical Risk Minimization, Regularization, Autoencoders.		
UNIT – III	**DEEP NEURAL NETWORKS**	**9 Periods**
Difficulty of training deep neural networks, Greedy layerwise training. Gradient Descent (GD), Stochastic Gradient Descent (GD), Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), Regularization methods (dropout, drop connect, batch normalization).		
UNIT – IV	**CONVOLUTIONAL NEURAL NETWORKS**	**9 Periods**
Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet		
UNIT – V	**RECURRENT NEURAL NETWORKS**	**9 Periods**
Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	Ian Goodfellow and Yoshua Bengio and Aaron Courville., ***" Deep Learnin ",*** MIT Press, 2016

REFERENCES:

1	Raúl Rojas, ***"Neural Networks: A Systematic Introduction ",*** Springer-Verlag, Berlin, 1996.
2	Yegnanarayana, B., ***"Artificial Neural Networks ",*** PHI Learning Pvt. Ltd, 2009
3	Christopher Bishop., ***"Pattern Recognition and Machine Learning ",*** Springer,2016
4	Nikhil Buduma, ***"Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms",*** O'Reilly publications, 2017

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Summarize the basics of neural network and deep learning	K2
CO2	Implement basic neural network model with hidden layers	K3
CO3	Analyze optimization and generalization in deep learning	K3
CO4	Criticize convolutional neural network and how it is applied to analyzing visual imagery	K3
CO5	Appraise Recurrent Neural Network (RNN) and its temporal dynamic behavior which helps us to remembers some information about a sequence to predict the next information	K3

COURSE ARTICULATION MATRIX															
a) CO and PO Mapping															
COs/ Pos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO1	1	1	1	1	-	-	-	-	-	-	-	-	2	1	
CO2	2	2	2	2	1	-	-	-	-	-	-	-	2	1	
CO3	3	3	3	3	2	-	-	-	-	-	-	-	2	1	
CO4	3	3	3	3	2	-	-	-	-	-	-	-	2	1	
CO5	3	3	3	3	2	-	-	-	-	-	-	-	2	1	
22IPE$03	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	
1– Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	1.1.1, 2.1.1, 3.2.1, 4.1.1														
CO2	1.1.1, 1.2.1, 2.1.1, 2.2.2, 3.1.2, 3.3.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1														
CO3	1.1.1, 1.2.1, 1.3.1, 1.3.2, 2.1.1, 2.2.2, 2.2.3, 2.3.1, 3.1.2, 3.3.2, 3.3.3, 3.4.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.2.1, 5.2.3														
CO4	1.1.1, 1.2.1, 1.3.1, 1.3.2, 2.1.1, 2.2.2, 2.2.3, 2.3.1, 3.1.2, 3.3.2, 3.3.3, 3.4.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.2.1, 5.2.3														
CO5	1.1.1, 1.2.1, 1.3.1, 1.3.2, 2.1.1, 2.2.2, 2.2.3, 2.3.1, 3.1.2, 3.3.2, 3.3.3, 3.4.2, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.2.1, 5.2.3														

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	20	40	5	5	-	100
Assignment 2	30	20	30	10	5	5	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IPE$04	TEXT TO SPEECH ANALYSIS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Understand natural language processing basics, text classification, phonetics and retrieve information using question answering and dialogue system.	
UNIT – I	**NATURAL LANGUAGE BASICS**	**9 Periods**
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		
UNIT – II	**TEXT CLASSIFICATION**	**9 Periods**
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 Periods**
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	**PHONETICS**	**9 Periods**
Speech,Sounds and Phonetic Transcription, Articulatory Phonetics, Prosody, Acoustic Phonetics and Signals, Phonetic Resources		
UNIT – V	**AUTOMATIC SPEECH RECOGNITION AND TEXT-TO-SPEECH**	**9 Periods**
The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture, CTC, ASR Evaluation: Word Error Rate, TTS, Other Speech Tasks		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Dipanjan Sarkar,* ***"Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data"****, APress,2018*
2	*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	*Tanveer Siddiqui, Tiwary U S,* ***"Natural Language Processing and Information Retrieval"****, Oxford University Press, 2008*
2	*. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana,* ***"Fundamentals of Speech Recognition"*** *, 1st Edition, Pearson, 2009.*
3	*. Steven Bird, Ewan Klein, and Edward Loper,* ***"Natural language processing with Python"****, O'REILLY.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand natural language processing basics	K2
CO2	Apply classification algorithms to text documents	K3
CO3	Build question-answering and dialogue systems	K2
CO4	Understand speech, sound and phonetics	K2
CO5	Develop a speech recognition system	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	2						2	3	1
CO2	3	3	3	3	2	2						2	3	1
CO3	3	3	3	3	2	2						2	3	1
CO4	3	3	3	3	2	2						2	3	1
CO5	3	3	3	3	2	2						2	3	1
22IPE$04	3	3	3	3	2	2						2	3	1
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	75	25	-	-	-	100
CAT2	-	-	100	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	75	25	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	-	75	25	-	-	-	100

22IPE$31	OPTIMIZATION TECHNIQUES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To Understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function.	
UNIT – I	**INTRODUCTION TO CLASSICAL OPTIMIZATION TECHNIQUES**	**9 Periods**
Introduction to Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.**Classical Optimization Techniques:**Single variable Optimization, Multi variable Optimization with and without constraints, Multivariable Optimization with equality constraints - solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints - Kuhn – Tucker conditions.		
UNIT – II	**LINEAR PROGRAMMING**	**9 Periods**
Linear Programming: Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming, Graphical method of Linear Programming problem. **Simplex Method :**Phase I and Phase II of the Simplex Method, The Revised Simplex method, Primal and Dual Simplex Method, Big –M method.		
UNIT – III	**TRANSPORTATION PROBLEM AND QUEUING**	**9 Periods**
Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. (Including assignment and travelling salesman problems) (No degeneracy problems). **Queuing:**Queuing Models : Essential features of queuing systems, operating characteristics of queuing system, probability distribution in queuing systems, classification of queuing models.		
UNIT – IV	**DYNAMIC PROGRAMMING**	**9 Periods**
Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.**IntegerProgramming:**Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.		
UNIT – V	**SIMULATION MODELING**	**9 Periods**
Simulation Modeling: Introduction, Definition and types, Limitations, Various phases of modeling, Monte Carlo method, Applications, advantages and limitations of simulation.		
Contact Periods: **Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*S.S.Rao, **"Engineering optimization: Theory and practice"**, New Age International (P) Limited.*
2	*H A Taha ,**"Operations Research: An Introduction"** , 5th Edition, Macmillan, New York.*

REFERENCES :

1	*K.V. Mittal and C. Mohan, **"Optimization Methods in Operations Research and systems Analysis"** New Age, International (P) Limited, Publishers*
2	*by S.D.Sharma, KedarnathRamanath& Co ,**"Operations Research "***
3	*G. Hadley, **"Linear programming ",** Narosa Publishing House, New Delhi.*
4	*M. Mahajan, DhanpatRai& co,**" Industrial Engineering and Production Management".***
5	*by NVR Naidu, G Rajendra, T Krishna Rao, **"Operations Research ",**I K International Publishing house, New Delhi.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function. Review differential calculus in finding the maxima and minima of functions of several variables.	K2
CO2	Formulate real-life problems with Linear Programming. Solve the Linear Programming models using graphical and simplex methods.	K4
CO3	Formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms. Analyze the Queuing model for effective customer satisfaction	K4
CO4	Apply dynamic programming to optimize multi stage decision problems.	K4
CO5	Construct precedence diagram for series of activities in a huge project to find out probability of expected completion time using PERT-CPM networks. Also reduce the duration of project by method of crashing.	K6

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO2	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO3	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO4	3	3	3	3	2	2	-	-	-	-	-	2	3	1
CO5	3	3	3	3	2	2	-	-	-	-	-	2	3	1
22IPE$31	**3**	**3**	**3**	**3**	**2**	**2**	-	-	-	-	-	**2**	**3**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1,2.4.2,2.4.3,2.4.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1,4.1.2,4.1.3,4.1.4, 4.2.1,4.2.2,4.3.1,4.3.2, 5.1.1, 5.2.1, 5.3.2, 6.1.1, 6.1.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	50	50	-	-	-	100
CAT2	-	50	50	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	-	50	50	-	-	-	100

22IPE$32	GAME THEORY *(Common to CSE $ IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of the course is to understanding of strategic decision-making, equilibrium concepts, and Master strategic complexities in games with incomplete information. Apply game theory to analyze cooperative behavior and coalition formation strategies.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Introduction: What is Game Theory - An outline of the history of game theory- Definition of Games-Actions, Strategies, Preferences, Payoffs – Examples - Strategic form games and examples: Prisoner's Dilemma, Bach or Stravinsky, Matching Pennies - Notion of Nash Equilibrium - Examples of Nash Equilibrium - Best Response Functions - Dominated Actions - Symmetric Games and Symmetric Equilibria.		
UNIT – II	**GAMES WITH PERFECT INFORMATION**	**9 Periods**
Mixed Strategy Nash Equilibrium- Randomization of Actions, Mixed strategy Nash equilibrium, Dominated actions, Pure strategy equilibria in the presence of randomization, Illustrations: expert diagnosis reporting a crime - Finding all mixed strategy Nash equilibria of some representative games.		
UNIT – III	**EXTENSIVE GAMES WITH PERFECT INFORMATION**	**9 Periods**
Extensive games with Perfect Information- Extensive games, Strategies and outcomes, Nash equilibrium, Subgame perfect equilibrium, finding subgame perfect equilibria using backward induction - Allowing for simultaneous moves in extensive games with perfect information - Example of committee decision making - Two Player Zerosum Games: Maxminimization and Nash Equilibrium - Strictly competitive games - Nash equilibrium in strictly competitive games - Minimax theorem - Solution via linear programming - Examples.		
UNIT – IV	**GAMES WITH IMPERFECT INFORMATION**	**9 Periods**
Bayesian and Repeated Games - Motivational Examples - Definition of a Bayesian Game and Bayesian Nash Equilibrium and examples - Auctions: Independent private values, Nash equilibrium of first price auction and second price auction, common valuations, revenue equivalence of auctions - Idea of repeated games - Finitely repeated prisoner's dilemma, infinitely repeated prisoner's dilemma, strategies in a repeated prisoner's dilemma, Nash equilibria and equilibria payoffs in infinitely repeated prisoner's dilemma, sub-game perfect equilibria and equilibria payoffs in infintely repeated prisoner's dilemma.		
UNIT – V	**COALITIONAL GAMES**	**9 Periods**
Coalitional Games - The Core - Illustrations: Ownership and distribution of wealth - exchanging homogeneous items - exchanging heterogeneous items - voting – matching - Shapley value and examples.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*M. J. Osborne,* ***" An Introduction to Game Theory"****,Oxford University Press, 2012(reprinted 2022).*

