KPR Institute of Engineering and Technology

Learn Beyond (Autonomous, NAAC "A")

Avinashi Road, Arasur, Coimbatore.

Great Place To Work. Certified MAR 2022 - MAR 2023 INDIA

B.E. – Computer Science and Engineering

(Artificial Intelligence and Machine Learning)

Curriculum and Syllabi

Regulations – 2021

B.E. – AM – R2021 – CBCS

I. Vision and Mission of the Institute

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of industry, society, the nation and the world at large

Mission

- Commitment to offer value-based education and enhancement of practical skills.
- Continuous assessment of teaching and learning processes through scholarly activities.
- Enriching research and innovation activities in collaboration with industry and institutes of repute.
- Ensuring the academic processes to uphold culture, ethics, and social responsibilities.

II. Vision and Mission of the Department

Vision

To establish as a technology hub of education, research and solution in artificial intelligence and machine learning.

Mission

The Mission of the Department is to

- Provide an enriched educational experience in artificial intelligence and machine learning, that students are technically competent.
- Interact and collaborate with every industry segment and solving to mobilize the possibilities of artificial intelligence and machine learning.
- Create new computing technologies and solution for industry and society with high ethical and novel values.

III. Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) of the Computer Science and Engineering (Artificial Intelligence and Machine Learning) represents major accomplishments that the graduates are expected to achieve after four years of graduation.

PEO1: Devise cutting edge solutions to the emerging technological problem.

PEO2: Practice lifelong learning by upskilling in advanced research in artificial intelligence and machine learning technologies.

PEO3: Function in their profession as socially responsible individuals adhering to the rich cultural and moral ethics.

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IV. Program Outcomes (POs)

Graduates of Computer Science and Engineering (Artificial Intelligence and Machine Learning) will be able to

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

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

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

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

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

PO 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.

PO 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.

PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 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.

PO 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.

PO 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.

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V. Program Specific Outcomes (PSOs)

Graduates of Computer Science and Engineering (Artificial Intelligence and Machine Learning) will be able to

PSO1: Design and develop an intelligent automated system applying fundamental knowledge from mathematical, analytical programming and operational skills to solve the arising problems in the field of technology.

PSO2: Efficiently apply machine learning techniques to fit various business situations.

VI. PEO/PO Mapping

Following three levels of correlation should be used:

1. Low
2. Medium
3. High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	2	2	2	3	2	3	3	3
PEO2	3	3	3	3	3	3	1	2	2	2	3	3
PEO3	3	3	3	3	3	2	2	2	1	2	1	3

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B.E. Computer Science and Engineering (Artificial Intelligence and Machine Learning)

REGULATIONS 2021 (Revised)

For the students admitted in 2022

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I - VIII SEMESTERS

SEMESTER I

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
THEORY COURSES								
1	U21GEG01	Heritage of Tamils	HSMC	1	0	0	0	1
2	U21MA101	Calculus and Differential Equations	BSC	3	1	0	0	4
3	U21EEG01	Basics of Electrical and Electronics Engineering	ESC	3	0	0	0	3
THEORY COURSE WITH LABORATORY COMPONENT								
4	U21EN101	English for Technologist	HSMC	1	0	2	0	2
5	U21CSG01	Problem Solving and C Programming	ESC	2	0	2	0	3
6	U21PH101	Engineering Physics	BSC	2	0	2	0	3
7	U21CY101	Engineering Chemistry	BSC	2	0	2	0	3
LABORATORY COURSES								
8	U21ECG03	Engineering Studio	ESC	0	0	4	0	2
MANDATORY NON-CREDIT COURSES								
9	U21MYC01	Induction program	MNC	Three Weeks				
			TOTAL	**14**	**1**	**12**	**0**	**21**

SEMESTER II

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
THEORY COURSES								
1	U21GEG02	Tamils and Technology	HSMC	1	0	0	0	1
2	U21MA204	Applied Linear Algebra	BSC	3	0	0	0	3
3	U21PH201	Materials Science	BSC	2	0	0	0	2
4	U21AM201	Introduction to Artificial Intelligence	PCC	3	0	0	0	3
THEORY COURSE WITH LABORATORY COMPONENT								
5	U21EN201	Personality Enhancement	HSMC	1	0	2	0	2
6	U21CSG02	Python Programming	ESC	2	0	2	0	3
7	U21ECG01	Digital Electronics	ESC	2	0	2	0	3
LABORATORY COURSES								
8	U21MEG01	Engineering Graphics	ESC	0	0	4	0	2
MANDATORY NON-CREDIT COURSES								
9	U21MYC02	Environmental Sciences	MNC	1	0	0	0	0
			TOTAL	**15**	**0**	**10**	**0**	**19**

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SEMESTER III

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
THEORY COURSES								
1	U21MAG01	Probability and Statistics	BSC	3	1	0	0	4
2	U21CS301	Computer Organization and Architecture	PCC	3	0	0	0	3
3	U21CS302	Database Management Systems	PCC	3	0	0	0	3
4	U21AM301	Introduction to R Programming	PCC	3	1	0	0	4
THEORY COURSE WITH LABORATORY COMPONENT								
5	U21CSG03	Data Structures	PCC	2	0	2	0	3
6	U21CSG04	Java Programming	PCC	2	0	2	0	3
LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT								
7	U21CS304	Database Management Systems Lab	PCC	0	0	4	0	2
8	U21AM302	Design Studio I	EEC	0	0	0	2	1
MANDATORY NON-CREDIT COURSES								
9	U21MYC03	Essence of Indian Traditional Knowledge	MNC	1	0	0	0	0
			TOTAL	17	2	8	2	23

SEMESTER IV

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
THEORY COURSES								
1	U21MAG02	Discrete Mathematics	BSC	3	1	0	0	4
2	U21CS403	Operating Systems	PCC	3	0	0	0	3
3	U21AM401	Machine Learning I	PCC	3	0	0	0	3
4	U21AM402	Algorithmics	PCC	3	0	0	0	3
5	U21ITG01	Software Engineering	PCC	3	0	0	0	3
6		Open Elective I	OEC	3	0	0	0	3
LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT								
7	U21CS404	Operating Systems Laboratory	PCC	0	0	2	0	1
8	U21AM403	Machine Learning I Laboratory	PCC	0	0	2	2	2
9	U21AM404	Algorithmics Laboratory	PCC	0	0	2	0	1
10	U21AM405	Design Studio II	EEC	0	0	0	2	1
11	U21SSG01	Soft Skills – I	HSMC	0	0	2	0	1
MANDATORY NON-CREDIT COURSES								
12	U21MYC04	Indian Constitution	MNC	1	0	0	0	0
			TOTAL	19	1	8	4	25

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SEMESTER V

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
THEORY COURSES								
1	U21AM501	Machine Learning II	PCC	3	0	0	0	3
2	U21AM502	Internet and Web Programming	PCC	3	0	0	0	3
3		Professional Elective - I	PEC	3	0	0	0	3
4		Professional Elective - II	PEC	3	0	0	0	3
5		Open Elective - II	OEC	3	0	0	0	3
THEORY COURSE WITH LABORATORY COMPONENT								
6	U21CSG05	Computer Networks	PCC	2	0	2	0	3
LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT								
7	U21AM503	Machine Learning II Laboratory	PCC	0	0	2	2	2
8	U21AM504	Internet and Web Programming Laboratory	PCC	0	0	2	2	2
9	U21AM505	Proto Studio I	EEC	0	0	0	2	1
10	U21SSG02	Soft Skills – II	HSMC	0	0	2	0	1
MANDATORY NON-CREDIT COURSES								
11	U21MYC05	Cyber Security Essentials	MNC	1	0	0	0	0
			TOTAL	18	0	10	4	24

SEMESTER VI

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
THEORY COURSES								
1	U21AM601	Optimization Techniques	PCC	3	1	0	0	4
2	U21AM602	Deep Learning I	PCC	3	0	0	0	3
3		Professional Elective - III	PEC	3	0	0	0	3
4		Professional Elective - IV	PEC	3	0	0	0	3
5		Open Elective - III	OEC	3	0	0	0	3
THEORY COURSE WITH LABORATORY COMPONENT								
6	U21AM603	High-Performance Computing	PCC	3	0	2	0	4
LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT								
7	U21AM604	Deep Learning I Laboratory	PCC	0	0	2	2	2
8	U21AM605	Proto Studio II	EEC	0	0	0	2	1
9	U21SSG03	Soft Skills – III	HSMC	0	0	2	0	1
MANDATORY NON-CREDIT COURSES								
10	U21MYC06	Introduction to UNSDG's: An Integrative Approach	MNC	1	0	0	0	0
			TOTAL	18	1	8	2	24

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SEMESTER VII

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
THEORY COURSES								
1	U21AM701	Deep Learning II	PCC	3	0	0	0	3
2	U21AM702	Cloud and Big Data Analytics	PCC	3	0	0	0	3
3		Professional Elective - V	PEC	3	0	0	0	3
4		Professional Elective - VI	PEC	3	0	0	0	3
5		Open Elective - IV	OEC	3	0	0	0	3
LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT								
6	U21AM703	Deep Learning II Laboratory	PCC	0	0	2	2	2
7	U21AM704	Project work Phase – I	EEC	0	0	0	4	2
			TOTAL	15	0	0	6	19

SEMESTER VIII

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21AM801	Project work Phase - II	EEC	0	0	0	16	8
			TOTAL	0	0	0	16	8

INDUSTRIAL TRAINING / INTERNSHIP

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21AMI01	Industrial Training / Internship *	EEC	0	0	0	0	2
			TOTAL	0	0	0	0	2

***Four Weeks during any semester vacation from III to VI Semester**

NCC CREDIT COURSES

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21NCC01	National Cadet Corps I	-	1	0	2	0	2
2	U21NCC02	National Cadet Corps II	-	1	0	2	0	2
3	U21NCC03	National Cadet Corps III	-	1	0	2	0	2
4	U21NCC04	National Cadet Corps IV	-	2	0	2	0	3
5	U21NCC05	National Cadet Corps V	-	1	0	2	0	2
6	U21NCC06	National Cadet Corps VI	-	2	0	2	0	3
			TOTAL	8	-	12	-	14

NCC Credit Course (Level 1 – Level 6) are offered for NCC students only. The grades earned by the students will be recorded in the mark sheet, however the same shall not be considered for the computation of CGPA.

TOTAL CREDITS: 165

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PROFESSIONAL ELECTIVES COURSES: VERTICALS

Vertical I Data Science	Vertical II Artificial Intelligence and Machine Learning	Vertical III Cloud Computing and Data Processing Technologies	Vertical IV Networking and Cyber Security	Vertical V Full Stack Development	Vertical VI IT and IT Enabled Services (ITeS)
U21ADP01 - Mathematical Foundation for Data Science	U21AMP01 - Knowledge Engineering	U21CSP01-Foundations of Cloud Computing	U21ITP01- Parallel and Distributed Computing	U21CSP09-UI / UX Design	U21ITP09-Next Generation Networks
U21ADP02 - Pattern Recognition	U21AMP02 - Soft Computing	U21CSP02-Data Storage and Management in Cloud	U21ITP02- Mobile Computing	U21CSP10-Python Web Development	U21ITP10-Game Development
U21ADP03 - Speech Processing and Analytics	U21AMP03 - Deep Neural Networks	U21CSP03-Virtualization Techniques	U21ITP03 - Wireless Sensor Networks	U21CSP11-App Development	U21ITP11-Blockchain Technologies
U21ADP04 - Web Mining	U21AMP04 - Reinforcement Learning	U21CSP04-Security and Privacy in Cloud	U21ITP04 - Software Defined Networks	U21CSP12-JavaScript frameworks	U21ITP12-Augmented Reality /Virtual Reality
U21ADP05 - Exploratory Data Analysis and Visualization	U21AMP05 - Computer Vision	U21CSP05-Data Analysis in Cloud Computing	U21ITP05 - Cyber Security	U21CSP13-Webservices and API Design	U21ITP13-Quantum Computing
U21ADP06 - Predictive Analytics	U21AMP06 - Feature Engineering	U21CSP06-Edge Computing	U21ITP06 - Internet Security	U21CSP14-SOA and Microservices	U21ITP14-Graphics Processing Unit
U21ADP07 - Time Series Analysis and Forecasting	U21AMP07 - Object Detection & Face Recognition	U21CSP07-Cloud Service Management	U21ITP07 - Ethical Hacking	U21CSP15-Cloud Native Applications Development	U21ITP15-Agile Methodologies
U21ADP08 -Health care Analytics	U21AMP08 - Text and Visual Analytics	U21CSP08-Big Data Integration and Processing	U21ITP08 - Digital Forensics	U21CSP16-Devops	U21ITP16-Software Testing Tools and Techniques

Institute of Engineering and Technology, Centre for Academic Courses, Coimbatore

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Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VII.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: DATA SCIENCE

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21ADP01	Mathematical Foundation for Data Science	PEC	3	0	0	0	3
2	U21ADP02	Pattern Recognition	PEC	3	0	0	0	3
3	U21ADP03	Speech Processing and Analytics	PEC	3	0	0	0	3
4	U21ADP04	Web Mining	PEC	3	0	0	0	3
5	U21ADP05	Exploratory Data Analysis and Visualization	PEC	3	0	0	0	3
6	U21ADP06	Predictive Analytics	PEC	3	0	0	0	3
7	U21ADP07	Time Series Analysis and Forecasting	PEC	3	0	0	0	3
8	U21ADP08	Health care Analytics	PEC	3	0	0	0	3

VERTICAL 2: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21AMP01	Knowledge Engineering	PEC	3	0	0	0	3
2	U21AMP02	Soft Computing	PEC	3	0	0	0	3
3	U21AMP03	Deep Neural Networks	PEC	3	0	0	0	3
4	U21AMP04	Reinforcement Learning	PEC	3	0	0	0	3
5	U21AMP05	Computer Vision	PEC	3	0	0	0	3
6	U21AMP06	Feature Engineering	PEC	3	0	0	0	3
7	U21AMP07	Object Detection & Face Recognition	PEC	3	0	0	0	3
8	U21AMP08	Text and Visual Analytics	PEC	3	0	0	0	3

VERTICAL 3: CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21CSP01	Foundations of Cloud Computing	PEC	3	0	0	0	3
2	U21CSP02	Data Storage and Management in Cloud	PEC	3	0	0	0	3
3	U21CSP03	Virtualization Techniques	PEC	3	0	0	0	3
4	U21CSP04	Security and Privacy in Cloud	PEC	3	0	0	0	3
5	U21CSP05	Data Analysis in Cloud Computing	PEC	3	0	0	0	3
6	U21CSP06	Edge Computing	PEC	3	0	0	0	3
7	U21CSP07	Cloud Service Management	PEC	3	0	0	0	3
8	U21CSP08	Big Data Integration and Processing	PEC	3	0	0	0	3