REFERENCES :

1	*M. Machler, E. Solan, S. Zamir,* ***"Game Theory"****, Cambridge University Press, 2013*
2	*N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani (Editors),* ***"Algorithmic Game Theory"*** *Cambridge University Press, 2007.*
3	*A.Dixit and S. Skeath,* ***"Games of Strategy"****, Second Edition, W W Norton & Co Inc, 2004.*
4	*YoavShoham, Kevin Leyton-Brown,* ***"Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations"****, Cambridge University Press 2008.*
5	*Zhu Han, Dusit Niyato, Walid Saad, Tamer Basar and Hjorungnes,* ***"Game Theory in Wireless and Communication Networks"****, Cambridge University Press, 2012.*
6	*Y.Narahari,* ***"Game Theory and Mechanism Design"****, IISC Press, World Scientific.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Summarize the fundamentals of game theory and concepts.	K1
CO2	Discuss the use of Nash Equilibrium for other problems.	K1
CO3	Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.	K3
CO4	Identify some applications that need aspects of Bayesian Games.	K3
CO5	Use various Coalitional games concepts.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	1	2	1	2	2	-	-	-	-	-	-	2	2	2	1
CO2	1	2	1	2	2	-	-	-	1	2	1	2	2	2	1
CO3	1	2	2	2	3	-	-	-	-	2	2	1	2	2	2
CO4	1	2	2	2	3	-	-	-	1	2	2	1	2	2	2
CO5	1	2	2	2	3	-	-	1	2	2	2	2	2	2	2
22IPE$32	**1**	**2**	**2**	**2**	**3**	**-**	**-**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial															

CO and Key Performance Indicators Mapping	
CO1	1.1.1, 2.1.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 3.2.2, 3.2.3, 3.3.1, 3.4.2, 4.1.2, 4.2.1, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 12.1.1, 12.2.1,12.3.2.
CO2	1.1.1, 2.1.1, 2.1.2, 2.1.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.2, 4.3.3, 5.1.2, 5.2.1, 5.3.2, 9.1.2, 9.2.4, 10.1.1, 10.1.2,10.2.1, 10.3.1, 11.3.1, 12.1.1, 12.1.2,12.3.2.
CO3	1.1.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.3.1,5.3.2, 10.1.1, 10.1.2,10.2.1, 10.3.1, 11.1.2, 11.3.1, 12.1.1, 12.3.2.
CO4	1.1.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.3.1,5.3.2, 9.1.2, 9.2.4, 10.1.1, 10.1.2,10.2.1, 10.3.1, 11.1.2, 11.3.1, 12.1.1, 12.3.2.
CO5	1.1.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.3.1,5.3.2, 8.1.1, 9.1.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2,10.2.1, 10.3.1,11.1.2, 11.3.1, 12.1.1, 12.2.1, 12.3.2.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	30	10	-	-	100
CAT2	20	20	30	30	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	30	30	-	-	100
ESE	20	40	30	10	-	-	100

22IPE$33	COGNITIVE SCIENCE *(Common to CSE $ IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To introduce the students theoretical background of cognition and computational intelligence, make them explore probabilistic programming language and understand computational inference models and computational learning models of cognition.	
UNIT– I	**PHILOSOPHY,PSYCHOLOGY AND NEUROSCIENCE**	**9 Periods**
Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn –The Philosophy of Science–The Mind in Cognitive Science –Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing–Neurosciences:CognitiveNeuroscience–Perception–Decision–LearningandMemory– Language Understanding and Processing.		
UNIT– II	**COMPUTATIONAL INTELLIGENCE**	**9 Periods**
MachinesandCognition–ArtificialIntelligence–ArchitecturesofCognition–KnowledgeBased Systems – Logical Representation and Reasoning – Logical Decision Making – Decision making under Uncertainty – Learning – Language – Vision – Robotics.		
UNIT– III	**PROBABILISTIC PROGRAMMING LANGUAGE**	**9 Periods**
Web PPL Language–Syntax–Using Java script Libraries–Manipulating probability types and distributions–Finding Inference–Exploring random computation–Coroutines: Functions that receive continuations–Enumeration–Other basic computation.		
UNIT– IV	**IMPLEMENTING THE INFERENCE MODELS OF COGNITION**	**9 Periods**
Generative Models–Conditioning–Causal and statistical dependence–Conditional dependence–Data Analysis–Algorithms for Inference.		
UNIT– V	**IMPLEMENTING THE LEARNING MODELS OF COGNITION**	**9 Periods**
Learning as Conditional Inference–Learning with a Language of Thought–Hierarchical Models–Occam's Razor–Learning(Deep)Continuous Functions–Mixture Models.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXTBOOK :

1	*Robert A. Wilson, Frank C. Keil,* ***"The MIT Encyclopedia of the Cognitive Sciences"****, The MIT Press, 1999.*

REFERENCES:

1	*NoahD. 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 Prob Mods Contributors,* ***"Probabilistic Models of Cognition"****, Second Edition, 2016, https://probmods.org/.*

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the theory behind cognition.	K2
CO2	Connect to the cognition elements computationally.	K2
CO3	Implement mathematical functions through Web PPL.	K3
CO4	Develop a cognitive inference model.	K4
CO5	Develop a cognitive learning model.	K4

COURSEARTICULATIONMATRIX:

a)CO and PO Mapping														
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	3	3	1	-	-	-	-	-	1	-	1	3	3
CO2	2	3	3	1	-	-	-	-	-	1	-	1	3	3
CO3	2	3	3	1	3	-	-	-	-	1	-	1	3	3
CO4	2	3	3	1	-	-	-	-	-	1	-	1	3	3
CO5	2	3	3	1	-	-	-	-	-	1	-	1	3	3
22IPE$33	**2**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**3**	**3**
1–Slight, 2–Moderate,3– Substantial														

b)CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2,2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2,4.2.1,10.2.1, 12.1.2, 12.2.1
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2,2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2,4.2.1,10.2.1, 12.1.2, 12.2.1
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1,3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2,4.2.1, 5.1.1,5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2,10.2.1, 12.1.2, 12.2.1
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4,2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1,3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2,4.2.1,10.2.1,12.1.2, 12.2.1
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4,2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1,3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2,4.2.1,10.2.1,12.1.2, 12.2.1

ASSESSMENTPATTERN–THEORY							
Test/Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzin g (K4)%**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	30	-	-	-	100
CAT2	20	40	30	10	-	-	100
Individual Assessment 1 /CaseStudy1/ Seminar1/ Project1	20	40	40	-	-	-	100
Individual Assessment 2 /CaseStudy2/ Seminar 2 / Project2	-	40	40	20	-	-	100
ESE	20	40	40	-	-	-	100

22IPE$34	ETHICS AND AI *(Common to CSE $ IT)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of the course is to understand the need for ensuring ethics in Artificial Intelligence and to overcome the risk for human rights and other fundamental values.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Role of Artificial Intelligence in human life – Understanding Ethics – Need for Ethics in Artificial Intelligence – Ethical considerations of AI – Current initiatives of Ethics in AI – Ethical issues and artificial entities.		
UNIT – II	**FRAMEWORKS AND MODELS**	**9 Periods**
AI Governance by human rights – Incompatible initiatives of private sector AI – Normative Models – Codes and Standards – The role of professional norms in the governance of Artificial Intelligence.		
UNIT – III	**CONCEPTS AND ISSUES**	**9 Periods**
Accountability in Computing Systems – Transparency – Responsibility an AI – Ethical analysis and design – Race and Gender- AI as a moral right holder – autonomy.		
UNIT – IV	**PERSPECTIVES AND APPROACHES**	**9 Periods**
Social failure modes of technology and the Ethics of AI – A human centered approach for AI Ethics – Integrating Ethical values and economical values - Fairness – The complexity of otherness – Calculative composition		
UNIT – V	**CASES AND APPLICATIONS**	**9 Periods**
Ethics of AI in Transport – The case for Ethical AI in Military – Ethics of AI in Biomedical research, patient care and public health- Ethics of AI in Law – Robot teaching: pedagogy and policy – Smart City Ethics.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Markus D Dubber, Frank Pasquale, Sunil Das, " **The Oxford Handbook of Ethics of AI**", Oxford University Press, 2020.*
2	*Paula Beddington, "**Towards a Code of Ethics for Artificial Intelligence**", Springer, 2017.*

REFERENCES:

1	*S. Matthew Liao, "Ethics of Artificial Intelligence", Oxford University Press, 2020.*
2	*Nick Bostrom and Eliezer Yudkowsky, **"The Ethics of Artificial Intelligence",** Cambrige University Press, 2014.*
3	*Wallach W and Allen C, " **Moral Machines: Ceaching Robots Right From Wrong**", Oxford Univeristy Press, 2008*
4	*Mark Coeckelbergh, "**AI Ethics**", MIT Press, 2020.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the need for Ethics in Artificial Intelligence	K2
CO2	Summarize frameworks for normative assessment and governance.	K2
CO3	Describe the ethical dimensions of Artificial Intelligence	K3
CO4	Criticize selection of methodological approached for AI Ethics.	K4
CO5	Argue Ethics in AI for selected Artificial Intelligence applications.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping														
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	3	-	3	1	-	-	1	-	2
CO2	-	-	-	-	-	3	-	3	1	-	-	3	-	2
CO3	-	-	-	-	-	3	-	3	1	-	-	3	-	2
CO4	-	-	-	-	-	3	-	3	1	-	-	3	-	2
CO5	-	-	-	-	-	3	-	3	1	-	-	3	-	2
22IPE$34	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**1**	**-**	**-**	**3**	**-**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial														
b) CO and Key Performance Indicators Mapping														
CO1	6.1.1, 6.2.1,8.1.1, 8.2.1, 8.2.2, 9.1.2,12.1.2, 12.2.2													
CO2	6.1.1, 6.2.1,8.1.1, 8.2.1, 8.2.2, 9.1.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2,12.3.1													
CO3	6.1.1, 6.2.1,8.1.1, 8.2.1, 8.2.2, 9.1.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2,12.3.1													
CO4	6.1.1, 6.2.1,8.1.1, 8.2.1, 8.2.2, 9.1.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2,12.3.1													
CO5	6.1.1, 6.2.1,8.1.1, 8.2.1, 8.2.2, 9.1.2,12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2													

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	35	35	-	-	-	100
CAT2	-	35	35	30	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	50	50	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	50	50	-	-	100
ESE	10	20	30	40	-	-	100

22COE$01	DISASTER MANAGEMENT AND MITIGATION *(Common to All Branches)*					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**OE**	**3**	**0**	**0**	**3**
Course Objective	To impart knowledge to create appropriate planning, preparation and response for emergency treatment in disaster situation					
UNIT – I	**INTRODUCTION TO DISASTERS**					**9 Periods**
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Classification, Causes, Impacts - Global Trends in Disasters: Urban Disasters, Pandemics, Complex Emergencies, Climate Change- Dos and Don'ts during various types of Disasters.						
UNIT – II	**HAZARDS AND RISK VULNERABILITY**					**9 Periods**
Hazard Identification and Hazard Profiling - Hazard Analysis - Types of hazards - Natural and technological Components of Risk- likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – Purpose, Risk Acceptability, Alternatives, Personnel. Political/ Social, Economic. Vulnerability-Physical Profile, Social Profile, Environmental Profile, Economic Profile - Factors Influencing Vulnerability, Risk Perception.						
UNIT – III	**MITIGATION AND PREPAREDNESS**					**9 Periods**
Mitigation - Types, Obstacles, Assessment and Selection of Mitigation options, Emergency Response capacity, Incorporating Mitigation into Development and Relief Projects. Preparedness- Government Preparedness, Public Preparedness, Media as a Public educator. Obstacles to public education and preparedness.						
UNIT – IV	**RESPONSE AND RECOVERY**					**9 Periods**
Response the Emergency- Pre disaster, post disaster, Provision of Water, Food and Shelter, Volunteer Management, Command, Control and Coordination. Recovery- Short Term and Long-term Recovery- Components of Recovery- Planning, Coordination, Information, Money and Supplies, Allocation of Relief Funds, Personnel. Types of Recovery- Government, Infrastructure, Debris Removal Disposal and Processing, Environment, Housing, Economic and Livelihood, Individual, Family and Social Recovery- Special Considerations in Recovery.						
UNIT – V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES**					**9 Periods**
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.						
Contact Periods: **Lecture: 45 Periods Tutorial: 00 Periods Practical: 00 Periods Total: 45 Periods**						

TEXT BOOKS :

1	*Singhal J.P. **"Disaster Management",** Laxmi Publications, 2010.*
2	*Tushar Bhattacharya, **"Disaster Science and Management",** McGraw Hill India Education Pvt. Ltd., 2012.*

REFERENCES:

1	*Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.*
2	*Government of India, National Disaster Management Policy,2009.*
3	*Gupta Anil K, Sreeja S. Nair. **"Environmental Knowledge for Disaster Risk Management"**, NIDM, New Delhi, 2011*
4	*Kapur Anu Vulnerable India: **A Geographical Study of Disasters**, IIAS and Sage Publishers, New Delhi, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the types of disasters, causes and their impact on environment and society	K2
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.	K2
CO3	Comprehend the mitigation and preparedness process.	K2
CO4	Describe about response and recovery process during disaster.	K2
CO5	Perform disaster damage assessment and management.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO2	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO3	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO4	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO5	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
22COE$01	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO2	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, **7.2.2,** 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO3	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO4	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO5	1.2.1, 3.3.6, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22COE$02	**WATER SANITATION AND HEALTH** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To understand the overview of Environment, Health and Safety (EHS) in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System	
UNIT – I	**INTRODUCTION**	**9 Periods**
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of Trade Union Safety Representatives – Ergonomics.		
UNIT – II	**OCCUPATIONAL HEALTH AND HYGIENE**	**9 Periods**
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria.		
UNIT – III	**WORKPLACE SAFETY AND SAFETY SYSTEMS**	**9 Periods**
Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels.		
UNIT – IV	**HAZARDS AND RISK MANAGEMENT**	**9 Periods**
Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies.		
UNIT – V	**ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT**	**9 Periods**
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	***Industrial Health and Safety Acts and Amendments**, by Ministry of Labour and Employment, Government of India.*
2	*Dr.K.U.Mistry, Siddharth Prakashan, **"Fundamentals of Industrial Safety and Health"**, 2012*

REFERENCES:

1	*Bill Taylor, **"Effective Environmental, Health, and Safety Management Using the Team Approach",** Culinary and Hospitality Industry Publications Services, 2005.*
2	*Nicholas P.Cheremisinoff and Madelyn L. Graffia, **"Environmental and Health and Safety Management"**, William Andrew Inc. NY, 1995.*
3	*Brian Gallant, **"The Facility Manager's Guide to Environmental Health and Safety"** , Government Inst Publ., 2007.*
4	*https://archive.nptel.ac.in/courses/114/106/114106017/*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Outline the needs for EHS in industries and related Indian regulations	K2
CO2	Assess the various types of Health hazards, effect, assessment and control methods	K2
CO3	Identity the various safety systems in working environments	K2
CO4	Select the methodology for preparation of Emergency Plans and Accident investigation	K3
CO5	Describe the EHS Management System and its elements	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO2	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO3	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO4	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO5	2	-	1	-	2	3	3	2	1	-	2	-	1	1	-
22COE$02	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
1 – Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.														
CO2	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.														
CO3	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.														
CO4	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.														
CO5	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.														

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22MOE$03	NANOTECHNOLOGY AND SURFACE ENGINEERING *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To educate the production techniques and characterization techniques of nano materials and to familiarize about the surface modification techniques using nano materials.	
UNIT – I	**ELEMENTS OF NANO-SCIENCE AND NANOTECHNOLOGY**	**9 Periods**
Engineering scale of nanotechnology, different classes of nano-materials, synthesis of nano-materials, fabrication and characterization of nanostructures, Engineering applications- Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry.		
UNIT – II	**NANOTECHNOLOGY AND CERAMICS**	**9 Periods**
Introduction, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods		
UNIT – III	**CHARACTERIZATION OF NANOMATERIALS**	**9 Periods**
X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy, UV / Visible Spectroscopy.		
UNIT – IV	**SURFACE ENGINEERING**	**9 Periods**
Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings.		
UNIT – V	**SURFACE MODIFICATION TECHNIQUES**	**9 Periods**
Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*G. Cao, **"Nanostructures and Nanomaterials: Synthesis",** Properties and Applications by Imperial College Press, 2nd edition, 2011.*
2	*Keith Austin "**Surface Engineering Hand Book**", London : Kogan Page, 1998*

REFERENCES:

1	*Gregory Timp, "**Nanotechnology",** Springer, 2012*
2	*Dheerendra Kumar Dwivedi, **"Surface Engineering: Enhancing Life of Tribological Components"**, Springer, 2018*
3	*D. Phil Woodruff,**"Modern Techniques of Surface Science**", Cambridge University Press, 2016*
4	*Sulabha K. Kulkarni ,**"Nanotechnology: Principles and Practices**", Springer, 2019*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Choose appropriate nano material and its manufacturing method.	K1
CO2	Select most suitable technique to deposit a layer of nano material on ceramic surface.	K2
CO3	Identify appropriate techniques to characterize nano materials.	K2
CO4	Select surface preparation, coating techniques and predict their combinational effect for engineering applications.	K2
CO5	Adopt different techniques to modify surfaces and make surface composites as per requirement.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO2	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO3	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO4	-	2	2	1	1	-	-	-	-	-	1	-	2	3	3
CO5	-	1	2	1	1	-	-	-	-	-	1	-	3	2	3
22MOE$03	**-**	**1**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2														
CO2	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2														
CO3	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2														
CO4	2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1														
CO5	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1														