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VERTICAL 4: NETWORKING AND CYBER SECURITY

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21ITP01	Parallel and Distributed Computing	PEC	3	0	0	0	3
2	U21ITP02	Mobile Computing	PEC	3	0	0	0	3
3	U21ITP03	Wireless Sensor Networks	PEC	3	0	0	0	3
4	U21ITP04	Software Defined Networks	PEC	3	0	0	0	3
5	U21ITP05	Cyber Security	PEC	3	0	0	0	3
6	U21ITP06	Internet Security	PEC	3	0	0	0	3
7	U21ITP07	Ethical Hacking	PEC	3	0	0	0	3
8	U21ITP08	Digital Forensics	PEC	3	0	0	0	3

VERTICAL 5: FULL STACK DEVELOPMENT

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21CSP09	UI / UX Design	PEC	3	0	0	0	3
2	U21CSP10	Python Web Development	PEC	3	0	0	0	3
3	U21CSP11	App Development	PEC	3	0	0	0	3
4	U21CSP12	JavaScript frameworks	PEC	3	0	0	0	3
5	U21CSP13	Webservices and API Design	PEC	3	0	0	0	3
6	U21CSP14	SOA and Microservices	PEC	3	0	0	0	3
7	U21CSP15	Cloud Native Applications Development	PEC	3	0	0	0	3
8	U21CSP16	Devops	PEC	3	0	0	0	3

VERTICAL 6: IT AND IT ENABLED SERVICES (ITES)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21ITP09	Next Generation Networks	PEC	3	0	0	0	3
2	U21ITP10	Game Development	PEC	3	0	0	0	3
3	U21ITP11	Blockchain Technologies	PEC	3	0	0	0	3
4	U21ITP12	Augmented Reality /Virtual Reality	PEC	3	0	0	0	3
5	U21ITP13	Quantum Computing	PEC	3	0	0	0	3
6	U21ITP14	Graphics Processing Unit	PEC	3	0	0	0	3
7	U21ITP15	Agile Methodologies	PEC	3	0	0	0	3
8	U21ITP16	Software Testing Tools and Techniques	PEC	3	0	0	0	3

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OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVES – I (SEMESTER: IV)

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1.	U21AMX01	Big data and its Applications	OEC	3	0	0	0	3

OPEN ELECTIVES – II (SEMESTER: V)

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1.	U21AMX02	AI Fundamentals	OEC	3	0	0	0	3
2.	U21AMX03	Joy of Programming	OEC	3	0	0	0	3

OPEN ELECTIVES – III (SEMESTER: VI)

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1.	U21AMX04	AI in Healthcare	OEC	3	0	0	0	3

Scheme of Credit distribution – Summary

S. No.	Stream	Credits/Semester								Credits
		I	II	III	IV	V	VI	VII	VIII	
1.	Humanities and Social Sciences including Management (HSMC)	3	3		1	1	1			09
2.	Basic Science Courses (BSC)	10	5	4	4					23
3.	Engineering Science Courses (ESC)	8	8							16
4.	Professional Core Courses (PCC)		3	18	16	13	13	8		71
5.	Professional Elective Courses (PEC)					6	6	6		18
6.	Open Elective Courses (OEC)				3	3	3	3		12
7.	Employability Enhancement Courses (EEC)			1	1	1	1	2	8	14
8.	Industrial Training/ Internship								2	02
9.	Mandatory Non-Credit Course (MNC)									
Total		21	19	23	25	24	24	19	10	165

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Head 01.02.2024
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SEMESTER I

		Category: HSMC				
U21GEG01	HERITAGE OF TAMILS (Common to All Branches)	L	T	P	J	C
		1	0	0	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn the extensive literature of classical Tamil.
- To review the fine arts heritage of Tamil culture.
- To realize the contribution of Tamils in Indian freedom struggle.

COURSE OUTCOMES:

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

CO1: Understand the extensive literature of Tamil and its classical nature (Understand)

CO2: Understand the heritage of sculpture, painting and musical instruments of ancient people (Understand)

CO3: Review on folk and martial arts of tamil people (Understand)

CO4: Realization of thinai concepts, trade and victory of Chozha dynasty (Understand)

CO5: Understand the contribution of tamils in Indian freedom struggle, Self-esteem movement and siddha medicine (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I LANGUAGE AND LITERATURE 3

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

31.1.22

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

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 of Temples in Social and Economic Life of Tamils

UNIT III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – 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

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: - Periods Practical: – Periods Project – Periods

Total 15 Periods

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

EVALUATION PATTERN:

Continuous Internal Assessment	Total
	100

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KPRIET
Learn Beyond

SEMESTER I

		Category: HSMC				
U21GEG01	தமிழர் மரபு (அனைத்து துறைகளுக்கும் பொதுவனது)	L	T	P	J	C
		1	0	0	0	1

முன்கூட்டிய துறைசார் அறிவு: தேவையில்லை

பாடத்தின் நோக்கங்கள்:

- தமிழ் மொழியின் இலக்கியச் செறிவைக் கற்றுணர்தல்
- தமிழர் பண்பாட்டின் நுண்கலைகள் பற்றிய ஒரு மீள்பார்வை
- இந்திய தேசிய இயக்கத்தில் தமிழர்களின் பங்கினை அறிதல்

பாடம் கற்றதின் விளைவுகள்:

CO1: தமிழ் மொழியின் செந்தன்மை மற்றும் இலக்கியங்கள் குறித்த தெரிதல் (புரிதல்)
CO2: தமிழர்களின் சிற்பக்கலை, ஓவியக்கலை மற்றும் இசைக்கருவிகள் குறித்த தெளிவு (புரிதல்)
CO3: தமிழர்களின் நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள் குறித்த அறிமுகம் (புரிதல்)
CO4: தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால வணிகம் மற்றும் சோழர்களின் வெற்றிகள் குறித்த தகவல்கள் (புரிதல்)
CO5: இந்திய தேசிய இயக்கம், சுயமரியாதை இயக்கம் மற்றும் சித்த மருத்துவம் பற்றிய புரிதல் (புரிதல்)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

பாடத்திட்டங்கள்:

அலகு I மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக்குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள் – தமிழகத்தில் சமண, பௌத்த சமயங்களின் தாக்கம் – பக்தி

இலக்கியம் – ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரி முனையில் திருவள்ளுவர் சிலை – இசைக்கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக, பொருளாதார வாழ்வில் கோவில்களின் பங்கு

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

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

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

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

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிற பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு

Contact Periods:

Lecture: 15 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 15 Periods

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)

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9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

மதிப்பீட்டு முறை:

தொடர்ச்சியான உள் மதிப்பீடு	மொத்தம்
	100

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SEMESTER I

		Category: BSC				
U21MA101	**CALCULUS AND DIFFERENTIAL EQUATIONS** (Common to AD, AM, BM, CE, CH, CS, EC, IT, ME, MI)	**L**	**T**	**P**	**J**	**C**
		3	**1**	**0**	**0**	**4**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of matrices and calculus which will enable them to model and analyze physical phenomena involving continuous change
- To understand the methodologies involved in solving problems related to fundamental principles of calculus
- To develop confidence to model mathematical pattern and give appropriate solutions

COURSE OUTCOMES:

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

CO1: Apply the knowledge of matrices with the concepts of eigenvalues to study their problems in core areas (Apply)

CO2: Apply the basic techniques and theorems of functions of several variables in other areas of mathematics (Apply)

CO3: Analyze the triple integrals techniques over a region in two dimensional and three-dimensional geometry (Apply)

CO4: Apply basic concepts of integration to evaluate line, surface and volume integrals (Apply)

CO5: Solve basic application problems described by second and higher order linear differential equations with constant coefficients (Understand)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I MATRICES **9 + 3**

Eigenvalues and eigenvectors – Properties (without proof) – Cayley Hamilton theorem (without proof) – Diagonalization using orthogonal transformation – Applications

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SEMESTER I

U21EEG01	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Common to AD, AM, BM, CB, CS and IT)	Category: ESC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To solve an electric network by applying basic laws
- To acquire the knowledge of operating principle, characteristics, starting, methods of DC and AC Machines
- To acquire the knowledge of construction, operating principle, characteristics of semiconductor devices and its applications

COURSE OUTCOMES:

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

CO1: Solve an electric network by applying basic laws. (Apply)

CO2: Acquire the knowledge of operating principles, characteristics, starting, and speed control methods of DC motors. (Understand)

CO3: Explain the operating principles of AC motor and characteristics, starting methods of induction motor. (Understand)

CO4: Summarize the construction, principle and characteristics of semiconductor devices. (Understand)

CO5: Interpret the applications of semiconductor devices. (Understand)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I BASIC CONCEPTS OF ELECTRIC CIRCUITS 9

Active elements – Passive elements – Sources – Elements in series and parallel connections – Star and delta conversion – Ohm's law and Kirchhoff's laws – Mesh and Nodal analysis in DC Networks

UNIT II FUNCTIONS OF SEVERAL VARIABLES **9 + 3**

Partial derivatives – Total derivative – Jacobians – Taylor's series expansion – Extreme values of functions of two variables – Lagrange multipliers method

UNIT III MULTIPLE INTEGRALS **9 + 3**

Double integrals – Change of order of integration – Triple integrals – Applications in area and volume

UNIT IV LINE AND SURFACE INTEGRALS **9 + 3**

Line integrals – Surface integrals – Green's theorem in a plane – Gauss divergence theorem – Stokes' theorem (excluding proofs)

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **9 + 3**

Second and higher order linear differential equations with constant coefficients – Variable coefficients – Euler Cauchy equation – Legendre's equation – Method of variation of parameters – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project – Periods

Total 60 Periods

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley India Pvt Ltd, New Delhi, 2018
2. Grewal B S, "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017

REFERENCES:

1. Bali N P and Dr Manish Goyal, "A textbook of Engineering Mathematics", 12th edition, Laxmi Publications, 2016
2. Thomas G B and Finney R L, "Calculus and Analytic Geometry", 14th edition, Pearson Education India, 2018
3. Maurice D Weir, Joel Hass and Christopher Heil, "Thomas Calculus", 14th edition, Pearson Education, India, 2018
4. James Stewart, "Calculus: Early Transcendental", 7th edition, Cengage Learning, New Delhi, 2015

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
Individual Assignment / Seminar / MCQ	Written Test	Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

31.1.24

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SEMESTER I

U21EN101	**ENGLISH FOR TECHNOLOGISTS** (Common to AD, AM, BM, CH, CE, CS, EE, EC, ME, MI and IT)	**Category: HSM**				
		L	**T**	**P**	**J**	**C**
		1	**0**	**2**	**0**	**2**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To infer and interpret the meaning of Technical, Business, Social and Academic contexts.
- To enhance the listening skills and facilitate effective pronunciation.
- To make effective presentation and conversation in technical and professional environment.

COURSE OUTCOMES:

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

CO1: Comprehend language and learn strategies for error-free communication (Understand)

CO2: Improve speaking skills in academic and social contexts (Apply)

CO3: Enhance both reading and writing skills to excel in professional career (Analyse)

CO4: Evaluate different perspectives on a topic (Analyse)

CO5: Develop listening skills to understand complex business communication in a variety of global English accents through Personality Development (Understand)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO5	-	-	-	-	-	-	-	2	-	3	-	1	-	-
Correlation levels:	1: Slight (Low)					2: Moderate (Medium)						3: Substantial (High)		

SYLLABUS:

UNIT I SUBJECTIVE INTROSPECTION **9**

Module:1 Vocabulary Building

Activity: Word Puzzles, Snappy words, Word Sleuthing

Module:2 Introducing and Sharing Information

Activity: Get to know oneself, Introducing Peer Members

UNIT II DC MOTOR 9

DC motor – Construction, principle of operation, types, torque equation, characteristics and applications – Starters for DC motor: Two point – Three point – Speed control – Armature and field control (Qualitative Analysis only)

UNIT III TRANSFORMER AND AC MOTOR 9

Single phase transformer – Three phase induction motor – Construction, principle of operation, characteristics and applications – Starters – DOL, Star–delta. (Qualitative Analysis only).

UNIT IV SEMICONDUCTOR DEVICES 9

Construction, operation and characteristics: PN Junction, Zener Diode – BJT – FET

UNIT V APPLICATIONS OF SEMICONDUCTOR DEVICES 9

Rectifier– Half wave, Full wave – Filters – Voltage regulator – Series and shunt – CE, CB and CC Configuration

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", 5th edition, McGraw–Hill Education, New Delhi, 2017
2. R.K.Rajput, "Electrical Machines", 6th edition, Laxmi Publications, Jan 2016
3. V.K Metha and Rohit Metha, "Principles of Electronics", 12th edition, S. Chand Publications, 2020

REFERENCES:

1. J William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", 8th Edition, McGraw–Hill Education, New Delhi, 2013
2. S.K. Bhattacharya, "Electrical Machines", 4th Edition, McGraw–Hill Education, New Delhi, 2017
3. R.S..Sedha, "A text book of Applied Electronics", Revised Edition, S.Chand Publications, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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Module:3 Opinion Paragraph
Activity: Note making, analyzing and writing a review

UNIT II CAREER ENHANCEMENT 9

Module:4 Reading Comprehension
Activity: Reading Newspaper articles/Blogs, Sentence completion
Module:5E-mail Communication
Activity: Drafting personal and professional emails
Module:6 Career Profiling
Activity: Resume Writing & Digital Profiling

UNIT III LANGUAGE ADEPTNESS 9

Module:7 Rewriting passages
Activity: Conversion of voices & Rephrasing Articles
Module:8 Enhancing Pronunciation skills
Activity: Listening to short technical Reels and reproducing it
Module:9 Making Conversations
Activity: Role play & Narrating Incidents

UNIT IV TECHNICAL WRITING 9

Module:10 Spotting Errors
Activity: Proof reading, Rewriting sentences
Module:11 Data Interpretation
Activity: Interpretation of Graphics/Charts/Graphs
Module:12 Expository Writing
Activity: Picture inference, Captions for Posters& Products

UNIT V LANGUAGE UPSKILLING 9

Module:13 Listening for Specific Information
Activity: TED talks/Announcement/Documentaries
Module:14 Presentation
Activity: Extempore & Persuasive Speech
Module:15 Team Communication
Activity: Team building activities, Group Discussion