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	70	-	-	-	-	100
ESE	40	60	-	-	-	-	100

22MOE$04	**INDUSTRIAL SAFETY MANAGEMENT** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To learn the techniques of industrial safety and management to implement and solve safety problems in engineering.	
UNIT – I	**ENVIRONMENT AND SAFETY PHILOSOPHY**	**9 Periods**
Henrichs Axioms Of Industrial Safety - Concepts Of Safety – Ethics of environmental conservation – Environmental Impact Assessment – Environmental economics – Safety philosophy – Planning for safety – Organising for safety – Directing for safety - Role of Occupier and Factory Manager, Factory Safety Committee, Structure and Functions and Working Tenure Details		
UNIT – II	**SAFETY APPRAISAL AND CONTROL TECHNIQUES**	**9 Periods**
Plant and equipment safety appraisal techniques – Laws and regulation – Hazards and Risks – Major accident hazard control – Importance of Disaster management		
UNIT – III	**ACCIDENT PREVENTION AND SAFETY MANAGEMENT**	**9 Periods**
Incident - Accident - Injury - Dangerous occurrence - Unsafe Act - Unsafe Conditions - Hazards - Error, Oversight - Mistake , Near Miss - Measurement of safety performance - Key elements of Safety Management system (ISO 14001, OHSAS 18001 etc.). ILO Legislations – Convention and Recommendation concerning Safety, Health and Environment – Objectives of Health, Safety and Environment Policy, Responsibility for Implementation of HSE Policy.		
UNIT – IV	**SAFETY MANAGEMENT IN INDUSTRIES**	**9 Periods**
Safe Guarding of machines – Manual handling and storage of materials – Mechanical handling of materials – Hand tools and portable power tools – Electrical hazards – Earth , insulation and continuity tests – Industrial lighting – Safety of pressure vessels – Ventilation and heat control – Housekeeping – Special precautions - Safety in Construction Industry – Safety in Engineering Industry – Safety in Chemical Industries – Safety in Textile Industries – Safety in Dock and Port – Transportation Safety – Safety in Fire and explosive industries.		
UNIT – V	**INDUSTRIAL HYGIENE AND POLLUTION CONTROL**	**9 Periods**
Industrial Hygiene – Air sampling – Noise and vibration – Industrial physiology - Occupational health – Personal Protective Equipment's – Pollution Control strategies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Akhil Kumar Das, **"Principles of Industrial Safety Management":Understanding the Ws of Safety at Work"** PHI Learning , 2021*
2	*Jain R K and Sunil.S.Rao, **"Industrial Safety Health and Environment Management System"**, Seventh reprint, Khanna publishers, 2023.*

REFERENCES:

1	*Prathibha Bansal and Anupama Prashar, **"Industrial safety and Environment"**, S.K.Kattaria Sons, 2005.*
2	*A.K.Gupta, **"Industrial safety and Environment"**, Laxmi Publication Pvt Limited, 2008.*
3	***"Accident Prevention Manual For Industrial Operations"**, N.S.C Chicago, 13th Edition 2009.*
4	*Dan Petersen, **"Techniques of Safety Management"**, Americal Society of Safety Emgineers, 4th edition, 2003.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand Environment and safety philosophy.	K1
CO2	Frame Safety appraisal and control technique to create safety management.	K2
CO3	Follow accident prevention procedure to solve safety problem.	K2
CO4	Implement safety management for Industries.	K3
CO5	Follow Industrial Hygiene and Pollution control	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	-	1	3	-	-	-	-	-	-	-	3	1	2
CO2	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO3	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
CO4	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
22MOE$04	3	3	-	1	3	-	-	-	-	-	-	-	3	1	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.4.4, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO4	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	70	20	10	-	-	-	100
CAT2	50	30	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	60	40	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	30	20	-	-	-	100
ESE	50	30	20	-	-	-	100

22EOE$05	RENEWABLE POWER GENERATION SYSTEMS *(Common to All Branches)*				
PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**OE**	**3**	**0**	**0**	**3**

Course Objectives	To understand energy scenarios, energy sources and their utilization, society's present needs and future energy demands, the principles of renewable energy conversion systems	
UNIT – I	**ENERGY SCENARIO**	**9 Periods**
Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).		
UNIT – II	**SOLAR ENERGY**	**9 Periods**
Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.		
UNIT – III	**WIND AND BIOMASS ENERGY**	**9 Periods**
Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multi blade system. Vertical axis- Savonius and Darrieus types. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies -fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft).		
UNIT – IV	**TIDAL AND OCEAN THERMAL ENERGY**	**9 Periods**
Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC.		
UNIT – V	**GREEN ENERGY**	**9 Periods**
Introduction, Fuel cells: Classification of fuel cells – H_2; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	G D Rai, Non Conventional Energy sources, Khanna Publication, Fourth Edition, 2009
2	Boyle, "Renewable Energy – Power For A Sustainable Future", Oxford, 2012

REFERENCES :

1	S Rao,B.B.Parulekhar, "Energy Technology 3/e: Nonconventional, Renewable and Conventional", Khanna Publishers, 1994
2	G. N. Tiwari,"Solar Energy - Fundamentals, Design, Modelling and Applications", 2002
3	Gilbert M. Masters, "Renewable and Efficient Electric Power Systems" Wiley,2005
4	Shobh Nath Singh, "Non-Convention Energy Resources", Pearson, 2018

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems, their prospects and limitations.	K2
CO2	Summarize the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, electric power generation.	K2
CO3	Apply the conversion principles of wind and tidal energy for the production of electric power generation	K3
CO4	Apply the concept of biomass energy resources and green energy for developing sustainable electric power generation set-up	K3
CO5	Analyze the basic knowledge of ocean thermal energy conversion and hydrogen energy and hence design & evaluate the power generation system	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO2	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO3	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO4	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO5	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
22EOE$05	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping (Times New Roman, Size 11)	
CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	20	30	30	-	-	100
CAT2	20	20	30	30	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	30	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	30	30	-	-	100
ESE	20	20	30	30	-	-	100

22EOE$06	SMART GRID TECHNOLOGY *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To provide a comprehensive understanding of Smart Grid Technology, including its components, functions, applications and implications for Energy Management and Distribution.	
UNIT – I	**BASICS OF POWER SYSTEMS**	**9 Periods**
Basics of Power Systems: Load and Generation - Power Flow Analysis- Economic Dispatch and Unit Commitment Problems. Smart Grid: Definition – Applications- Government and Industry-Standardization		
UNIT – II	**SMART GRID COMMUNICATIONS**	**9 Periods**
Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure		
UNIT – III	**WIDE AREA MEASUREMENT**	**9 Periods**
Sensor Networks - Phasor Measurement Units- Communications Infrastructure- Fault Detection and Self-Healing Systems -Applications and Challenges		
UNIT – IV	**SECURITY AND PRIVACY**	**9 Periods**
Cyber Security Challenges in Smart Grid - Load Altering Attacks- False Data Injection Attacks-Defense Mechanisms - Privacy Challenges- Cyber Security Standards		
UNIT – V	**ECONOMICS AND MARKET OPERATIONS**	**9 Periods**
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process - Entities involved. The market place mechanisms-Energy and Reserve Markets- Market Power - Generation Firms- Locational Marginal Prices- Financial Transmission Rights		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage "***Smart Grid Technologies and applications"** *John Wiley Publishers Ltd., 2012.*
2	*P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan "***Electrical Power Systems- Analysis, Security and Deregulation"** *PHI Learning Private Limited, New Delhi, 2012.*

REFERENCES :

1	*Lars T. Berger, Krzysztof Iniewski "***Smart Grid applications, Communications and Security***" John Wiley Publishers Ltd., 2012.*
2	*Yang Xiao,* **"Communication and Networking in Smart Grids",** *CRC Press Taylor and Francis Group, 2012.*
3	*Caitlin G. Elsworth,* **"The Smart Grid and Electric Power Transmission"***, Nova Science Publishers Inc, August 2010*
4	*Lars T. Berger, Krzysztof Iniewski "***Smart Grid applications, Communications and Security***" John Wiley Publishers Ltd., 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recollect the fundamentals of conventional power systems and learn the concept of smart grid	K1
CO2	Interpret the role of communication Technologies in a smart grid	K2
CO3	Apply the state-of-the-art measurement and protection techniques for reliable grid	K3
CO4	Utilize the techniques for ensuring safety and security of the smart grid	K3
CO5	Analyze the economical aspects of the smart grids	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	2	2	2	2	2	-	-	1	1	-	3	2	1
CO2	3	3	1	2	2	-	-	-	-	2	3	2	3	2	1
CO3	3	3	1	2	2	-	-	-	-	2	3	2	3	3	2
CO4	3	3	1	2	2	3	2	2	1	-	-	3	3	3	2
CO5	3	2	2	2	2	-	2	2	-	1	3	3	3	3	2
22EOE$06	**3**	**3**	**1**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,1.3.1,1.4.1,2.3.1,2.3.2,2.4.4,3.1.3,3.1.6,3.2.1,4.1.4,4.2.1,4.3.4,5.1.1,5.3.1,6.1.1,7.1.1,7.2.2,10.1.1,10.3.1,11.1.1
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,8.2.2,9.1.2,7.2.1,7.2.2,6.2.1,6.1.1,5.3.2,5.3.1,5.3.212.1.2,12.2.2,12.3.2,
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	40	20	-	-	100
CAT2	10	30	40	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	30	30	20	20	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	30	30	20	20	-	100
ESE	10	30	40	20	-	-	100

22LOE$07	**CMOS VLSIDESIGN** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components	
UNIT – I	**CMOSLOGICDESIGN**	**9 Periods**
Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates –Tristated – Multiplexers –CMOS Fabrication and Layout: Fabrication Process – Layout Designrule–GateLayouts–StickDiagrams–DesignPartitioning.		
UNIT – II	**MOSTRANSISTORTHEORY**	**9 Periods**
Introduction – Long Channel I-V Characteristics – C-V Characteristics – Non-ideal I-V Effects –DC Transfer Characteristics – CMOS Technologies – Sources of Power Dissipation - DynamicPower–Static Power.		
UNIT – III	**COMBINATIONALCIRCUITDESIGN**	**9 Periods**
CircuitFamilies:StaticCMOS–RatioedCircuits–CascodeVoltageSwitchLogic–Dynamic Circuits–PassTransistorCircuits.Silicon-on-InsulatorCircuitDesign–SubthresholdCirucitDesign.		
UNIT – IV	**SEQUENTIALCIRCUITDESIGN**	**9 Periods**
Sequentialstaticcircuits–Circuitdesignoflatchedandflip-flops–Sequencingdynamiccircuits –Synchronizers–Wavepipelining -VLSIclocking:CMOS clockingstyles-Pipelinedsystems-Clockgenerationanddistribution.		
UNIT – V	**DESIGNOFVLSISYSTEMS**	**9 Periods**
System Specifications – Structural Gate Level Modeling – Switch Level Modeling – BehavioralandRTL Modeling-Addition/subtraction–Comparators–counters––Multiplexers-BinaryDecoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM –DRAM–ROM.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*N. Weste and David Money Harris, "**CMOS VLSI Design**", Fourth Edition, PearsonEducation,2011*
2	*Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*

REFERENCES:

1	*JanM.Rabaey,"**DigitalIntegratedCircuits:ADesignPerspective**",PHI,SecondEdition,2012.*
2	*R.JacobBaker,"**CMOS:CircuitDesign,Layout,andSimulation**",Wiley-IEEE,RevisedSecondEdition,2008.*
3	*Pucknell,"**BasicVLSIDesign**",PrenticeHall,2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Realize the CMOS logic design	K2
CO2	Explain the basic MOS transistor theory and power dissipation in CMOS logic.	K2
CO3	Develop combinational circuit design of CMOS logic	K3
CO4	Interpret sequential circuit design of CMOS logic	K2
CO5	Model the digital system using Hardware Description Language	K2

¶

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO2	3	2	1	-	-	2	-	-	-	2	-	3	2	1	2
CO3	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO4	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO5	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
22LOE$07	**3**	**3**	**2**	-	-	**2**	-	-	-	**2**	-	**3**	**3**	**1**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	40	40	20	-	-	-	100

22LOE$08	**MOBILE COMMUNICATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To understand and recall the mobile radio propagation, cellular architectures, equalization and diversity techniques, digital modulation techniques and various wireless network standards.	
UNIT – I	**MOBILE RADIO PROPAGATION**	**9 Periods**
Review of free-space propagation - Radio Wave Propagation in wireless environment - Free Space Propagation Model - Ground Reflection Model, Diffraction, Scattering - Practical link budget design - Small scale fading - Time dispersion parameters - Coherence bandwidth - Doppler spread & Coherence time, Fading due to Multipath time delay spread - Fading due to Doppler spread.		
UNIT – II	**CELLULAR CONCEPT**	**9 Periods**
Hexagonal cell-Cell clustering-Frequency Reuse-Static and dynamic channel assignment strategies - Handoff Strategies - Interference and System Capacity - Trunking - Capacity in Cellular Systems. Multiple Access Techniques: FDMA, TDMA, CDMA, OFDMA.		
UNIT – III	**MULTIPATH MITIGATION TECHNIQUES**	**9 Periods**
Equalization – Adaptive equalization: Linear and Non-Linear equalization, - Diversity – Micro and Macro diversity - Diversity combining techniques - Rake receiver- MIMO Coding: Alamouti Scheme (Qualitative)		
UNIT – IV	**MODULATION TECHNIQUES**	**9 Periods**
Modulation in cellular wireless systems: Binary Phase Shift Keying (BPSK) – QPSK –Orthogonal QPSK-Minimum Shift Keying-Gaussian Minimum Shift Keying - Multicarrier modulation: Orthogonal Frequency Division Multiplexing (OFDM) -PAPR reduction –Windowed OFDM - Filtered OFDM		
UNIT – V	**WIRELESS NETWORKS**	**9 Periods**
Second Generation Cellular Standard: GSM - Third Generation Cellular standards: CDMA -WCDMA-Fourth Generation Cellular Standards: 4G LTE – LTE Advanced – 5G Network – Near Field Communication (NFC) systems – Wireless LAN technology – Hyper LAN – Bluetooth technology – Ultra Wideband (UWB) communication - Introduction to 60 GHz mmWave.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Theodore S. Rappaport, "Wireless communications", 2nd Edition, Pearson Education, 2010*
2	*Mischa Schwartz, "Mobile Wireless Communications", 1st Edition, Cambridge University Press, 2010*

REFERENCES:

1	*Suvra Sekhar Das and Ramjee Prasad, "Evolution of air interface towards 5G Radio Access Technology and Performance Analysis", River Publishers,2018*
2	*David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", 1st Edition, Cambridge University Press, 2006.*
3	*Andreas.F. Molisch, "Wireless Communications", 2nd Edition, Wiley, 2011.*
4	*Aditya K Jagannatham, "Principles of Modern Wireless Communication Systems Theory and Practice", 1st Edition, McGraw Hill Education (India) Private Limited, 2017*
5	*William Stallings, "Wireless Communications and networks", 2nd Edition, Pearson, 2009.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the concepts of radio propagation and fading channel models in wireless communication	K3
CO2	Interpret the functionalities of various cellular concepts and multiple access techniques and solve problems in channel assignment and traffic intensity in cellular system	K4
CO3	Explain various equalization and diversity combining techniques used in multipath propagation	K2
CO4	Discuss the need for digital and multicarrier modulation techniques used in modern cellular system	K2
CO5	Recall the functionalities of various wireless networks used in day-today life.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
22LOE$08	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	-	-	100
CAT2	50	50		-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	20	40	20	20	-	-	100

22POE$09	**RAPIDPROTOTYPING** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	*To educate the students with fundamental and advanced knowledge in the field of Rapid Prototyping technology and associated Aerospace, Architecture, Art, Medical and Industrial applications.	
UNIT- I	**INTRODUCTION**	**9 Periods**
Overview - Need - Development of Rapid Prototyping (RP) Technology: Rapid Prototyping -Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. RP Process Chain, Benefits, Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare.		
UNIT- II	**VAT POLYMERIZATION AND MATERIAL EXTRUSION**	**9 Periods**
Photo polymerization: Stereo lithography Apparatus (SLA) - Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modelling (FDM) - Process-Materials -Applications and Limitations.		
UNIT- III	**POWDER BED FUSION AND BINDER JETTING**	**9 Periods**
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications.		
UNIT- IV	**MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION**	**9 Periods**
Material Jetting: Multi jet Modelling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery -Materials –Benefits - Applications.		
UNIT- V	**SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY**	**9 Periods**
Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "**Additive manufacturing technologies".** 3rd edition Springer Cham, Switzerland, 2021.*
2	*Andreas Gebhardt and Jan-Steffen Hötter "**Additive Manufacturing: 3D Printing for Prototyping and Manufacturing**", Hanser publications, United States, 2015.*

REFERENCES:

1	*Andreas Gebhardt,* ***"Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing"****, Hanser Gardner Publication, Cincinnati., Ohio, 2011.*
2	*Milan Brandt,* ***"Laser Additive Manufacturing: Materials, Design, Technologies, and Applications"****, Woodhead Publishing., United Kingdom, 2016.*
3	*Amit Bandyopadhyay and Susmita Bose,* ***"Additive Manufacturing",*** *1st Edition, CRC Press., United States, 2015.*
4	*Kamrani A.K. and Nasr E.A.,* ***"Rapid Prototyping: Theory and practice",*** *Springer., United States ,2006.*
5	*Liou, L.W. and Liou, F.W.,* ***"Rapid Prototyping and Engineering applications: A tool box for prototype development"****, CRC Press., United States, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the development of RP technology and how RP technology propagated into various businesses and developing opportunities.	K3
CO2	Demonstrate the Vat polymerization and material extrusion processes and its applications.	K3
CO3	Elaborate the process and applications of powder bed fusion and binder jetting.	K3
CO4	Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.	K3
CO5	Describe the sheet lamination and direct write technology.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	2	-	2	-	3	-	3	3	3	3	-	-	-
CO2	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO3	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO4	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO5	2	2	3	2	3	3	3	-	3	3	1	3	-	-	-
22POE$09	**2**	**2**	**3**	**2**	**3**	**1**	**3**	**-**	**3**	**3**	**2**	**3**	**-**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	52	33	-	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	75	16	-	-	-	100