LIST OF EXERCISES

1. Introducing oneself
2. Role play
3. Listening to short technical Reels
4. Listening to TED Talks/ Announcements/ Documentaries
5. Presentation
6. Group Discussion

Contact Periods:

Lecture: 15 Periods Tutorial: - Periods Practical: 30 Periods Project: - Periods

Total: 45 Periods

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TEXT BOOKS:

1. Ashraf Rizvi, "Effective Technical Communication", 2nd edition, Mc Graw – Hill. India 2017
2. Rod Ellis, "English for Engineers & Technologists", Vol. II: (English for Engineers and Technologist: A Skills Approach). 2nd edition, Orient Black Swan, 1990

REFERENCES:

1. Raymond Murphy, "Intermediate English Grammar", 2nd edition, Cambridge University Press, 2009
2. Thomas L Means, "English and Communication for Colleges", 4th edition, Cengage 2017
3. Using English: "A Coursebook for Undergraduate Engineers and Technologists", 1st edition, Orient Black Swan, 2017

EVALUATION PATTERN:

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SEMESTER I

U21CSG01	PROBLEM SOLVING AND C PROGRAMMING (Common to All Branches)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide exposure to problem-solving through programming
- To develop computational thinking perspective of one's own discipline
- To write, compile and debug programs using C language

COURSE OUTCOMES:

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

CO1: Formulate the algorithmic solutions for a given computational problem (Understand)

CO2: Describe modularization, structures and pointers in C language (Understand)

CO3: Design and implement algorithms for a given problem using C control structures (Apply)

CO4: Apply the C programming constructs for searching and sorting techniques (Apply)

CO5: Solve real time problems using suitable non-primitive data structures in C (Apply)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	-	-	-	1	2	2	-	3	2	2
CO2	2	1	1	2	-	-	-	1	2	2	-	2	2	-
CO3	3	2	2	2	-	2	-	1	2	2	-	2	2	1
CO4	3	2	2	2	-	-	-	1	2	2	-	2	2	-
CO5	3	2	2	2	-	-	-	1	2	2	-	2	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I COMPUTATIONAL THINKING 6

Computational Thinking – Modern Computer – Information based Problem solving – Real world information and Computable Data – Data types and data encoding – Number Systems – Introduction to programming languages – Basics of C programming – variables– Data types – keywords – C program structure – Simple programs in C

UNIT II ALGORITHMIC APPROACH 6

Logic – Boolean Logic – Applications of Propositional logic – Problem Definition – Logical Reasoning and Algorithmic thinking – Pseudo code and Flow chart – Constituents of algorithms – Sequence,

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Selection and Repetition – Problem understanding and analysis – Control structures in C – Algorithm design and implementation using control structures

UNIT III SEARCHING, SORTING, AND MODULARIZATION 6

Data Organization – Arrays – Introduction to Searching and Sorting – Linear Search, Binary Search – Basic sorting techniques – Two-dimensional arrays – Matrix manipulation – Modularization – Functions – Function prototype – Function definition – Function call – Built-in functions (string functions and math functions) – Recursion

UNIT IV STRUCTURES AND POINTERS 6

Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program – Sorting of names – Parameter passing – Pass by value – Pass by reference – Structure – Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Unions

UNIT V FILES 6

Files – Types of file processing – Sequential access – Random access – Sequential access file – Example Program – Finding average of numbers stored in sequential access file – Random access file – Example Program – Transaction processing using random access files – Command line arguments

LIST OF EXPERIMENTS

A. Lab Programs

1. Using IO Statements, get higher secondary marks of a student. Calculate and display the medical and engineering cut-off marks. [Assume the calculation formula]
2. Develop a C program to emulate the operations of an ATM using control structures. Authentication, Deposit, Withdrawal, and Balance check and pin change operations are to be supported.
3. Develop a calculator to perform the operations including addition, subtraction, multiplication, division and square of a number.
4. Given different prices of a vegetable which is varying through the day (from morning to evening), find out the best buy price and sell price for the maximum profit.
   Eg. For the prices [33, 35, 28, 36, 39, 25, 22, 31], best buy is at 22 and best sell is at 39.
5. Collect the height and weight of 4 of your friends and calculate their body mass index. Use 2-dimensional array to store the values.
6. Weights of 10 students of your class who are standing in a line is given in a random order. Find out if there is a heavy person whose weight is the sum of previous two persons.
7. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
8. From a given paragraph perform the following using built-in functions:
   a) Find the total number of words.
   b) Capitalize the first word of each sentence.
9. Solve Towers of Hanoi using recursion.
10. Develop an expense manager which reads date, product, price and product category. The program should display the total expense amount based on product category or date as per user's selection. Use structures.
11. Develop a banking application to store details of accounts in a file. Count the number of account holders based on a search condition such as - whose balance is less than the minimum balance.

B. Mini Project (SAMPLE)

Create a Railway Reservation system with the following modules of Booking,

- Availability checking
- Cancellation
- Prepare chart

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Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project – Periods

Total 60 Periods

TEXT BOOKS:

1. David D. Railey and Kenny A.Hunt, "Computational Thinking for Modern problem Solver", 1st edition, CRC Press, 2014
2. Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", 2nd edition, Pearson, 2015

REFERENCES:

1. Paolo Ferragina and Fabrizio Luccio, "Computational Thinking First Algorithms", Then Code" ,1st edition, Springer International Publishing, 2018
2. Reema Thareja, "Programming in C", 2nd edition, Oxford University Press, 2016
3. Paul Deitel and Harvey Deitel, "C How to Program", 7th edition, Pearson Publication, 2016
4. Juneja, B. L and Anita Seth, "Programming in C",1st edition, Cengage Learning India Pvt. Ltd., 201
5. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", 1st edition, Oxford University Press, 2009

EVALUATION PATTERN:

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31.4.24

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SEMESTER I

U21PH101	ENGINEERING PHYSICS (Common to All Branches)	Category: BSC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental principles of laser and fibre optics with their applications
- To acquire the knowledge of ultrasonic waves, thermal conductivity and properties of liquids
- To understand the concepts of crystals

COURSE OUTCOMES:

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

CO1: Demonstrate the types of laser for various industrial and medical applications (Understand)
CO2: Apply the concepts of fibre optics in engineering (Understand)
CO3: Understand the production methods of ultrasonic waves and uses in engineering and medicine (Understand)
CO4: Apply the concepts of thermal conductivity in hybrid vehicles and viscosity of liquids in engineering applications (Understand)
CO5: Explain the basic concepts of crystals and its growth techniques (Understand)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I LASER **6**

Laser characteristics – Spontaneous and stimulated emission – Pumping methods – CO_2 laser – Semiconductor laser – Material Processing – Selective laser Sintering – Hologram – Medical applications (Opthalmology)

UNIT II FIBER OPTICS **6**

Total internal reflection – Numerical aperture and acceptance angle – Classification of optical fibers (Materials, modes and refractive index profile) – Fiber optical communication system – Displacement and temperature sensor – Medical Endoscopy

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UNIT III ULTRASONICS 6

Properties of ultrasonic waves – Piezoelecrtic generator – Acoustic grating – Applications of ultrasonics in industry– SONAR – NDT – Ultrasonic scanning methods – Fetal heart movement

UNIT IV THERMAL PHYSICS AND PROPERTIES OF FLUIDS 6

Modes of heat transfer – Thermal conductivity – Lee's disc method – Solar thermal power generation – Hybrid vehicles – Microwave oven – Surface tension and coefficient of viscosity – Poiseuille's flow experiment

UNIT V CRYSTAL PHYSICS 6

Unit cell – Bravais lattices – SC, BCC, FCC structures – Miller indices – d spacing in cubic lattice – Crystal growth from melt: Bridgeman Technique – Silicon ingots from Czochralski method – Silicon wafers from ingots and its applications.

LIST OF EXPERIMENTS

1. Determination of the wavelength of a given laser source
2. Determination of acceptance angle and numerical aperture of an optical fibre
3. Determination of velocity of sound and compressibility of a liquid using Ultrasonic interferometer
4. Determination of thermal conductivity of a bad conductor using Lee's disc method
5. Determination of viscosity of the given liquid using Poiseuille's flow method

Contact Periods:

Lecture: 30 Periods Tutorial: - Periods Practical: 30 Periods Project: - Periods

Total: 60 Periods

TEXT BOOKS:

1. Bhattacharya D K and Poonam Tandon, "Engineering Physics", 2nd edition, Oxford University Press, Chennai, 2017
2. Marikani A, "Engineering Physics", 3rd edition, PHI publishers, Chennai, 2021

REFERENCES:

1. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", 2nd edition, Pearson India Education Services Private Limited, Chennai, 2018
2. Avadhanulu M N, Kshirsagar P G and Arun Murthy TVS, "A Text book of Engineering Physics", 2nd edition, S Chand Publishing, New delhi, 2018
3. Thyagaran K, Ajoy Ghatak, "Lasers – Fundamantals and Applications", 2nd edition, Laxmi Publications Pvt Limited, New delhi, 2019
4. https://nptel.ac.in/downloads/104104085/
5. https://nptel.ac.in/courses/122107035/8/

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

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SEMESTER I

		Category: BSC				
U21CY101	ENGINEERING CHEMISTRY (Common to All Branches)	L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To inculcate the fundamentals of water technology and electrochemistry
- To gain basic knowledge of corrosion of metals and alloys
- To acquire knowledge about the properties of fuels and applications of polymers

COURSE OUTCOMES:

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

CO1: Apply the principles of water technology in treatment of industrial and domestic water and estimate the various constituents of industrial water (Apply)

CO2: Describe the principles and applications of electrochemical cells, fuel cells and solar cells (Understand)

CO3: Outline the different types of corrosion processes and preventive methods adopted in industries (Understand)

CO4: Explain the analysis and calorific value of different types of fuels (Understand)

CO5: Classify the polymers and their engineering applications (Understand)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I CHARACTERISTICS OF WATER AND ITS TREATMENT 6

Characteristics of water – Hardness – Types, Dissolved oxygen, Total dissolved solids, Disadvantages due to hard water in industries – (Scale, Sludge, Priming, Foaming and Caustic embrittlement), Water softening methods – Lime-soda, Zeolite, Ion exchange processes and reverse Osmosis and their applications. Specifications of domestic water (ICMR and WHO).

Water treatment for municipal supply –Sedimentation with coagulant – Sand Filtration – Chlorination, Disinfection methods– UV treatment, Ozonolysis, Electro dialysis

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UNIT II ELECTROCHEMISTRY AND ENERGY STORAGE SYSTEMS 6

Introduction, Electrodes – (Calomel electrode), Electrochemical series and its applications, Brief introduction to conventional primary and secondary batteries – (Pb acid, Lithium)

Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells – Working principles, advantages, applications. Solar cells – Dye sensitized solar cells –Working principles, characteristics and applications

UNIT III CORROSION AND ITS CONTROL 6

Types – Dry – Chemical corrosion and Wet – Galvanic and differential aeration (Pitting, Crevice, pipeline) – Factors influencing rate of corrosion – Corrosion control methods – Sacrificial anode and impressed current method – Protective coating – Electroplating – Ni plating.

Alloys – Ferrous (stainless steel), Heat treatment – Non-ferrous alloys (Brass -Dutch metal, German Silver) – Composition, properties and uses

UNIT IV FUELS AND COMBUSTION 6

Fuels- Solid fuel: Coal - Analysis of coal (Proximate analysis only) – Liquid fuel – Manufacture of synthetic petrol (Bergius process) – Octane number, cetane number, Knocking in engines- Anti-knocking agents, Gasoline additives, Gaseous fuel: Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Composition only.

Calorific value – Higher and lower calorific values – Flue gas analysis (ORSAT method). Measurement of calorific value using bomb calorimeter, Three-way catalytic converter – Selective catalytic reduction of NO_x

UNIT V POLYMERS 6

Introduction – Monomer, dimers, functionality, degree of polymerisation, transition glass temperature Classification of polymers, Difference between thermoplastics and thermosetting plastics, Engineering application of plastics - ABS, PVC, PTFE and Bakelite.

Types of compounding of plastics – Moulding, Injection moulding, Extrusion moulding, Compression moulding

Conducting polymers – Polypyrrole, Polyacetylene, Polyaniline – Structure and applications, Composites – FRP – Properties and applications

LIST OF EXPERIMENTS

1. Determination of total, permanent and temporary hardness of a given sample water by EDTA method
2. Estimation of ferrous ion by potentiometric titration
3. Estimation of Copper in Brass by EDTA method
4. Determination of percentage of moisture, volatile, ash and carbon content in a given sample of coal.
5. Determination of molecular weight and degree of polymerization of an oil sample by viscosity measurement (Ostwald's viscometer).
6. Determination of chloride content in the water sample
7. Determination of strength of HCl by pH metric method

Contact periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods
Total: 60 Periods

TEXT BOOKS:

1. Jain P C and Monika Jain, "Engineering Chemistry", 16th edition, Dhanpat Rai Publishing Company, Pvt. Ltd., New Delhi, 2015
2. Vairam S, Kalyani P and Suba Ramesh, "Engineering Chemistry", 2nd edition, Wiley India Pvt. Ltd, New Delhi, 2014

31.1.25

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REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", 2nd edition, Scientific International Pvt. Ltd, New Delhi, 2014
2. Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India, Pvt. Ltd, Delhi, 2015
3. Shikha Agarwal, "Engineering Chemistry, Fundamentals and Applications", 1st edition, Cambridge University Press, 2015
4. https://nptel.ac.in/courses/113/104/113104008/

EVALUATION PATTERN:

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SEMESTER I

U21ECG03	ENGINEERING STUDIO (Common to All Branches)	Category: ESC				
		L	T	P	J	C
		0	0	4	0	2

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To enable the students, understand the functioning of simple to complex devices and systems
- To help the students design and build simple applications on their own
- To create an immersive environment in the engineering lab

COURSE OUTCOMES:

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

CO1: Understand basics of electronics (Understand)
CO2: Use basic electronic components and Arduino for prototyping (Apply)
CO3: Create simple real time use cases (Create)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	2	-	-	-	1	-	-	1	1	-
CO2	3	3	3	3	2	2	1	1	2	-	-	1	1	-
CO3	3	3	3	3	3	2	3	3	3	-	-	3	2	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)							3: Substantial (High)		

LIST OF EXPERIMENTS

Basics of Electronics

1. Breadboard Basics – LED glowing, Ohm's Law
   Series and Parallel Circuits
2. Controlling the circuit response using Potentiometer
   Capacitor Charging and Discharging
3. Water level Indicator using transistor
   Touch sensor using transistor
4. Automatic night light- (LDR –transistor) circuit
   Fire alarm Circuit
5. IR Sensor-Obstacle detecting circuit
   Doorbell using 555 Timer circuit
6. LED Chaser circuit using Counter IC
   Shadow detector using IC741
7. Regulated output using Regulator IC
   Logic gate Realization