22POE$10	MANAGERIALECONOMICS *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	*To introduce the fundamental economic principles necessary for production managers	
UNIT- I	**FUNDAMENTALS OF MANAGERIAL ECONOMICS**	**9 Periods**
Introduction to Economics - Scope of Managerial Economics - General Foundations of Managerial Economics: Economic Approach, Working of Economic System and Circular Flow of Activities - Economics and Business Decisions: Relationship between Economic Theory and Managerial Economics - Role of managerial Economics in Decision making - Concept of Economic Rationality - Opportunity Cost - Marginal and Incremental approach.		
UNIT- II	**DEMAND ANALYSIS**	**9 Periods**
Demand and Supply - Determinants of Demand - Demand Estimation and Forecasting - Price Elasticity of Demand - Price Elasticity- Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Advertisement or Promotional Elasticity - Elasticity of Supply.		
UNIT- III	**DEMAND THEORY**	**9 Periods**
Utility Analysis - Total and Marginal Utility - Law of Diminishing marginal utility - Indifference curve analysis - Consumer Equilibrium - Consumer Surplus - Price effect, Substitution Effect and Income Effect.		
UNIT- IV	**THEORY OF PRODUCTION AND COST**	**9 Periods**
The Production Function - Profit-Maximizing Input Usage - Isoquants and Isocosts – CostMinimization and Optimal Input Substitution - The Cost Function - Breakeven analysis,Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions andEconomies of Scope - Learning curve.		
UNIT- V	**THEORY OF MARKET AND PRICING**	**9 Periods**
Forms of Markets: Meaning and Characteristics - Market Equilibrium: Practical Importance, Market Equilibrium and Changes in Market Equilibrium. Pricing Functions: Market Structures - Pricing and output decisions under different competitive conditions: Monopoly Monopolistic completion and Oligopoly.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Maheshwari.Y* ***"Managerial Economics",*** *Prentice Hall of India, 2012*
2	*Thomas and Maurice* ***"Managerial Economics: Concept and Applications",*** *McGrawHill, 2005*

REFERENCES:

1	*D.N. Dwivedi,* ***"Managerial Economics",*** *Vikas Publishing house, 2015*
2	*Christopher R Thomas, S Charles Maurice,* ***"Managerial economics",*** *Mcgraw Hill, 2014*
3	*M. A. Beg, "****Managerial Economics****",Global Professional Publishing Ltd, 2010*
4	*K.C. Sankaranarayanan, "****Managerial Economics****", CBS, 2015*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain fundamentals of managerial economics	K2
CO2	Discuss the dynamics of Demand	K3
CO3	Explain about various theories of demand	K3
CO4	Discuss about the factors influencing production	K4
CO5	Describe about the theory of market and pricing method	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	1	3	1	3	3	-	1	3	3	3	-	1	2
CO2	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
CO3	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
CO4	1	3	2	3	1	3	3	-	1	3	3	3	1	1	2
CO5	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
22POE$10	**1**	**3**	**2**	**3**	**1**	**3**	**3**	-	**1**	**3**	**3**	**3**	**1**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50		-	-	-	100
CAT2	50	50		-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33	-	-	-	100
ESE	42	42	16	-	-	-	100

22NOE$11	MEASUREMENT AND CONTROL *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To teach about the concepts of variable sensors for industrial parameter measurement and to impart knowledge on automatic control system	
UNIT - I	**INTRODUCTION TO MEASUREMENTS**	**9 Periods**
Elements of measurement system - Classification of Instruments – Static and dynamic characteristics of a measurement system - Errors in measurement - Calibration of instruments.		
UNIT - II	**STRAIN AND DISPLACEMENT MEASUREMENT**	**9 Periods**
Strain: Types of strain gauges, theory of operation, strain gauge materials, strain gauge circuits and applications. Displacement: Resistive potentiometer: Linear, circular and helical – LVDT - RVDT - Capacitance transducers – Piezoelectric transducers – Hall Effect devices - Proximity sensors.		
UNIT - III	**PRESSURE AND TEMPERATURE MEASUREMENT**	**9 Periods**
Pressure: Mechanical devices: Diaphragm, bellows, and bourdon tube - Electrical devices: Variable resistance, inductance and capacitance transducers. Temperature: Resistance type temperature sensors: RTD , Thermocouples, Thermopiles and Thermistor - Laws of thermocouple – Radiation methods for temperature measurement.		
UNIT - IV	**FLOW AND LEVEL MEASUREMENT**	**9 Periods**
Flow: Variable head type flow meters: Orifice plate, Venturi tube, Flow nozzle, Pitot tube - Variable area type: Rotameter - Turbine flow meter - Electromagnetic flow meter - Ultrasonic flow meter. Level: Resistive, inductive and capacitive techniques – Ultrasonic methods – Air purge system .		
UNIT - V	**AUTOMATIC CONTROL SYSTEM**	**9 Periods**
Elements of control system – Concept of open loop and closed loop systems – Mathematical modelling - Controllers – Brief idea of Proportional, Derivative and Integral Modes – Pneumatic Controller – Hydraulic Controller.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*A.K. Sawhney, Puneet Sawhney,* ***"A Course in Mechanical Measurements and Instrumentation & Control"*** *Dhanpat Rai & Co, 2012.*
2	*S. K. Singh, "****Industrial Instrumentation and Control****", McGraw Hill Publication, 3rd Edition, 2016.*

REFERENCES:

1	*William Bolton, "****Instrumentation and Control Systems****," Newnes, Publication, 3rd Edition, 2021.*
2	*E. D. Doeblin,* ***"Measurement Systems: Application and Design",*** *McGraw Hill Publication, 6th Edition, 2017.*
3	*E.W. Golding and F.C. Widdis,* ***"Electrical Measurements and Measuring Instruments"*** *A.H.Wheeler and Co., 5th Edition, 2011.*
4	*Alan S. Morris,* ***"Measurement and Instrumentation Principles",*** *Butterworth-Heinemann Publications, 3rd Edition, 2011.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Describe the methods of measurement and classification of measuring instruments.	K2
CO2	Suggest suitable sensor for the measurement of strain and displacement.	K2
CO3	Explain the construction and working of transducers for pressure and temperature measurement.	K2
CO4	Elucidate the characteristics of flow and level measuring instruments.	K2
CO5	Elaborate the concept of automatic control system.	K2

COURSE ARTICULATION MATRIX

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	-	-	3	3
22NOE$11	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

b) CO and Key Performance Indicators mapping

CO1	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4
CO2	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2,2.2.3, 2.3.1, 2.3.2, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4
CO3	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2
CO4	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2,2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2
CO5	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Remembering (K1)%	Understanding (K2) %	Applying (K3)%	Analyzing (K4)%	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	40	60	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	70	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	70	-	-	-	-	100
ESE	40	60	-	-	-	-	100

22NOE$12	**INDUSTRIAL AUTOMATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To elaborate on the basic concept of automation, including the necessary components and various automation controllers utilized in industrial automation.	
UNIT - I	**INTRODUCTION TO AUTOMATION**	**9 Periods**
Automation overview – Requirement of automation systems – Architecture of industrial automation system –Industrial bus systems: Modbus and Profibus.Introduction to Industry 4.0 and its evolution.		
UNIT - II	**AUTOMATION COMPONENTS**	**9 Periods**
Sensors for temperature – Pressure – Force – Displacement - Speed – Flow- level – Humidity and pH measurement. Actuators – Process control valves –Power electronic drives: DIAC- TRIAC – power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control.		
UNIT - III	**PROGRAMMABLE LOGIC CONTROLLERS**	**9 Periods**
PLC Hardware – power supplies and isolators –Relays – Switches -Seal-in circuits – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics.		
UNIT - IV	**DISTRIBUTED CONTROL SYSTEM**	**9 Periods**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers.		
UNIT - V	**SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS**	**9 Periods**
Introduction - Supervisory Control and Data Acquisition Systems – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Frank D. Petruzella, "**Programmable Logic Controllers**", 5th Edition, McGraw Hill, 2016.*
2	*S.K. Singh "**Industrial Instrumentation and Control**", 3rd Edition, McGraw Hill Companies, 2004.*

REFERENCES:

1	*Sudip Misra, Chandana Roy, Anandarup Mukherjee, **"Introduction to Industrial Internet of Things and Industry 4.0**", CRC Press, 1st edition, 2021*
2	*Bela G Liptak, "**Process software and digital networks – Volume 3**", 4th Edition, CRC press, 2012.*
3	*Romily Bowden, "**HART application guide and the OSI communication foundation**",1999.*
4	*John.W. Webb Ronald A Reis, "**Programmable Logic Controllers - Principles and Applications**", Prentice Hall Inc., 5th Edition, 2003.*
5	*M. P. Lukcas, "**Distributed Control Systems"**, Van Nostrand Reinhold Co., 1986.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Elaborate the basic architecture of automation systems and Industry 4.0.	K2
CO2	Describe the various automation components and industrial bus system involved in industrial automation	K2
CO3	Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications	K3
CO4	Illustrate the functionary components and supervisory control of DCS with relevant diagrams	K2
CO5	Describe the basics of SCADA technology.	K2

COURSE ARTICULATION MATRIX

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	3	3
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	-	-	-	-	1	-	-	2	1	3	3
CO4	3	2	2	-	-	-	-	-	-	-	-	-	1	3	3
CO5	3	2	1	-	-	-	-	-	-	-	-	-	1	3	3
22NOE$12	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**3**	**3**

b) CO and Key Performance Indicators mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 9.1.1, 9.1.2, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Remembering (K1)%	Understanding (K2) %	Applying (K3)%	Analyzing (K4)%	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	20	60	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	60	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	60	20	-	-	-	100
ESE	20	60	20	-	-	-	100