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Basics of IoT (With Arduino)

1. Basics of ARDUINO and IoT
   Working with LEDs
2. Working with digital switch
   Adjusting voltage using potentiometer
3. Measuring the presence / absence of light using LDR
   Finding the distance of an object using ultrasonic sensor
4. Finding the Temperature and Humidity in the surroundings
   Detecting the motion of human using PIR
5. Working with Servo motor
   Establish communication using Bluetooth

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments
Evaluation of course workbook, Tasks **(Rubrics based)**
100

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SEMESTER II

		Category: HSMC				
U21GEG02	**TAMILS AND TECHNOLOGY** (Common to All Branches)	**L**	**T**	**P**	**J**	**C**
		1	**0**	**0**	**0**	**1**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn weaving, ceramic and construction technology of Tamils
- To understand the agriculture, irrigation and manufacturing technology of Tamils
- To realize the development of scientific tamil and tamil computing

COURSE OUTCOMES:

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

CO1: Understand the weaving and ceramic technology of ancient tamil people nature (Understand)

CO2: Understand the construction technology, building materials in sangam period and case studies (Understand)

CO3: Infer the metal process, coin and beads manufacturing with relevant archeological evidence (Understand)

CO4: Realize the agriculture methods, irrigation technology and pearl diving (Understand)

CO5: Apply the knowledge of scientific tamil and tamil computing (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other

worship places – Temples of Nayaka 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

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola 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

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: - Periods Practical: – Periods Project – Periods

Total 15 Periods

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

EVALUATION PATTERN:

Continuous Internal Assessment	Total
	100

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SEMESTER II

		Category: HSMC				
U21GEG02	தமிழரும் தொழில்நுட்பமும் (அனைத்து துறைகளுக்கும் பொதுவனது)	L	T	P	J	C
		1	0	0	0	1

முன்கூட்டிய துறைசார் அறிவு: தேவையில்லை

பாடத்தின் நோக்கங்கள்:

- தமிழர்களின் சங்ககால நெசவு, பானை வனைதல் மற்றும் கட்டட **தொழில்நுட்பம்** குறித்து அறிதல்
- தமிழர்களின் சங்ககால வேளாண்மை, நீர்ப்பாசனம் மற்றும் உற்பத்தி முறைகள் குறித்த கற்றல்
- நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிதல்

பாடம் கற்றதின் விளைவுகள்:

CO1: சங்ககாலத் தமிழர்களின் நெசவு மற்றும் பானை வனைதல் தொழில்நுட்பம் குறித்த கற்றுணர்தல் (புரிதல்)
CO2: சங்ககாலத் தமிழர்களின் கட்டட **தொழில்நுட்பம்**, கட்டுமானப் பொருட்கள் மற்றும் அவற்றை விளக்கும் தளங்கள் குறித்த அறிவு (புரிதல்)
CO3: சங்ககாலத் தமிழர்களின் உலோகத்தொழில், நாணயங்கள் மற்றும் மணிகள் சார்ந்த தொல்லியல் சான்றுகள் பற்றிய அறிவு (புரிதல்)
CO4: சங்ககாலத் தமிழர்களின் வேளாண்மை, நீர்ப்பாசன முறைகள் மற்றும் முத்து குளித்தல் குறித்த தெளிவு (புரிதல்)
CO5: நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிந்துகொள்ளலும் மற்றும் பயன்படுத்துதலும் (கற்றலை பயன்படுத்துதல்)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

பாடத்திட்டங்கள்:

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

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

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

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

அலகு III உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருகுதல், எக்கு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் – கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3

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

அலகு V அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி – கணினித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக் கழகம் – தமிழ் மின்நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்

Contact Periods:

Lecture: 15 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 15 Periods

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)

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9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

மதிப்பீட்டு முறை:

தொடர்ச்சியான உள் மதிப்பீடு	மொத்தம்
	100

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SEMESTER II

U21MA204	APPLIED LINEAR ALGEBRA (Common to AD and AM)	Category: BSC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge of decomposition of matrices
- To understand postulates of vector spaces and linear transformations
- To understand concepts of eigenvalues and eigenvectors of a matrix and inner product spaces

COURSE OUTCOMES:

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

CO1: Apply the concepts of the linear system of equations to solve core engineering problems (Apply)

CO2: Analyze the basic properties of vector spaces and subspaces and find basis and dimension of a vector space (Understand)

CO3: Compute linear transformations, kernel and range, and inverse linear transformations and find matrices of general linear transformations (Understand)

CO4: Compute inner products on a real vector space and compute angle and orthogonality in inner product spaces to solve application problems (Understand)

CO5: Find the eigen values and eigen vectors of the linear transformations for the simple real life problems (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	1	1
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I LINEAR SYSTEMS 9

Geometric interpretation of linear system in 2 and 3 unknowns – Row reduction and echelon forms – Vector equation – Matrix equation Ax=b-LU decomposition – Applications of linear systems

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UNIT II VECTOR SPACES 9

Vector spaces and subspaces – Linear combination, Span, linear independence and dependence – Null space, column space, and row space – Basis and dimension of a vector space – Rank and nullity – Applications to electrical network

UNIT III LINEAR TRANSFORMATION 9

General linear transformations – Kernel and range – Matrices of general linear transformation – Geometry linear operators – Change of basis

UNIT IV INNER PRODUCT SPACES 9

Inner product, length, angle and orthogonality – Orthogonal sets – Orthogonal projections – Inner product spaces – Orthonormal basis: Gram-Schmidt process

UNIT V EIGENVALUES AND EIGENVECTORS 9

Eigenvalues and eigenvectors – Singular value decomposition – Eigenvalues and linear transformations – Linear discrete dynamical systems – Direct Method

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11th edition, John Wiley & Sons Inc, 2011
2. David C. Lay, "Linear Algebra and its Applications", 5th edition, Pearson Education, 2015

REFERENCES:

1. Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Cengage India Pvt. Ltd., 2005
2. Steven J. Leon, "Linear Algebra with Applications", 9th edition, Pearson College Division, 2014

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
Individual Assignment / Seminar / MCQ	Written Test	Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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SEMESTER II

U21PH201	**MATERIALS SCIENCE** (Common to all Branches Except BM)	**Category: BSC**					
		L	**T**	**P**	**J**	**C**
		2	**0**	**0**	**0**	**2**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain the knowledge of conducting and semiconducting materials
- To understand the concepts of magnetic, dielectric and optical properties of materials
- To enhance the knowledge of new engineering materials

COURSE OUTCOMES:

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

CO1: Demonstrate the electrical characteristics of conducting materials (Understand)

CO2: Interpret the properties and types of semiconducting materials (Understand)

CO3: Compare various types of magnetic materials for engineering applications (Understand)

CO4: Explain the fundamental concepts of dielectric and optical materials (Understand)

CO5: Examine new engineering materials for industrial applications (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	1	-	-	-	-	-	1	-	-
CO3	3	2	-	-	-	1	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	1	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	1	-	-	-	-	-	1	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

SYLLABUS:

UNIT I CONDUCTING MATERIALS **6**

Classical free electron theory – Expression for electrical conductivity and thermal conductivity – Wiedemann - Franz law – Drawbacks – Fermi distribution function – Density of energy states in metals

UNIT II SEMICONDUCTING MATERIALS **6**

Intrinsic and Extrinsic semiconductor – Carrier concentration in n-type semiconductor – P-type semiconductor(qualitative) – Applications of semiconductors – Solar cell – LED – Hall effect and its experimental determination.

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UNIT III MAGNETIC MATERIALS 6

Origin of magnetism – Dia, para and ferro magnetic materials – Domain theory – Soft and hard magnetic materials – Magnetic bubble memories – GMR sensor

UNIT IV DIELECTRIC AND OPTICAL MATERIALS 6

Dielectrics – Types of polarisation – Electronic polarisation – Dielectric breakdown – Ferroelectrics – Applications of dielectrics – Classification of optical materials – Nonlinear optics – Applications

UNIT V NEW ENGINEERNG MATERIALS AND CHARACTERIZATION TECHNIQUES 6

SMA – SiC – GaN – Rheological materials – Nanomaterials – Synthesis (Ball milling and CVD) – Quantum dot, quantum wire and quantum well(qualitative) – Characterisation techniques – Powder XRD(qualitative) – SEM

Contact Periods:

Lecture: 30 Periods Tutorial: - Periods Practical: - Periods Project: - Periods

Total: 30 Periods

TEXT BOOKS:

1. Wahab M A, "Solid State Physics: Structure and Properties of Materials", 3rd edition, Narosa Publishing House, Chennai, 2018
2. Marikani A, "Materials Science", 1st edition, PHI publishers, Chennai, 2017

REFERENCES:

1. Pillai S O "Solid State Physics", 9th edition, New Age International Publishers, New Delhi, 2020
2. Bangwei Zhang, "Physical Fundamentals of Nanomaterials", 1st edition, Chemical Industry Press, China, 2018
3. Joginder Singh Galsin, "Solid State Physics – An Introduction to Theory" , 1st edition, Academic Press, India, 2019
4. https://nptel.ac.in/courses/108/108/108108122/
5. https://nptel.ac.in/courses/113/105/113105081/

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
Individual Assignment / Seminar / Mini Project / MCQ	Written Test	Individual Assignment / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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SEMESTER II

U21AM201	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- U21CSG02 – Python Programming

COURSE OBJECTIVES:

- To study and design Intelligent Agents for various AI applications
- To understand the concepts of Problem Solving, Uncertain knowledge and reasoning, communicating, perceiving, and acting problems
- To understand about AI, its applications and use cases

COURSE OUTCOMES:

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

CO1: Understand the basics of AI (Understand)

CO2: Apply the AI Problem areas and analyse it in a structured manner (Apply)

CO3: Analyse AI algorithms and prove their performance mathematically (Apply)

CO4: Design and visualize a real-world AI application with a data science tool (Apply)

CO5: Analyse various AI Applications and its uses (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I FOUNDATIONAL CONCEPTS OF AI **9**

What is AI – How AI works – Uses of AI – Types of AI – What is Intelligence – Decision Making– How do you make decisions – Introduction to AI and related terminologies: Define AI – Machine Learning – Deep Learning – Differentiate Image processing and computer Vision

UNIT II AI PROJECT CYCLE **9**

Introduction to AI Project Cycle – Understanding Problem Scoping – Data Acquisition – Visualizing Data – Data Exploration: Visualizing Data (data sets)

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UNIT III INTRODUCTION TO MODELLING 9

Introduction to Modeling – Introduction to Rule – Based & Learning Based AI Approaches – Introduction to Supervised, Unsupervised & Reinforcement Learning Models – Neural Networks – Evaluating the Model: Understanding Accuracy, Precision, Recall & F1 Score, confusion matrix

UNIT IV BASICS OF DATA SCIENCE 9

Introduction to Data Science – Applications of Data Science – Revisiting AI Project Cycle – Concepts of Data Sciences – Basics of Statistical Learning & Data Visualization (Bar chart, Pie chart, Scatter plots, box plots)

UNIT V REAL-LIFE AI IMPLEMENTATIONS 9

Artificial Intelligence Applications – AI in Marketing – Chatbots in Banking – Object Detection in Agriculture – Health care – Games – Case Study Space Exploration – Autonomous Vehicles

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th edition, Prentice Hall, 2020
2. K.R.Chowdhary , "Fundamentals of Artificial Intelligence", 1st edition, Springer, 2020

REFERENCES:

1. Prateek Joshi, "Artificial Intelligence with Python",1st edition, Packt Publishing, 2017
2. Deepak Khemani, "A First Course in Artificial Intelligence", 2nd edition, McGraw Hill Education (India), 2017
3. Nick Bostrom, "Super intelligence: Paths, Dangers, Strategies", 1st edition, Oxford University Press, 2015
4. David Poole, Alan Mackworth, "Artificial Intelligence: Foundations of Computational Agents", 2nd edition, 2017
5. Elaine Rich and Kevin Knight. "Artificial Intelligence", 3rd edition, Tata McGraw Hill, 2019

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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SEMESTER II

U21EN201	PERSONALITY ENHANCEMENT (Common to AD, AM, BM, CH, CE, CS, EE, EC, ME, MI, IT)	Category: HSM				
		L	T	P	J	C
		1	0	2	0	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop of personality traits that contributes in the professional environment
- To create a basic awareness about the significance of soft skills in professional and interpersonal communications
- To enhance the level of self-confidence that helps to excel in the leadership skills

COURSE OUTCOMES:

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

CO1: Nurture a deep understanding of personality development and interpersonal relationship for overall self-development (Understand)

CO2: Communicate proficiently in high-end interviews and in all social situations (Understand)

CO3: Synthesize complex concepts and present them in speech and writing (Analyse)

CO4: Negotiate and lead teams towards success (Understand)

CO5: Present ideas in an effective manner using web tools (Apply)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO2	-	-	-	-	-	-	-	1	2	3	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO5	-	-	-	-	-	-	-	1	-	3	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I LEXICAL REASONING **9**

Module:1 Establishing Associations

Activity: Verbal Analogy, Logical Reasoning

Module:2 Lateral Thinking

Activity: Reasoning and Assertions

Module:3 Sentence Completion

Activity: Cloze Test, Single Word Substitutes

UNIT II SOCIAL CORRESPONDENCE **9**

Module:4 Etiquettes

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Activity: Brain storming & performing in actions

Module:5 Introspection

Activity: SWOT Analysis, Goal Setting

Module:6 Co-verbal Gesture

Activity: Body Language, Nonverbal cues

UNIT III ART OF NETWORKING 9

Module:7 Addressing a Multitude

Activity: Welcome address, Vote of Thanks, Public Speaking

Module:8Persuasive Communication

Activity: Making Technical Presentation

Module:9 Career Oriented Communication

Activity: Face to face Conversation, Mock Interview

UNIT IV CRITICAL THINKING 9

Module:10 Organizing ideas

Activity: Mind Mapping

Module:11 Problem Solving Skills

Activity: Conflict management, Case Study

Module:12 Critical Review

Activity: Book/ Movie Review, Comparative Analysis

UNIT V CONTENT WRITING 9

Module:13 Reports

Activity: Writing Event Report, Project Report

Module:14 Writing for Digital platform

Activity: Writing Posts, Blogs

Module:15 Developing Content

Activity: Product Description, Writing Proposals

LIST OF EXERCISES

1. Listening to Inspirational Speech
2. Listening to Product Description
3. Book/Movie Review
4. Presentation
5. Mock Interview
6. Public Speaking

Contact Periods:

Lecture: 15 Periods Tutorial: - Periods Practical: 30 Periods Project: - Periods

Total: 45 Periods

TEXT BOOKS:

1. Meenakshi Raman & Sangeetha Sharma. "Professional English: for AKTU",1st edition, Oxford University Press. 2018
2. Barun. K.Mitra. "Personality Development and Soft Skills", OUP India. 2nd edition, 2016

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REFERENCES:

1. Mathew Allen. "Smart Thinking: Skills for Critical Understanding and Writing", 2nd edition, OUP India, 2016
2. Means, Thomas L, "English and Communication for Colleges", 4th edition, Cengage 2017
3. Using English: "A Coursebook for Undergraduate Engineers and Technologists", 1st edition, Orient Black Swan, 2017

EVALUATION PATTERN:

<table>
<tr><td colspan="4">Continuous Internal Assessments</td><td>End Semester Examinations</td></tr>
<tr><td colspan="2">Assessment I
(Theory)
(100 Marks)</td><td colspan="2">Assessment II
(Practical)
(100 Marks)</td><td rowspan="2">Practical Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>Individual Assignment / Seminar / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)</td><td>Test</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td><td></td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>50</td></tr>
<tr><td colspan="4">50</td><td>50</td></tr>
<tr><td colspan="5">Total: 100</td></tr>
</table>

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SEMESTER II

U21CSG02	PYTHON PROGRAMMING (Common to All Branches)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand syntax and semantics of python programming
- To implement programs using python data structures
- To gain expertise in using python libraries for solving real time problems

COURSE OUTCOMES:

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

CO1: Describe the basic operations of tokens in python (Understand)

CO2: Demonstrate the programs using control statements (Apply)

CO3: Develop programs using python data structures (Apply)

CO4: Implement the exceptions in file-handling concepts (Apply)

CO5: Apply the python libraries in real-world problems (Apply)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	-	-	-	1	2	2	-	2	2	2
CO2	2	1	1	2	-	-	-	1	2	2	-	2	2	3
CO3	3	2	2	2	-	-	-	1	2	2	-	2	2	3
CO4	3	2	2	2	-	-	-	1	2	2	-	2	2	3
CO5	3	2	2	2	1	-	-	1	2	2	-	2	2	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I LANGUAGE BASICS 6

Python interpreter and interactive mode – Tokens – Data types – Numbers and math functions – Input and Output operations – Comments – Reserved words – Indentation – Operators and expressions – Precedence and associativity – Type conversion – Debugging – Common errors in Python

UNIT II CONTROL STATEMENTS, FUNCTIONS, AND MODULES 6

Selection – Conditional branching statements – if – if-else – Nested-if – if-elif-else statements – Iterative statements – while – for loop – break – continue and pass statements – Functions – Function Definition and Function call – Variable scope and Lifetime – Return statement – Lambda functions or Anonymous functions – Recursion – Modules and Packages

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UNIT III PYTHON DATA STRUCTURES 6

Strings – Slicing – Immutability – Built-in string methods and functions – Concatenating – Appending and Multiplying strings – String modules – List – Creation – Accessing values – Slicing – List methods – In-built functions for Lists – Tuples – Creation – Operations on tuples – Traversing – Indexing and Slicing – Tuple assignment – In-built functions for tuples – Sets – Creation – Operations – Dictionaries – operations and methods

UNIT IV EXCEPTION AND FILE HANDLING 6

Exceptions – Errors and Exceptions – Handling exception – Built-in and User-defined exceptions – Files – Types – Operations – Open – Read – Write – Close

UNIT V NUMPY and PANDAS 6

Numpy – Introduction – Computations using NumPy functions – Computation on Arrays – Aggregation – Indexing and Sorting – Pandas – Introduction and Basic Pandas Concepts – Data frames – Data Handling

LIST OF EXPERIMENTS

1. Programs on selection and Iteration operations.
   Get an integer input from a user. If the number is odd, then find the factorial of a number and find the number of digits in the factorial of the number. If the number is even, then check the given number is palindrome or not.
2. Strings and its operations.
   Given two strings, PRINT (YES or NO) whether the second string can be obtained from the first by deletion of none, one or more characters.
3. List and its operations.
   Programs for positive and negative indexing.
   Program to check if the given list is in Ascending order or Not.
4. Tuples and its operations.
   Python program to convert a tuple to a string.
   Python program to reverse a tuple.
5. Sets and its operations.
   Python program to check if a set is a subset of another set.
6. Dictionaries and its operations.
   Python program to iterate over dictionaries using for loops.
7. Computations using NumPy functions.
   NumPy program to convert a list of numeric value into a one-dimensional NumPy array.
   NumPy program to convert a list and tuple into arrays.
8. Data manipulations using Pandas.
   Program to convert a NumPy array and series to data frames.
   Program to add, subtract, multiple and divide two Pandas Series.
   Program to retrieve and manipulate data using dataframes.

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Reema Thareja, "Python programming: Using problem solving approach", 1st edition, Oxford Press, 2017
2. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd edition, Shroff/O'Reilly Publication, 2017

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REFERENCES:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", 2nd edition, McGrawHill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach",1st edition, Pearson India Education Services Pvt. Ltd., 2016
4. https://python-iitk.vlabs.ac.in/
5. https://greenteapress.com/wp/think-python/

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th colspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I
(Theory)
(100 Marks)</th><th colspan="2">Assessment II
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(100 Marks)</th><th rowspan="2">Theory Examinations
(Examinations will be conducted for 100 Marks)</th><th rowspan="2">Practical Examinations
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<tr><td>40</td><td>60</td><td>75</td><td>25</td><td></td><td></td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>25</td></tr>
<tr><td colspan="4">50</td><td colspan="2">50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

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SEMESTER II

		Category: ESC				
		L	T	P	J	C
U21ECG01	**DIGITAL ELECTRONICS** (Common to AD, AM, BM, CS, CSBS, EC, and IT)	2	0	2	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the fundamentals of digital logic circuits
- To design the combinational logic circuits.
- To design the synchronous and asynchronous sequential circuits

COURSE OUTCOMES:

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

CO1: Apply various reduction methods to simplify logic expressions (Apply)
CO2: Implement the combinational logic circuits using gates (Apply)
CO3: Examine the performances of latches and flip-flops (Analyze)
CO4: Construct sequential logic circuits using flip-flops (Apply)
CO5: Design hazard free circuit for asynchronous sequential circuit (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	-	-	-	2	2	2	-	2	-	-
CO2	3	2	-	2	-	-	-	2	2	2	-	2	-	-
CO3	3	3	2	2	-	-	-	2	2	2	-	2	-	-
CO4	3	2	-	2	-	-	-	2	2	2	-	2	-	-
CO5	3	3	2	2	-	-	-	2	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I BOOLEAN THEOREMS AND LOGIC REDUCTION **6**

Number system – Complements – Boolean theorems – Codes – Logic gates – NAND and NOR gates – Representation of boolean expression – SOP, POS, canonical form – Simplification of logic functions using K-map, Quine McCluskey method

UNIT II COMBINATIONAL LOGIC DESIGN **6**

Adder-1 Bit adder/subtractor, parallel adder, 2's complement adder/subtractor – Implementation of combinational circuits – Multiplexers, decoders, encoders, demultiplexers – Code converters – Error detection and correction codes – Parity generator and checker

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UNIT III LATCHES AND FLIPFLOPS 6

Latches – NOR, NAND – Digital pulses – Clocked flip-flops – Master/Slave flip-flop – Asynchronous inputs – Flip-flop timing considerations – Conversion of flip-flop

UNIT IV SEQUENTIAL CIRCUITS 6

General model of sequential circuits – Mealy/Moore models, excitation table, state table, state diagram – Design of synchronous sequential circuits – Synchronous up/down counters, modulus counters – Asynchronous counter – Sequence detector

UNIT V REGISTERS AND HAZARDS 6

Shift registers – Ring counter, Johnson counter – Hazards and Essential Hazards in logic circuits – Design of Hazard free circuits

LIST OF EXPERIMENTS (INDICATIVE)

1. Characteristics of digital IC's
2. Implementation of combinational logic design using MUX IC's
3. Design and implementation of various data path elements (Adder/Subtractor)
4. Characteristics of flip-flop
5. Design and implementation of synchronous sequential circuit (Counters/ Shift registers)
6. Design and implementation of asynchronous mod counters

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: - Periods
Total: 60 Periods

TEXT BOOKS:

1. M.Morris Mano, Michael D Ciletti, "Digital Design", 6th edition, Pearson, 2018
2. Charles H. Roth, Jr, Larry L. Kinney" Fundamentals of logic design",7th edition, Kluwer Academic Publishers,2014

REFERENCES:

1. Thomas L.Floyd, "Digital Fundamentals", 11th edition, Prentice Hall, 2015
2. A.Anand Kumar, "Fundamentals of Digital Circuits", 2nd edition, PHI Learning, 2013
3. Ronald J Tocci, Neal S Widmer, Gregory L Moss, "Digital Systems Principles and Applications", 10th edition, Pearson, 2009
4. D. Donald Givone, "Digital Principles and Design", 4th edition, Tata McGraw Hill, 2008.

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

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SEMESTER II

U21MEG01	ENGINEERING GRAPHICS	Category: ESC				
		L	T	P	J	C
		0	0	4	0	2

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To expose the standards and conventions followed in preparation of engineering drawings
- To develop graphic skills for communication of concepts, ideas and engineering drawings
- To expose on 2D & 3D drawings and its projections

COURSE OUTCOMES:

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

CO1: Sketch the curves and orthographic projections of points as per BIS conventions (Apply)

CO2: Illustrate the orthographic projections of straight lines and plane surfaces (Apply)

CO3: Sketch the orthographic projections of solids, lateral surfaces of frustums, truncated solids and its development (Apply)

CO4: Develop the lateral surfaces of simple solids (Apply)

CO5: Interpret the orthographic and isometric views of simple components (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

BASICS OF ENGINEERING DRAWING AND CAD (Not for examination)

Introduction – Drawing instruments and its uses – Sheet layout – BIS conventions – Lines – Lettering and dimensioning practices – Lines – Co – Ordinate points – Axes – Poly lines – Square – Rectangle – Polygons – Splines – Circles – Ellipse – Text – Move – Copy – Off – Set – Mirror – Rotate – Trim – Extend – Break – Chamfer – Fillet – Curves – Constraints viz. agency – Parallelism – Inclination and perpendicularity

UNIT I CONICS, SPECIAL CURVES AND PROJECTION OF POINTS **12**

Construction of parabola – Ellipse and hyperbola using eccentricity method – Construction of involutes for squares and circles – Construction of Tangent and normal to the above curves – Introduction – Method of projection – Planes of projection – Reference line and notations – Orthographic Projection of points – Points in all four quadrants

UNIT II PROJECTION OF STRAIGHT LINES AND SURFACES **12**

Projection of straight lines – Lines inclined to HP / VP plane – Inclined to both HP and VP planes (straight lines are assumed to be in first quadrant only) – Projection of planes – Projection of square

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– Rectangle – Pentagon – Hexagon and circular plane – Inclined to both the plane by change of position method

UNIT III PROJECTION OF SOLIDS 12

Introduction – Projection of solids – Prisms – Pyramids – Cylinders and cones with axis inclined to both the planes (Solids resting on HP only)

UNIT IV DEVELOPMENT OF LATERAL SURFACES OF SOLIDS 12

Introduction – Cutting plane – Sectional views of right regular solids resting with base on HP – Prisms – Pyramids – Cylinder and cone – True shapes of the sections – Development of lateral surfaces of right regular prisms – pyramids – Cylinders – Cones resting with base on HP only – Development of the frustums and truncations

UNIT V ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS 12

Orthographic projection – Simple machine components using free hand sketching – Isometric projection – Simple Solid exercises and combination of solids

Contact Periods:

Lecture: - Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. ND Bhat & VM Panchal, "Engineering Drawing", 51st edition, Charotar Publishing House, Gujarat, 2013
2. Venugopal K. and Prabhu Raja V, "Engineering Graphics", 6th edition, New Age International (P) Limited, 2019

REFERENCE BOOKS:

1. Natrajan K.V., "A textbook of Engineering Graphics", 21st edition, Dhanalakshmi Publishers, Chennai, 2017
2. Sam Tickoo, "AutoCAD 2013 for Engineers and Designers", 1st edition, Dream tech Press, 2013
3. M.H.Annaiah & Rajashekar Patil, "Computer Aided Engineering Drawing", 4th edition, New Age International Publishers, 2012
4. Basant Aggarwal, "Engineering Drawing", 1st edition, Tata Mc Graw Hill Education Private Limited, 2010
5. D.M.Kulkarni, A.P.Rastogi, and A.K.Sarkar, "Engineering Graphics with AutoCAD", Revised edition, PHI Learning Private Limited, New Delhi, 2010

EVALUATION PATTERN:

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	
75	25	
100		100
60		40
100		

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SEMESTER III

		Category: BSC				
U21MAG01	**PROBABILITY AND STATISTICS** (Common to CH and AM)	**L**	**T**	**P**	**J**	**C**
		3	**1**	**0**	**0**	**4**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of probability, random variable and distributions that are applicable in the field of engineering
- To understand the concepts of testing of hypothesis for small and large samples which plays an important role in testing of industrial products
- To understand the concepts in design of experiments in the field of engineering

COURSE OUTCOMES:

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

CO1: Apply probability axioms and the moments of discrete and continuous random variables to core engineering problems (Apply)

CO2: Use discrete probability distributions including requirements, mean and variance for making decisions (Understand)

CO3: Compare correlation and linear regression with respect to two dimensional random variables (Understand)

CO4: Analyze large and small sample tests and perform small sample tests based on Chi-square, t and F distributions (Apply)

CO5: Design an experiment with proper observations and measurement to get a valid result using various design methods (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO5	3	3	-	-	-	-	-	-	-	-	-	-	2	1
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

SYLLABUS:

UNIT I PROBABILITY **9 + 3**

Probability – Axioms of probability – Conditional probability – Baye's theorem – Discrete and continuous random variables – Moments – Moment generating functions

UNIT II DISTRIBUTION FUNCTIONS **9 + 3**

Binomial distribution – Poisson distribution – Geometric distribution – Uniform distribution – Exponential distribution – Normal distribution