22SOE$13	PROGRAMMING IN JAVA *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of this course is to provide students with the essential Java constructs necessary for developing an object-oriented program.	
UNIT – I	**FUNDAMENTALS OF JAVA PROGRAMMING**	**9 Periods**
History and Evolution of Java- Overview of java– Operators- Control Structures– Methods- Classes and Objects– Inheritance- Packages and Interfaces- Exception Handling.		
UNIT – II	**THREADS , I/O AND STRING HANDLING**	**9 Periods**
Multi threaded Programming– Enumeration- Auto boxing– Annotations- String Handling- Input/Output: Exploring java.io		
UNIT – III	**EVENT HANDLING**	**9 Periods**
Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - Menus - Introducing Swing		
UNIT – IV	**IMAGING AND DATABASE CONNECTIVITY**	**9 Periods**
Imaging: Creating- loading and displaying- Image observer- Double buffering- Media tracker- Image producer– consumer– filters– animation- Java Database Connectivity		
UNIT – V	**NETWORKING**	**9 Periods**
Networking – Remote Method Invocation – Java Beans –Java servlets		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Herbert Schildt, "Java, **The Complete Reference** ", Tata McGrawHill, 12th Edition, 2022*

REFERENCES

1	*Deitel .H.M and Deitel.P.J, " **Java: How to Program** ", Pearson Education Asia, 9th Edition 2011*
2	*Lay.S&Horstmann Gary Cornell, " **Core Java Vol I** ", The Sun Microsystems & press Java Series, 9th Edition, 2012*
3	*NPTEL Course : "**PROGRAMMING IN JAVA"*** ***https://archive.nptel.ac.in/courses/106/105/106105191/***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces and exception handling	K4
CO2	Write java program using multithreading and string handling	K3
CO3	Write java programs for managing events and to access database	K4
CO4	Write java programs to display and manipulation of graphical images	K3
CO5	Develop client server programs using RMI and servlets	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	1	-	-	-	-	2	-	-	1	2	2
CO2	2	1	2	2	1	-	-	-	-	2	-	-	-	2	3
CO3	2	1	2	2	1	-	-	-	-	2	-	-	1	2	3
CO4	2	1	2	2	1	-	-	-	-	2	-	-	1	2	3
CO5	2	1	2	2	1	-	-	-	-	2	-	2	1	2	3
22SOE$13	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**1**	**2**	**3**

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.1.1, 5.2.2,10.1.1,10.1.2,10.1.3,12.1.1,12.2.1,12.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1)%**	**Understanding (K2) %**	**Applying (K3)%**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	30	40	30	-	-	100
CAT2	10	30	40	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	70	30	-	-	100
Individual Assessment 2 /Case Study 2/Seminar 2 / Project 2	-	-	50	50	-	-	100
ESE	-	30	40	30	-	-	100

22SOE$14	**NETWORK ESSENTIALS** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of the course is to understand the basics of networking and able to configure and troubleshoot switches and routers.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics		
UNIT – II	**WIRELESS NETWORKING**	**9 Periods**
Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation		
UNIT – III	**ADDRESSING AND ROUTING FUNDAMENTALS**	**9 Periods**
IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet		
UNIT – IV	**ROUTING PROTOCOLS**	**9 Periods**
Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP, DNS - Analyzing Internet Traffic.		
UNIT – V	**TROUBLESHOOTING AND NETWORK SECURITY**	**9 Periods**
Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Jeffrey S.Beasley Piyasat Nilkaew "**Network Essentials**" 3 rd Edition, Pearson, 2018*
2	*Larry L. Peterson and Bruce S. Davie "**Computer Networks, A Systems Approach**" 5 th edition, Morgan Kaufmann Publishers Inc, 2014.*

REFERENCES :

1	*Behrouz A. Forouzan, "**Data Communications and Networking with TCP/IP Protocol Suite**", Sixth Edition TMH, 2022.*
2	*James F. Kurose, Keith W. Ross, "**Computer Networking, A Top-Down Approach Featuring the Internet**", Eighth Edition, Pearson Education, 2021.*
3	*Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "**Computer Networks: An Open Source Approach**", McGraw Hill, 2012.*
4	*Nader F. Mir, "**Computer and Communication Networks",** Second Edition, Prentice Hall, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify topologies and types of Computer Networks and enumerate the layers of the OSI model and TCP/IP	K2
CO2	Explain the significance of wireless networks and configure a Wireless LAN	K3
CO3	Configure a switcher and a router	K3
CO4	Describe basic routing algorithms and network services	K3
CO5	Troubleshoot the router and switch interface	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-			1	-	-	-	-	-	-	1	2	-
CO2	2	3	-			1	-	-	-	-	-	-	1	2	-
CO3	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
CO4	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
CO5	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
22SOE$14	**2**	**3**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.4.4, , 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO2	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	35	35	-	-	-	100
CAT2	10	45	45	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	10	40	50	-	-	-	100

22I0E$15	VIDEO CREATION AND EDITING *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	Upon completion of the course the students will be familiar with the principles and techniques of video creation and editing, video production equipment and software, visual storytelling and video production, planning, executing, and editing video projects. also able to foster critical thinking and creativity in developing and executing video projects.	
UNIT – I	**INTRODUCTION TO VIDEO CREATION AND EDITING**	**9 Periods**
Overview of video creation and editing -Brief history of video and film production - Understanding visual storytelling: developing documentary and dramatic projects- introduction to digital and film systems		
UNIT – II	**PRE-PRODUCTION**	**9 Periods**
Developing a concept and idea - Scriptwriting and storytelling -The Digital image - Film systems and cameras -The film image - Case Study : Non linear editing system		
UNIT – III	**PRODUCTION**	**9 Periods**
Camera operation and techniques: The video camcorder- The Lens - Lighting and sound recording techniques - Directing actors and crew -Conducting interviews - Shooting the movie - Case Study : Professional video zoom lenses		
UNIT – IV	**POST-PRODUCTION**	**9 Periods**
Picture and Dialogue editing - Editing digital video -sound editing and mixing -Color grading and correction-Sound editing and mixing – working with film in post production Case Study : Digital Audio Recording		
UNIT – V	**DISTRIBUTION AND PROMOTION**	**9 Periods**
Presenting the project - funding sources - budgets- business arrangements- legal and copyright issues- distribution and marketing - publicity and the marketing campaigns- building and sustaining a career -Case Study : Creating a short movie.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Steven Ascher and Edward Pincus,The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age,Fifth edition Penguin Publishing Group, 2012

REFERENCES :

1	Walter Murch,In the Blink of an Eye: A Perspective on Film Editing", Silman-James Press,2001
2	Karel Reisz and Gavin Millar,The Technique of Film Editing",second edition ,Taylor and Francis Group 2017
3	Ken Dancyger, The technique of film and video editing , fifth edition , Elsevier 2011.
4	Chris Kenworthy,Digital video production cookbook, OReillyMedia ,2006
5	Mark Brindle, The Digital Filmmaking Handbook ,Quercus Publishing, 2014

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Demonstrate an understanding of the history and evolution of video production and editing.	2
CO2	Develop and execute a concept, script, and storyboard for a video project	3
CO3	Plan and prepare for a video shoot, including casting, location scouting, and budgeting.	3
CO4	Edit and assemble video footage using basic and advanced editing techniques.	2
CO5	Promote and distribute the final video on various platforms.	1

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1	1	-	-	-	-	-	-	-	-	1	1
CO2	1	2	3	2	3	-	-	-	-	-	-	-	1	1
CO3	1	2	1	3	3	-	1	-	3	1	2	-	1	1
CO4	1	2	2	2	3	3	-	-	3	1	2	-	1	1
CO5	1	2	2	2	3	3	1	3	3	3	2	-	1	1
22IOE$15	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**-**	**1**	**1**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.2.1,1.31,2.1.1,2.1.2,2.2.4,2.4.1,3.1.4,3.4.1,4.1.3,
CO2	1.1.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.4.3,3.1.1,3.1.2,3.1.3,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,4.1.1,4.1.3,4.2.1,4.3.1,4.3.2,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,
CO3	1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,3.4.2,4.1.1,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,7.1.1,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.2.1, 11.3.1,11.3.2
CO4	1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,,3.3.2,3.4.2,4.1.1,4.1.3,4.2.1,4.3.1,4.3.2,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,6.1.1,6.1.2,,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.3.1, 11.3.2
CO5	1.1.1 , 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4 2.3.2, 2.4.3, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.3, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.12, 8.1.1, 8.2.1,8.2.2, , 9.1.1, 9.1.2, 9.2.1,9.2.2, 9.2.3,9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3,10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Rememberin g (K1) %**	**Understandin g (K2) %**	**Applyin g (K3) %**	**Analyzin g (K4) %**	**Evaluatin g (K5) %**	**Creatin g (K6) %**	**Tota l %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments , if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IOE$16	DIGITAL MARKETING *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To give insight on the framework to analyze, strategies and plan digital marketing and communication activities for typical marketing situations. Familiarize with the key tools and techniques of digital marketing that are popularly used by professionals in the real world of digital marketing and help them develop the ability to formulate and analyze key metrics to evaluate the performance of typical digital marketing efforts.	
UNIT – I	**INTRODUCTION TO DIGITAL MARKETING**	**9 Periods**
Basics of Digital Marketing - online marketplace analysis: digital marketing environment - consumer choice and digital influence online consumer behavior- competitors -suppliers- new channel structures - rate of environment change - economic force-political force -legal force - social force- cultural force.		
UNIT – II	**DIGITAL MARKETING STRATEGY DEVELOPMENT**	**9 Periods**
Digital marketing strategy - The impact of digital media and technology on the marketing mix: product- price-place-promotion -people, process and physical evidence - relationship marketing using digital platforms: the challenge of customer engagement - customer lifecycle management		
UNIT – III	**DIGITAL MARKETING IMPLEMENTATION AND PRACTICE**	**9 Periods**
Delivering the online customer experience: planning website design and redesign projects - initiation of the website project - defining site or app requirement - designing the user experience - development and testing of content - site promotion or traffic building - campaign planning for digital media		
UNIT – IV	**MARKETING COMMUNICATIONS USING DIGITAL MEDIA CHANNELS**	**9 Periods**
Search engine marketing - online public relations - affiliated marketing - interactive display advertising -email marketing and mobile text messaging- social media and viral marketing - offline promotion techniques		
UNIT – V	**EVALUATION OF DIGITAL CHANNEL PERFORMANCE**	**9 Periods**
Create a performance management system - performance metric framework - tools and techniques for collecting metrics -customer experience and content management - online consumer behavior- online retailing - customer acquisition in B2B marketing - online inter- organizational trading		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Dave Chaffey Fiona Ellis-Chadwick, Digital Marketing,sixth edition, 2016