UNIT III TWO – DIMENSIONAL RANDOM VARIABLES **9 + 3**

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

UNIT IV TESTING OF HYPOTHESIS **9 + 3**

Large sample test for single mean and difference of means – Small sample test: t distribution – F distribution – Chi square distribution

UNIT V DESIGN OF EXPERIMENTS **9 + 3**

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

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Milton J S and Arnold J C, "Introduction to Probability and Statistics", 4th edition, Tata McGraw Hill, 2008
2. Gupta S C and Kapoor V K, "Fundamentals of Mathematical Statistics", 11th edition, Sultan Chand & Sons, New Delhi, 2013

REFERENCES:

1. Johnson R A, "Miller and Freund's Probability and Statistics for Engineers", 8th edition, Pearson Education, Asia, 2015
2. Devore J L, "Probability and Statistics for Engineering and the Sciences", 8th edition, Cengage Learning, New Delhi, 2014
3. Ross S M, "Introduction to Probability and Statistics for Engineers and Scientists", 3rd edition, Elsevier, 2010
4. Walpole R E, Myers R H, Myers S L and Ye K, "Probability and Statistics for Engineers and Scientists", 10th edition, Pearson Education, Asia, 2012

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Seminar / MCQ	Written Test	Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21CS301	COMPUTER ORGANIZATION AND ARCHITECTURE (Common to AM, CB, CS, IT)	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn the basic structure and operations of a computer
- To learn the arithmetic and logic unit and implementation of fixed-point and floating-point arithmetic unit
- To learn the basic of pipelined execution
- To understand the memory hierarchies, cache memories and virtual memories
- To learn the different ways of communication with I/O devices

COURSE OUTCOMES:

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

CO1: Describe the various parts of modern computer functional units, bus structure, addressing modes and Computer arithmetic (Understand)

CO2: Identify the process involved in executing an instruction (Understand)

CO3: Design the hardwired and micro programmed control (Apply)

CO4: Describe the memory hierarchy and memory system (Understand)

CO5: Explain pipelined execution and instruction scheduling (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	2	-	1
CO2	2	1	1	-	-	-	-	-	-	-	-	2	-	1
CO3	2	2	1	-	-	-	-	-	-	-	-	2	-	1
CO4	2	1	1	-	-	-	-	-	-	-	-	2	-	1
CO5	2	1	1	-	-	-	-	-	-	-	-	2	-	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION 9

Evolution of computers – Structure of computers – Basic operational concepts – GPR based and stack-based organization – Bus structures, Performance measurement – Processor clock, Basic performance equation, Clock rate – Machine instructions and programs – Memory location and addresses, Memory operation – Instructions and instruction sequencing – Addressing modes

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UNIT II DATAPATH AND CONTROL 9

Fetching and Storing words – Register Transfer – Execution of instruction – Instruction codes – Computer registers – computer instructions – Timing and control – Instruction cycle – Memory reference instructions – Hard-wired Control – Micro programmed Control – Micro instruction – Microprogram sequencing

UNIT III PIPELINING 9

Basic concepts of pipelining – The instruction pipeline – Pipeline hazards – Instruction level parallelism – Reduced instruction set – Computer principles – RISC versus CISC

UNIT IV MEMORY SYSTEM 9

Basic concepts – Semiconductor RAM memories – Read only memories – Speed, Size, and Cost – Cache memories – Mapping functions – Replacement algorithms – Page mode access – Interleaved access – Performance considerations – Virtual memories – Secondary storage

UNIT V INPUT/OUTPUT ORGANIZATION 9

Accessing i/o devices – Interrupts – Interrupt hardware – Enabling and disabling interrupts – Handling multiple devices – Controlling device requests – Exceptions – Direct memory access – Buses – Interface circuits – Standard I/O interfaces – PCI bus – SCSI bus, Bus – Arbitration schemes – USB

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. David A Patterson, John L Hennessy, "Computer Organization and Design", (The Hardware/ Software Interface), 5th edition, Morgan Kaufmann, 2014
2. CarlHamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization", 5th edition, Tata McGraw Hill, 2004

REFERENCES:

1. William Stallings, "Computer Organization and Architecture Designing for Performance", 10th edition, Pearson, 2008
2. Nicholas P Carter, "Computer Architecture & Organisation", 2nd edition O'Reilly Publishing, 2014

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21CS302	**DATABASE MANAGEMENT SYSTEMS** (Common to AM, CB, CS)	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concept of DBMS and ER Modeling
- To explain the normalization, Query optimization and relational algebra
- To apply the concurrency control, security and indexing for the real time data

COURSE OUTCOMES:

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

CO1: Explain the basic concepts of the database management systems (Understand)

CO2: Formulate SQL queries to create, manipulate and control the database (Apply)

CO3: Apply normalization technique to design database (Apply)

CO4: Employ ACID properties and concurrency control techniques to ensure transactional consistency and integrity (Apply)

CO5: Apply query optimization strategies and NoSQL database principles (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	3	-	2	2	-
CO2	3	2	2	-	2	-	-	-	-	-	-	2	3	-
CO3	3	3	2	-	2	-	-	-	-	-	-	2	3	-
CO4	3	3	2	-	-	-	-	-	-	-	-	2	3	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	3	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I INTRODUCTION TO RELATIONAL DATABASE 9

Database – System applications – Purpose of database systems – View of data – Database languages – Database architecture – Database schema and diagram – Relational algebra – ER diagrams – Entities, Attributes, Relationships, Constraints, Keys – Extended ER features

UNIT II STRUCTURED QUERY LANGUAGE 9

Basics of SQL, DDL, DML, DCL, TCL – Creation, Alteration, Defining constraints – Functions – Aggregate functions, Built-in functions – Views – Joins – Procedure

UNIT III DATABASE DESIGN 9

Functional dependencies – Normalization – Normal forms based on primary keys (1NF, 2NF, 3NF, BCNF, 4NF, 5NF) – Triggers – Cursor

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UNIT IV TRANSACTION MANAGEMENT 9

Introduction to transactions – States of transaction – ACID Properties – Concurrent executions – Serializability – Log based recovery – Need for concurrency – Lock based protocols – SQL for concurrency – Two phase commit protocol – Deadlocks

UNIT V IMPLEMENTATION TECHNIQUES AND NoSQL DATABASE 9

Indexing and hashing – B+ tree index files – B Tree index files – Query processing and optimization – Introduction to NoSQL databases – Types of NOSQL databases – CAP theorem – NoSQL Vs SQL – Limitations of NoSQL – Basics of MONGODB

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7th edition, Pearson education, 2017

REFERENCES:

1. Pramod J. Sadalage and Marin Fowler, "NOSQL Distilled: A Brief guide to merging world of Polyglot persistence", 2nd edition, Pearson Education, 2012
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd edition, McGraw Hill, 2003
3. https://nptel.ac.in/courses/106/105/106105175/
4. https://www.edureka.co/mongodb-certification-training
5. https://www.coursera.org/learn/introduction-to-nosql-databases
6. https://www.guru99.com/nosql-tutorial.html
7. https://www.coursera.org/learn/introduction-mongodb

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21AM301	**INTRODUCTION TO R PROGRAMMING**	**L**	**T**	**P**	**J**	**C**
		3	**1**	**0**	**0**	**4**

PRE-REQUISITES:

- U21CSG02 - Python Programming

COURSE OBJECTIVES:

- To introduce concepts related to R programming
- To perform data analysis & visualization using R programming
- To explore and understand how to use R programming
- To implement structured data into r from various sources

COURSE OUTCOMES:

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

CO1: Understand the basics of data analytics (Understand)

CO2: Implement and manipulate the data using R programming (Apply)

CO3: Execute exploratory data analysis using R programming (Apply)

CO4: Examine the statistical methods for summarizing data using R programming (Apply)

CO5: Visualize the data with the panda's library in R programming (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	1	1	3
CO2	3	2	2	1	2	-	-	-	-	-	-	-	2	3
CO3	3	2	2	1	2	-	-	-	-	-	-	-	2	3
CO4	3	2	2	1	2	-	-	-	-	2	-	1	2	3
CO5	3	2	2	1	2	-	-	-	-	2	-	1	2	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO R **9+3**

Data – Information – Characteristics of data – Data munging – Scraping – Sampling – Cleaning – Importance of data analytics – Success stories – Introduction to R – R installation – Basic operations in R using command line – Use of IDE R Studio – 'R help' feature in R

UNIT II DATA STRUCTURE **9+3**

Variables in R – Scalars – Vectors – Matrices – Lists – Data frames – Functions in R – Factors – Looping

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UNIT III DATA MANIPULATION 9+3

Selection of rows and columns – Find and removing duplicate records – Cleaning data – Recording data – Merging data – Data sorting and aggregation

UNIT IV DATA ANALYSIS WITH PYTHON & R 9+3

Importing Data into R : Reading tabular data files – CSV file – Excel file – Loading R data objects – Writing to files – Introduction to Python NumPy libraries: Array creation and manipulation – Indexing and slicing arrays – Array operations and broadcasting – Introduction to Pandas libraries: Series and DataFrame – Loading and saving data – Data cleaning and preprocessing techniques – Data indexing and slicing with Pandas

UNIT V R FOR DATA VISUALIZATION 9+3

Visualization with ggplot2 Package: Working with plots: Bar, Pie, Bubble, Heat Mao, 3D Graphs – Visualization with DPLYR Package: load data into Data frame – View data – Select columns and rows. Exploratory Data Analysis: Box plot – Histogram – Pie graph – Line chart – Barplot – Scatter Plot – Pareto Charts

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project – Periods

Total 60 Periods

TEXTBOOKS:

1. Garrett Grolemund, "Hands-On Programming with R: Write Your Own Functions and Simulations", 1st edition, O'Reilly Media, 2021
2. Matt Dowle and Arun Srinivasan, "Efficient Data Processing with R: A Guide to Loading, Manipulating, and Preparing Data in R", 1st edition, 2021

REFERENCES:

1. Wes McKinny, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", 1st edition, O - Reilly Media, 2017
2. Hadley Wickham and Garrett Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data", 1st edition, O - Reilly Media, 2017
3. Nina Zumel, Jim Porzak, and John Mount "Practical Data Science with R", 1st edition, Dreamtech, 2014

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER III

U21CSG03	DATA STRUCTURES (Common to AM, BM, CB, CS, EC, EE, IT)	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21CSG01 - Problem Solving and C Programming

COURSE OBJECTIVES:

- To understand the concepts of ADT and list operations
- To Learn linear data structures – stacks and queues
- To apply Tree and Graph structures

COURSE OUTCOMES:

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

CO1: Explain the concept of linear and non-linear data structures (Understand)

CO2: Demonstrate stack and queue with suitable applications (Apply)

CO3: Implement various searching, sorting, and hashing techniques (Apply)

CO4: Analyze non-linear data structures – trees (Apply)

CO5: Implement various problems in graph data structures (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	-	2	-	1	2	2	-	3	1	-
CO2	3	2	2	2	-	2	-	1	2	2	-	3	2	-
CO3	3	2	2	2	-	2	-	1	2	2	-	3	3	-
CO4	3	2	2	2	-	2	-	1	2	2	-	3	2	-
CO5	3	2	2	2	-	2	-	1	2	2	-	3	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

SYLLABUS:

UNIT I LINEAR DATA STRUCTURES – LIST 6

Abstract Data Types (ADT) – List ADT – Array-based implementation – Linked list-based implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of linked list

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 6

Stack ADT – Operations – Applications – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – DeQueue – Applications of queues

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UNIT III SEARCHING, SORTING, AND HASHING TECHNIQUES 6

Introduction to searching – Types of search – Linear search – Binary search – Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Hashing – Hash Functions – Separate chaining – Open addressing – Rehashing

UNIT IV NON-LINEAR DATA STRUCTURES – TREES 6

Tree ADT – Tree traversals – Binary Tree ADT – Expression trees – Implementation of expression tree – Applications of trees – Binary search tree ADT – Operations in binary search tree – Introduction to heap – Properties

UNIT V NON-LINEAR DATA STRUCTURES - GRAPHS 6

Introduction to graph – Types of graph – Graph traversal – Breadth-first traversal – Depth-first traversal – Topological sort – Minimum spanning tree algorithms – Shortest path algorithm – Dijkstra's algorithm

LIST OF EXPERIMENTS (INDICATIVE)

1. Write a function program to perform the following operations on a singly linked list
   i. Create a list cube
   ii. Insert an element to the list
   iii. Delete the maximum element from the list
   iv. Arrange the list in a sorted order
   v. Display the elements of the list
2. Write a main method to demonstrate the above functionalities
3. Creation of Array and linked list implementation of Stack and Queue ADTs
4. Implementation of quick, heap, and shell sort
5. Program to sort the elements in ascending order using selection sort and bubble sort
6. Implementation of hashing technique
7. Develop a program to perform a linear and binary search
8. Program to construct an expression tree for a given expression and perform various tree traversal methods.
9. Implement Prim's algorithm with the following functionalities
   i. Read a set of vertices minimum of six from the keyboard
   ii. Get the number of edges and form the graph
   iii. Find the value of each edge by using the distance formula for two points.
   iv. Develop a Minimum Spanning Tree for the graph
   v. Find the total length of all edges. Write a main method to execute the above functionalities
10. Choose an appropriate data structure and create a token system for banking service (withdrawal, deposit, and money transfer)
11. Create a food delivering system that allocates the path for the delivery of food using appropriate data structures
12. Create a book rack allocation system in a library, which allocates appropriate space for the books based on category using appropriate data structures

Contact Periods:

Lecture: 30 Periods	Tutorial: – Periods	Practical: 30 Periods	Project: – Periods
			Total: 60 Periods

TEXT BOOKS:

1. Reema Thareja, "Data structures using C", 1st edition, Oxford University Press, 2018
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd edition, University Press, 2017

REFERENCES:

1. R. Venkatesan, S. Lovelyn Rose, "Data Structures", 1st edition, Wiley, 2019
2. Seymour Lipschutz, "Data structures with C", 4th edition, McGraw Hill Education, 2017

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		**Assessment II (Practical) (100 Marks)**		**Theory Examinations (Examinations will be conducted for 100 Marks)**	**Practical Examinations (Examinations will be conducted for 100 Marks)**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test		
40	**60**	**75**	**25**		
25		**25**		**25**	**25**
50				**50**	
Total: 100					

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21CSG04	**JAVA PROGRAMMING** (Common to AM, BM, CB, CS, EC, EE)	**L**	**T**	**P**	**J**	**C**
		2	**0**	**2**	**0**	**3**

PRE–REQUISITES:

- U21CSG01 - Problem Solving and C Programming

COURSE OBJECTIVES:

- To describe object-oriented programming paradigm and its principles
- To implement programs with Core Java features and API
- To develop applications with Java Collections

COURSE OUTCOMES:

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

CO1: Describe the object-oriented programming concepts to develop simple java programs (Understand)
CO2: Develop Java programs using Inheritance principle (Apply)
CO3: Apply exception handling techniques in Java programs (Apply)
CO4: Develop Java programs with Input Output classes and multithreading (Apply)
CO5: Implement Java programs with Collections (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	1	2	2	1	2	2	-
CO2	3	2	2	2	-	-	-	1	2	2	2	2	3	-
CO3	3	2	2	2	-	-	-	1	2	2	2	2	3	-
CO4	3	2	2	2	-	-	-	1	2	2	2	2	3	-
CO5	3	2	2	2	-	-	-	1	2	2	2	2	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I OBJECT ORIENTED DEVELOPMENT AND JAVA BASICS 6

Object Oriented Programming (OOP) – Concepts – Abstraction – Encapsulation – Comparison with function-oriented programming – Characteristics of Java – Java Environment – JVM and JDK – Classes – Constructors – Methods – Static members – Comments – Data types – Variables – Operators – Control flow

UNIT II PACKAGES AND INHERITANCE 6

Defining a package – Importing packages – Inheritance – Creating super classes and sub classes – Access modifiers – Constructors in sub classes – Polymorphism – Method overloading – Method overriding – Abstract classes and abstract methods – Interfaces – Defining an interface – Implementing interface – Extending interfaces – Object class

UNIT III EXCEPTION HANDLING 6

Exceptions – Throwing and catching exceptions – Checked and unchecked exceptions – Exception hierarchy – Built in exceptions – Creating own exception – Chained exceptions – Stack trace elements

UNIT IV I/O STEAMS AND MULTITHREADING 6

Input/Output basics – Scanner class – Streams – Byte streams and Character streams comparison – Reading from and writing to console and files – Multithreaded programming – The Java thread model – Creating multiple threads – Thread class – Runnable interface

UNIT V COLLECTIONS 6

Collections framework overview – Basics of list – Set – Queue – Programs using array list – HashMap and HashSet – Hashcode and equals methods

LIST OF EXPERIMENTS (INDICATIVE)

1. Write a Java program to create a class Student with private data members and public methods to implement encapsulation and abstraction.
2. Develop a Java program to implement constructor overloading and method overloading.
3. Develop a Java program to implement run-time polymorphism with inheritance.
4. Develop a Java program to implement inheritance using Interfaces and Abstract classes. Use packages.
5. Develop a Java program to demonstrate exception handling
6. Develop a multithreaded java program using a Thread class and Runnable interface
7. Develop a Java program to implement basic console IO and File IO.
8. Develop a Java program to store multiple objects in an Array List and to implement search and sort operations.

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods
Total: 60 Periods

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 11th edition, McGraw Hill Education, 2018
2. Cay.S.Horstmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11th edition, Pearson Education, 2020

REFERENCES:

1. J.Nino and F.A. Hosch , "An Introduction to Programming and OO Design using Java", 1st edition, John wiley & Sons, 2018
2. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd edition, Pearson Education, 2015
3. E Balagurusamy, "Programming with Java",6th edition, McGraw Hill Education, 2019

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21CS304	DATABASE MANAGEMENT SYSTEMS LABORATORY (Common to AM, CB, CS)	L	T	P	J	C
		0	0	4	0	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the DDL and DML commands
- To learn the use of nested and join queries
- To explore functions, procedures and procedural extension of databases

COURSE OUTCOMES:

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

CO1: Create a database using data definition language (Apply)

CO2: Implement data manipulation queries to retrieve data from the database (Apply)

CO3: Apply PL-SQL stored procedures to the database (Apply)

CO4: Create a NOSQL database using MongoDB (Apply)

CO5: Develop an application for a database (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	1	-	1	2	2	2	3	3	-
CO2	3	2	2	2	3	1	-	1	2	2	2	3	3	-
CO3	3	2	2	2	3	1	-	1	2	2	2	3	3	-
CO4	3	2	2	2	3	1	-	1	2	2	2	3	3	-
CO5	3	2	3	2	3	2	-	1	2	2	2	3	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

LIST OF EXPERIMENTS

1. Conceptual Database design using E-R model – case study
2. Implementation of SQL commands DDL, DCL, TCL
3. Queries to demonstrate implementation of various integrity and key constraints
4. Practice on various DML commands to write a query to interact with database
5. Practice on and aggregate functions and views
6. Implement joins, nested queries and stored procedures
7. Practice on procedural extensions (Functions, Cursors, Triggers)
8. Document Database creation using MongoDB

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9. Mini Project (App development using oracle DB)
    i. Campus Management System
    ii. Library Management System
    iii. Student information system
    iv. Hall Booking System
    v. Online Exam Registration system
    vi. Stock maintenance system
    vii. Event Registration System
    viii. Passport automation system
    ix. Blood bank Management system
    x. E-ticketing for Airline reservation System

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7th edition, Pearson, 2017
3. R. Elmasri S. B. Navathe, "Fundamentals of Database Systems", 2nd edition, Addision Wesley, 2015.
4. Shashank Tiwari, "Professional NOSql",2nd edition, Wiley, 2011
5. Pramod J. Sadalage and Marin Fowler, "NOSQL Distilled: A Brief guide to merging world of Polyglot Persistance", 1st edition, Addision Wesley, 2012
6. https://nptel.ac.in/courses/106/105/106105175/
7. https://www.edureka.co/mongodb-certification-training
8. https://www.coursera.org/learn/introduction-to-nosql-databases
9. https://www.coursera.org/learn/introduction-mongodb

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (Practical) (100 Marks)		**Assessment II (Project) (100 Marks)**			**Practical Examinations (Examinations will be conducted for 100 Marks)**
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	Review I	Review II	Review III	
75	25	15	25	60	
25		25			50
50					50
Total: 100					

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SEMESTER III

		Category: EEC				
U21AM302	DESIGN STUDIO I	L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product
- To enable hands-on experience for active learning

COURSE OUTCOMES:

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

CO1: Understand design thinking, system thinking, mapping the problem statements to UNSDG. (Understand)

CO2: Apply the design thinking steps "empathize, define, ideate and prototype" (Apply)

CO3: Create experimental proof of concept (TRL3) (Apply)

CO4: Demonstrate teamwork, project management, technical report writing and presentation skills (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	3	3	3	3	3	3	3	-	-	-	1	-
CO2	3	3	3	3	3	3	3	3	3	-	2	1	1	1
CO3	3	3	3	3	3	3	3	3	3	-	3	2	1	1
CO4	-	-	-	-	2	-	-	2	3	3	3	1	1	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

Course conduction:

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor.
- With the guidance of assigned mentor, the students will find & validate a problem statement, map to UNSDG, identify the skills required for the project and self-learn.
- Applying the design thinking concept, the students will provide a solution and produce the version 1 of prototype.
- The student will learn teamwork, project management, technical report writing and presentation skills through this course.

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Lecture: – Hours Tutorial: – Hours Practical: – Hours Project: 30 Periods

Total: 30 Periods

EVALUATION PATTERN:

Review 0 (Within 10 days of commencement of semester)	**Review 1** (Between 35th to 40th working day)	**Review 2** (Between 80th to 90th working day)	**Total**
0	**40**	**60**	**100**

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SEMESTER IV

		Category: BSC				
		L	T	P	J	C
U21MAG02	DISCRETE MATHEMATICS (Common to AD, AM, CB, CS)	3	1	0	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basic concepts of propositions by various discrete structure techniques
- To understand the concepts in combinatorics techniques in solving the system by various methodology
- To understand the concepts of the different differential and integral techniques in solving the real time engineering problems

COURSE OUTCOMES:

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

CO1: Use the concepts of Boolean algebra for the analysis & design of various combinational & sequential logic circuits (Understand)

CO2: Use the mathematical concepts in abstract algebra with respect to characteristics of sets, group, ring and field (Understand)

CO3: Apply combinatorial principles and techniques to solve counting problems and linear recurrence relation (Understand)

CO4: Apply graph theory concepts to test and validate intuition and independent mathematical thinking in problem solving (Apply)

CO5: Analyze natural language arguments by means of symbolic propositional logic and proofs (Understand)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I BOOLEAN ALGEBRA **9 + 3**

Boolean algebra – Truth table – Basic logic gate – Basic postulates of Boolean algebra – Principle of duality – Canonical form – Karnaugh map

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UNIT II ABSTRACT ALGEBRA **9 + 3**

Algebra of sets – The power set – Ordered pairs and Cartesian product – Relations on sets – Types of relations and their properties – Equivalence relations – Functions – Type of functions – Group – Semi group – monoid – abelian group – subgroup – ring – field

UNIT III COMBINATORICS **9 + 3**

Basics of counting – Pigeonhole principle – Permutations and combinations – Recurrence relations – Generating functions – Mathematical Induction

UNIT IV GRAPH THEORY **9 + 3**

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton graphs – Shortest path – Graph coloring

UNIT V LOGIC **9 + 3**

Propositional logic – Propositional equivalences – Inconsistency predicates – Quantifiers – Rules of inference – Introduction to proofs – Method of proofs

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project – Periods

Total 60 Periods

TEXT BOOKS:

1. Herstein N, "Topics in Algebra", 2nd edition, John Wiley and Sons, 2006
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, Special Indian edition, 2016
3. Tremblay J. P. and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", 7th edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2011

REFERENCES:

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th edition, Pearson Education Asia, Delhi, 2014
2. Thomas Koshy, "Discrete Mathematics with Applications", 1st edition, Elsevier Publications, 2008
3. Seymour Lipschutz and Mark Lipson, "Discrete Mathematics", 3rd edition, Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2010

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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SEMESTER IV

		Category: PCC				
U21CS403	**OPERATING SYSTEMS** (Common to AM, CB, CS, and IT)	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the functions of operating systems, processes, and threads
- To study scheduling algorithms and deadlocks
- To understand various memory management schemes, I/O management, and file systems

COURSE OUTCOMES:

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

CO1: Describe the important computer system resources and the role of operating system (Understand)

CO2: Explain the various CPU scheduling algorithms and synchronization (Understand)

CO3: Exemplify with handling deadlock mechanisms (Understand)

CO4: Evaluate various page replacement algorithms (Apply)

CO5: Exhibit file system structure and disk scheduling algorithms (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	2
CO2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	2	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	2	2	-
Correlation levels:		1: Slight (Low)		2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I OPERATING SYSTEM OVERVIEW **9**

Computer system overview – Memory hierarchy – Cache memory – Interrupts – Operating system overview – Objectives and functions – System calls – System programs – System boot

UNIT II PROCESS MANAGEMENT **9**

Process concepts – Process Scheduling: Short term, Long term, Medium term – CPU scheduling algorithms: Pre-emptive, Non pre-emptive scheduling, FCFS, SJF, SRTF, Priority, Round robin – Inter Process Communications (IPC): Message passing, Shared memory, Critical sections, Mutual exclusion and Synchronization: Classical problems for synchronization – Peterson's solution – Semaphore – Mutex

UNIT III DEADLOCK MANAGEMENT 9

Principles of deadlock – Necessary conditions – Deadlock detection – Resource Allocation Graph (RAG) – Deadlock avoidance – Banker's algorithm – Deadlock prevention – Deadlock recovery

UNIT IV MEMORY MANAGEMENT 9

Main memory – Contiguous allocation – Fixed partitioning – Virtual memory – Paging – Segmentation – Swapping – Demand paging – Page replacement algorithms

UNIT V STORAGE MANAGEMENT 9

File system structure – Allocation methods – Free space management – Disk structure – Disk scheduling algorithms – Swap space management – Case study – Linux system

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th edition. John Wiley and Sons Inc., 2018
2. William Stallings, "Operating Systems: Internals and Design Principles", 9th edition, Pearson Education, 2018

REFERENCES:

1. Maurice J Bach, "The Design of the Unix Operating System", 3rd edition, Pearson Education, 2017
2. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems: A Spiral Approach", 1st edition, Tata McGraw Hill Edition, 2010
3. Achyut S.Godbole, Atul Kahate, "Operating Systems", 3rd edition, Mc Graw Hill Education, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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SEMESTER IV

U21AM401	MACHINE LEARNING I	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21CSG02 – Python Programming
- U21AM301 – Introduction to R Programming

COURSE OBJECTIVES:

- To understand the basic theory of intelligent agents in Artificial Intelligence (AI)
- To formulate learning problems corresponding to different applications
- To understand a range of Machine Learning (ML) algorithms
- To be able to apply machine learning algorithms to solve problems of moderate complexity

COURSE OUTCOMES:

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

CO1: Understand the basics of agents and AI search (Understand)
CO2: Analyse various AI logics, reasons, and fuzzy algorithms used in AI (Apply)
CO3: Develop the different learning systems of Machine Learning ML (Understand)
CO4: Classify various supervised learning algorithms for real-life applications (Apply)
CO5: Predict various application models using regression with its performance parameters (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	2	2	-	1	1	3
CO2	3	2	3	2	-	-	-	-	2	2	-	-	1	3
CO3	3	2	2	2	-	-	-	-	2	2	-	-	1	3
CO4	3	2	2	2	-	-	-	-	2	2	-	1	1	3
CO5	3	2	2	1	-	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTELLIGENT AGENTS 8

Introduction to AI – Agents and environments – The nature of environments – The structure of agents – Problem solving agents – AI search: Uninformed search, Informed (heuristic) search, Adversarial search – Local search algorithms and optimization problem – Constraint satisfaction problems – Local search and back tracking search for CSP

UNIT II KNOWLEDGE REPRESENTATION AND INFERENCE 8

Logic – Propositional – Predicate – Reasoning under uncertainty topics – Knowledge based agents – Prepositional logic – First order logic – Inferences – Knowledge representation – Production based system – Frame-based system – Backward chaining – Forward chaining – Rule value approach – Fuzzy reasoning – Certainty factors – Bayesian theory – Bayesian networks

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UNIT III LEARNING 7

Introduction to learning: Components of learning – Concept learning – Designing a learning system – Perspective and issues in Machine Learning (ML) – Find S algorithm – Version spaces and candidate elimination – Conditional independence representation – Inductive bias: Decision tree in learning (DT3)

UNIT IV SUPERVISED LEARNING MODELS: CLASSIFICATION 11

K-Nearest Neighbor (K-NN) algorithm – Naive Bayes classifier: Bayes theorem – Linear Discriminant Analysis (LDA) – Support Vector Machine (SVM) – Decision Trees (DT) – Random Forest – Bias, Variance trade-off – Cross validation methods: Leave One Out (LOO) cross validation, K-Folds cross validation – MNIST datasets for training and testing various image classification algorithms