REFERENCES :

1	Puneet singh Bhatia, Fundamentals of Digital Marketing , Pearson India Education services,2017
2	Mathur, Vibha, Arora, Saloni,"DigitalMarketing",PHI Learning Pvt. Ltd.,2020
3	Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Compaigns, Wiley 2016
4	Dr.Shakti Kundu, Digital Marketing Trends and Prospects:Develop an effective Digital Marketing strategy with SEO, SEM, PPC, Digital Display Ads & Email Marketing techniques,BPB PUBN,2021
5	Seema Gupta , Digital Marketing,Third Edition, McGraw Hill 2022
6.	Simon Kingsnorth, Digital Marketing Strategy:An Integrated Approach to Online Marketing, Kogan page,2022

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the role and importance of digital marketing in a rapidly changing business landscape	K1
CO2	Discuss the key elements of a digital marketing strategy	K2
CO3	Demonstrate advanced practical skills in common digital marketing tools such as Social media and Blogs	K2
CO4	Demonstrate advanced practical skills in common digital marketing tools such as SEM	K2
CO5	understand online consumer behavior and influence the extent to which individuals are likely to engage with the digital marketplace	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	2	2	-	-	-	-	-	-	-	-	2	2
CO2	1	1	2	2	-	-	-	-	-	-	-	-	2	2
CO3	1	1	2	2	3	-	-	-	-	-	-	-	2	2
CO4	1	1	2	2	3	2	3	3	3	3	3	3	2	2
CO5	1	1	2	2	1	-	3	3	3	3	3	3	2	2
22IOE$16	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,
CO2	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,
CO3	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1, 5.3.2
CO4	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1, 5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1, 10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12. 2.2,12.3.1,12.3.2
CO5	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,7.1.1,7.1.2, 7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1,10.1.2,10.1.3,10.2.1, 10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	
ESE	30	30	40	-	-	-	100

22BOE$17	**PRINCIPLES OF FOOD TECHNOLOGY** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To learn about the various food constituents and its additives. To learn about various microbes associated with food. To learn about different food processing and preservation techniques.	
UNIT – I	**FOOD AND ENERGY**	**9 Periods**
Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.		
UNIT – II	**FOOD BORNE DISEASES**	**9 Periods**
Classification – food infections – bacterial and other types; food intoxications and poisonings– bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.		
UNIT – III	**FOOD ADDITIVES**	**9 Periods**
Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.		
UNIT – IV	**FOOD PRESERVATION**	**9 Periods**
Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.		
UNIT – V	**FOOD PACKAGING**	**9 Periods**
Types of packaging material and containers; Interactions between packaging and foods; Packing - meat, dairy, fresh fruits and vegetables, beverages and confectionaries; Food packaging closure and sealing system; Nutrition labelling and legislative requirements.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	***od – The Chemistry Of Its Components****, 6th Edn. Royal Society,London, 2015.*
2	*W.C. Frazier And D.C. Westhoff ,* ***Food Microbiology****, 4th Ed., Mcgraw-Hill Book Co., NewYork 2013.*

REFERENCES

1	*Srinivasan Damodaran and Kirk L. Parkin., "Fennema's Food Chemistry", CRC Press, 5 thedition. 2017.*
2	*Fellows P.J, "Food Processing Technology: Principles and Practices", Woodhead Publishing 4 th edition,2016·*
3	*B. Sivasanker , Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	learn different constituents present in food and microorganism involved in processing of food.	K1
CO2	learn principles and different preservations techniques of food can also be known.	K1
CO3	learn techniques involved in modern food processing and impact of the process on food quality.	K2
CO4	Explain various preservation and packaging techniques for food product	K2
CO5	Describe the relationship between food and microorganism that basis for fermentation and preservation	K2

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	-	1	-	-	-	-	2	3	-	-	1	3
CO2	1	-	-	-	-	-	-	-	-	3	-	-	1	3
CO3	1	-	-	2	-	2	-	-	-	3	-	-	1	3
CO4	1	-	1	-	-	-	-	-	-	3	-	-	1	3
CO5	1	-	2	-	-	-	-	-	-	3	-	-	1	3
22BOE$17	**1**	**-**	**1**	**1**	**-**	**2**	**-**	**-**	**2**	**3**	**-**	**-**	**1**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial														
b) CO and Key Performance Indicators Mapping														
CO1	1.4.2, 2.1.3													
CO2	1.4.1, 3.1.3													
CO3	1.4.4, 2.1.4													
CO4	1.4.1, 2.1.3,3.4.2													
CO5	1.4.1,2.2.1													

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	60	40	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	50	50	-	-	-	-	100

22BOE$18	BIOLOGY FOR ENGINEERS *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	1. Understand and interpret commonly reported statistical measures published in healthcare research 2. Analyze the different type of data using appropriate statistical software 3. Demonstrate a good understanding of descriptive statistics and graphical tools 4. Explain fundamental concepts of estimation and hypothesis testing and be confident when interpreting P values and confidence intervals	
UNIT – I	**BASICS OF CELL BIOLOGY**	**9 periods**
An overview of cells – origin and evolution of cells-cell theory-classification of cells – prokaryotic cells and eukaryotic cells; Structure of prokaryotic and eukaryotic cells and their organelles comparison of prokaryotic and eukaryotic cells; Transport across membranes – diffusion - active and passive diffusion.		
UNIT – II	**BASICS OF MICROBIOLOGY**	**9 periods**
Classification of microorganism-microscopic examination of microorganisms; Structural organization and multiplication of bacteria-viruses-algae and fungi; Microorganism used for the production of penicillin-alcohol and vitamin B-12.		
UNIT – III	**HUMAN ANATOMY AND PHYSIOLOGY**	**9 periods**
Basics of human anatomy-tissues of the human body-epithelial-connective-nervous and muscular; Nervous system-Respiratory System-Circulatory system and Digestive system.		
UNIT – IV	**BIO MOLECULES AND IMMUNE SYSTEM**	**9 periods**
Introduction to Biochemistry-classification-structure and properties of carbohydrates- proteins-lipids and nucleic acids; Innate and acquired immunity; Types of immune responses.		
UNIT-V	**APPLIED BIOLOGY FOR ENGINEERS**	**9 periods**
Overview of biosensors - glucometer applications-medicine; Microarray analysis to diagnose the cancer; Microbial production of biofuels; Applications of stem cells.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*Darnell J, Lodish H, Baltimore D.* ***"Molecular Cell Biology"****, W.H.Freeman; 8th Edition, 2016.*
2	*Pelczar MJ, Chan ECS and Krein NR,* ***"Microbiology",*** *Tata McGraw Hill, 5thEdition, New Delhi.2001.*
3	*Wulf Cruger and Anneliese Cruger,* ***"A Textbook of Industrial Microbiology",*** *Panima Publishing Corporation, 2nd Edition, 2000.*

REFERENCES

1	*David L. Nelson and Michael M Cox,* ***"Lehninger's Principles of Biochemistry",*** *Macmillan Worth Publisher, 4th edition, 2004.*
2	*Brain R.Eggins ,* ***"Chemical Sensors and Biosensors",*** *John Wiley & Sons, 2002.*
3	*Anton Moser,* ***"Bioprocess Technology, Kinetics and Reactors",*** *Springer, Berlin (Verlag),1st edition, 1998*
4	*Kuby J,* ***"Immunology",*** *WH Freeman & Co., 7th edition, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the functions of cell and their structural organization	K1
CO2	Describe the mechanisms and role of cell in immune system	K1
CO3	Get familiarized biomolecules and human anatomy system	K2
CO4	Illustrate the applications of microbes in industrial process	K3
CO5	Apply the engineering concepts in biology	K3

a) Course Articulation Matrix

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	1	-	-	-	2	2	2	-	-	1	2	2	2
CO2	1	-	-	1	1	-	-	2	3	3	2	2	1	3
CO3	1	1	-	-	-	-	-	1	1	-	-	-	1	3
CO4	-	-	-	-	1	-	-	2	3	3	1	1	1	3
CO5	-	2	-	1	3	-	-	-	-	-	-	-	2	2
22BOE$18	**1**	**1**	**-**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	2.2.2, 6.1.1, 7.1.2, 8.1.1, 11.1.1, 12.1.2
CO2	1.1.1, 4.2.1, 5.2.1, 8.1.1, 9.1.1,9.2.1,10.1.1, 10.1.2, 11.1.1, 12.1.2
CO3	1.1.1, 2.1.1, 8.1.1, 9.1.1
CO4	5.2.1, 8.1.1, 9.1.1,9.2.1,10.1.1, 10.1.2, 11.1.1, 12.1.2
CO5	1.1.1,2.2.2, 4.2.1, 5.2.1, 6.1.1,7.1.2, 8.1.1, 9.1.1,9.2.1,10.1.1, 10.1.2, 11.1.1, 12.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	10	10	10	10	10	100
CAT2	50	10	10	10	10	10	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	20	20	10	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	20	20	10	10	100
ESE	50	10	10	10	10	10	100