UNIT V SUPERVISED LEARNING MODELS: REGRESSION 11

Regression: Linear regression – Single variable – Multi variable – Logistic regression – Polynomial regression – Lasso regression – Ridge regression – Boosting Algorithms: AdaBoost – Gradient Boosting – XGBoost – Neural Networks: Introduction – Representations – Problems for neural network learning – Perceptron's multilayer networks – Forward and Backpropagation algorithm – Problems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th edition, Pearson, 2022
2. Tom M. Mitchell, "Machine Learning", 1st edition, McGraw Hill Indian edition, 2020

REFERENCES:

1. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly Media, 2021
2. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning: Machine Learning and Deep Learning with Python, Scikit-learn, and TensorFlow 2", Packt Publishing, 2019
3. Christopher Bishop, "Pattern Recognition and Machine Learning published by Springer, 2011
4. Andriy Burkov, "The Hundred-Page Machine Learning Book", published independently, 2019
5. Kelleher, John D. and Tierney, Brian and Hollingsworth, Aoife, "Applied Machine Learning" by, published by Springer, 2021

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER IV

U21AM402	ALGORITHMICS	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21CSG03 – Data Structures

COURSE OBJECTIVES:

- To understand and apply the algorithm analysis techniques
- To analyze the efficiency of graph algorithms and algorithm design techniques
- To solve programming problems using state space tree
- To understand the concepts behind NP Completeness, and approximation algorithms

COURSE OUTCOMES:

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

CO1: Analyse the efficiency of algorithms (Understand)
CO2: Apply graph algorithms to find the shortest paths (Apply)
CO3: Execute algorithm design techniques to solve divide & conquer, greedy techniques (Apply)
CO4: Implement the state branch & bound methods to resolve the computing problems (Apply)
CO5: Determine the optimal solution by applying approximation algorithms (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	-	2	-	1	2	2	-	3	1	2
CO2	3	2	2	2	-	2	-	1	2	2	-	3	2	-
CO3	3	2	2	2	-	2	-	1	2	2	-	3	3	-
CO4	3	2	2	2	-	2	-	1	2	2	-	3	2	-
CO5	3	2	2	2	-	2	-	1	2	2	-	3	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I INTRODUCTION 9

Role of algorithms – Analyzing and designing algorithms – Importance of problem types – Time and space complexity – Asymptotic notations and its properties – Analysis framework – Mathematical analysis for recursive and non-recursive algorithms

UNIT II SHORTEST PATH ALGORITHMS 9

Representations of graphs – Connectivity, Strong connectivity, Bi-connectivity – Minimum spanning tree: Kruskal's and Prim's algorithm – Shortest path: Bellman-Ford algorithm – Dijkstra's algorithm – – Network flow: Flow networks - Ford-Fulkerson method – Maximum matching in bipartite graphs – The Stable Marriage Problem

UNIT III DIVIDE AND CONQUER & GREEDY TECHNIQUES 9

Finding maximum and minimum – Analyses of merge sort – Quick sort – Topological sort – Greedy technique: Elements of the greedy strategy – Activity selection problem – Optimal merge pattern – Huffman Trees – Kahn's algorithms

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UNIT IV DYNAMIC PROGRAMMING AND BRANCH & BOUND 9

Computing Warshall and floyd algorithm – Matrix chain multiplication – Multistage graph – Optimal binary search trees – AVL tree – Red black tree – Branch and Bound: Assignment problem – Knapsack problem – Travelling salesman problem – Pattern and string matching: Boyer Moore algorithm, Finite automata algorithm

UNIT V BACK TRACKING & NP-COMPLETE ALGORITHMS 9

Backtracking: N-Queens problem – Hamiltonian circuit problem – Subset sum problem – Graph coloring problem – NP algorithms – NP hardness and NP completeness – Polynomial time reductions – Bin packing problem

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 4th edition, MIT Press, 2022
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++", 2nd edition, Orient Blackswan, Universities Press, 2019

REFERENCES:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", International edition, Pearson education, 2014
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint edition, Pearson education, 2006
3. Sridhar, "Design and Analysis of Algorithms", 1st edition, Oxford university press, 2014

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="3">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I
(100 Marks)</th><th colspan="2">Assessment II
(100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER IV

U21ITG01	SOFTWARE ENGINEERING (Common to IT and AM)	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To describe the process of requirements gathering and analysis.
- Focuses on principles and proven software engineering practices, within the framework of unified processes.
- To acquire the knowledge and abilities necessary to assist software testing projects with the usage modern testing technology.

COURSE OUTCOMES:

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

CO1: Recognise several process models and the essential management tasks for software projects (Understand)

CO2: Understand software engineering principles involved in building large software programs and process of requirements specification and requirements validation (Understand)

CO3: Recognise the principles of object orientation and model development (Understand)

CO4: Identify the different number of test styles and techniques and assess their usefulness (Understand)

CO5: Understand the fundamental ideas behind automated CASE tools for software development processes (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	1	-	-	-	1	-	2	-	3	-
CO2	3	2	3	2	1	-	-	-	1	-	2	-	2	-
CO3	3	2	3	2	1	-	-	-	1	-	2	-	2	-
CO4	3	3	3	3	1	-	-	-	1	-	2	-	2	-
CO5	2	2	3	2	1	-	-	-	1	-	2	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I SOFTWARE PROCESS MODELS 9

Software – Software engineering – Software process – Work products – Importance of software engineering – Standard for software process – Waterfall model – Prototyping model – Iterative enhancement model – Spiral model – RAD model – 4th Generation models – Formal methods – Agile development

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UNIT II UNDERSTANDING REQUIREMENTS 9

Functional and Non-functional – User requirements – System requirements – Software requirements document – Requirement engineering process: Feasibility studies – Requirements elicitation and analysis – Requirements validation – Requirements management

UNIT III SOFTWARE DESIGN AND CODING 9

Design process – Data and behavioral Modeling – Design concepts – Modularity – Architectural design – Coupling and cohesion – Top-down and bottom-up design – Object-oriented analysis, Function- oriented and Object-oriented design approach – Software design document – Coding styles and documentation

UNIT IV SOFTWARE TESTING 9

Software testing strategies – System testing – Debugging – White box testing – Black box testing – Model based testing – Testing for specialized environments, Architectures and applications – Testing object-oriented and web based applications – User interface testing – Configuration testing – Security testing – Performance testing

UNIT V COMPUTER AIDED SOFTWARE ENGINEERING 9

Computer Aided Software Engineering (CASE) and its scope – CASE support in software Life Cycle – Architecture of CASE environment – Upper CASE and Lower CASE – Exposure to CASE tools – Software process improvement – Component based software engineering

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Roger Pressman S., Bruce R. Maxim, "Software Engineering: A Practitioner's Approach", 9th edition, McGraw- Hill, 2021
2. Pankaj Jalote, "Software Engineering, A Precise Approach", 2nd edition, Wiley India, 2020

REFERENCES:

1. Ian Sommerville, "Software Engineering", 10th edition, Pearson, 2016.
2. Hans van Vliet, "Software Engineering: Principles and Practice", 4th edition, Wiley, 2020
3. Waman.S Jawadekar, "Software Engineering: A Primer", 4th edition, Tata McGraw-Hill, 2021

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER IV

		Category: PCC				
U21CS404	**OPERATING SYSTEMS LABORATORY** (Common to AM, CB, CS, and IT)	L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn Unix commands and shell programming
- To implement various CPU Scheduling Algorithms
- To implement Process Creation and Inter Process Communication.
- To implement Deadlock Avoidance and Deadlock Detection Algorithms
- To implement Page Replacement Algorithms
- To implement File Organization and File Allocation Strategies

COURSE OUTCOMES:

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

CO1: Compare the performance of various CPU Scheduling Algorithms (Understand)

CO2: Implement Deadlock avoidance and Detection Algorithms (Apply)

CO3: Create processes and implement IPC (Apply)

CO4: Analyze the performance of the various Page Replacement Algorithms (Analyze)

CO5: Implement File Organization and File Allocation Strategies (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

LIST OF EXPERIMENTS

1. Write programs using basic Unix commands and shell programming.
2. Write programs using process and file management system calls of UNIX operating system.
3. Develop programs to implement CPU scheduling algorithms (FCFS, SJF, SRTF, Priority, and Round Robin).
4. Developing application to implement Inter Process Communication using shared memory and pipes.

5. Develop a program to understand synchronization using producer-consumer problem.
6. Develop a program to understand deadlock avoidance using Banker's algorithm.
7. Develop programs to implement the page replacement algorithms (FIFO, Optimal, and LRU).
8. Develop programs to implement disk scheduling algorithms (FCFS, SSTF, SCAN, C-SCAN).
9. Implementation of the various File Organization Techniques (Sequential , Random and Serial)
10. Implementation of the following File Allocation Strategies

    a) Sequential b) Indexed C) linked

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project – Periods

Total 30 Periods

REFERENCES:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th edition, John Wiley and Sons Inc., 2018
2. William Stallings, "Operating Systems: Internals and Design Principles", 9th edition, Pearson Education, 2018
3. Maurice J Bach, "The Design of the Unix Operating System", 3rd edition, Pearson Education, 2017
4. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems: A Spiral Approach", 1st edition, Tata McGraw Hill Edition, 2010
5. Achyut S.Godbole, Atul Kahate, "Operating Systems", 3rd edition, Mc Graw Hill Education, 2016

EVALUATION PATTERN:

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		

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SEMESTER IV

		Category: PCC				
U21AM403	MACHINE LEARNING I LABORATORY	L	T	P	J	C
		0	0	2	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of Problem solving, Uncertain knowledge, and Reasoning, and machine learning problems.

COURSE OUTCOMES:

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

CO1: Understand the mathematical and statistical prospectives of machine learning algorithms (Understand)

CO2: Evaluate the machine learning models through various feature engineering algorithms by python / R programming (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	-	-	-	1	2	2	-	1	1	2
CO2	3	2	3	2	-	-	-	1	2	2	-	1	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

LIST OF EXPERIMENTS

In machine learning lab session students will work on a selected set of problems and case studies on the following topics, tools and techniques with the help of Python/ R.

Note: Students are free to use any ML Libraries / R Packages.

- Python: NumPy (Scientific Computing), Pandas (Data manipulation and Analysis), Scikit-learn (Classification, Regression, Clustering, and Dimensionality Reduction)
- R Studio: ggplot2 / dplyr / tidyr /caret / glmnet

1. Familiarizing with Anaconda and Jupyter for importing modules and dependencies for ML
2. Familiarization with NumPy, Panda and Matplotlib by Loading Dataset in Python
3. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file
4. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
5. Working with Sample Datasets
6. Consider the Titanic dataset, summarized according to economic status (class), sex, age and survival. Using Random Forest asked to predict whether a passenger on the titanic would have been survived or not.

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7. Implement Linear regression on IRIS dataset.
8. Implement Logistic Regression for digit recognition.
9. Implement Support Vector Machine for digit recognition and compare the accuracy with logistic regression.
10. SVM Multiclass classification categorizing news article to sports, politics, economics, or social
11. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.
12. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
13. Mini Project

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

REFERENCES:

1. Garrett Grolemund, "Hands-On Programming with R: Write Your Own Functions and Simulations", 2021
2. Matt Dowle and Arun Srinivasan, "Efficient Data Processing with R: A Guide to Loading, Manipulating, and Preparing Data in R", 2021
3. Hadley Wickham and Garrett Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data", 2017
4. Nina Zumel, Jim Porzak, John Mount, "Practical Data Science with R", Dreamtech, 2014
5. Wes McKinny, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" O'Reilly Media, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (Practical) (100 Marks)		Assessment II (Project) (100 Marks)			Practical Examinations (Examinations will be conducted for 100 Marks)
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	Review I	Review II	Review III	
75	25	15	25	60	
30		30			40
60					40
Total: 100					

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SEMESTER IV

		Category: PCC				
U21AM404	ALGORTHMICS LABORATORY	L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To analyze the asymptotic performance of algorithms
- To write rigorous correctness proofs for algorithms
- To demonstrate a familiarity with major algorithms and data structures

COURSE OUTCOMES:

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

CO1: Analyse the efficiency of algorithms using time and space complexity (Apply)

CO2: Design algorithms using divide and conquer, greedy and dynamic programming (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	-	-	-	1	2	2	-	1	3	-
CO2	3	2	3	2	-	-	-	1	2	2	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

LIST OF EXPERIMENTS

1. Analyse the efficiency of any sorting algorithms using asymptotic notations (Time and Space Complexity)
2. Write a program to implement the following algorithms:
   a) Prim's algorithm
   b) Kruskal's algorithm
3. Write a program to find optimal ordering of matrix multiplication. (Note: Use Dynamic programming method)
4. Consider the problem of eight queens on an (8x8) chessboard. Two queens are said to attack each other if they are on the same row, column, or diagonal
   a) Write a program that implements backtracking algorithm to solve the problem i.e. place eight non-attacking queens on the board
5. Write a program to find the strongly connected components in a digraph
6. Write a program to implement file compression (and un-compression) using Huffman's algorithm
7. Write a program to implement dynamic programming algorithm to solve all pairs shortest path problem
8. Write a program to solve 0/1 knapsack problem using the following:
   a) Greedy algorithm
   b) Dynamic programming algorithm
   c) Backtracking algorithm
   d) Branch and bound algorithm

9. Write a program that uses dynamic programming algorithm to solve the optimal binary search tree problem
10. Write a program for solving traveling salesman problem using the following:
    a) Dynamic programming algorithm
    b) The back tracking algorithm
    c) Branch and Bound
11. Write a program that uses Branch and bound algorithm to solve the String-Matching problem

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 30 Periods

REFERENCES:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd edition, Pearson Education, 2017
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd edition, PHI Learning Private Limited, 2012
3. Cormen, Leiserson, Rivest, and Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint, Pearson education, 2006
5. Donald E. Knuth, "The Art of Computer Programming", Vol. 1 and 3, Pearson Education, 2009
6. Steven S. Skiena, "The Algorithm Design Manual", 2nd edition, Springer, 2008

EVALUATION PATTERN:

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (**Rubrics Based Assessments**)	Test	
75	25	
100		100
60		40
100		

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SEMESTER IV

		Category: EEC				
U21AM405	**DESIGN STUDIO II**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**0**	**2**	**1**

PRE–REQUISITES:

- U21AM302 – Design Studio I

COURSE OBJECTIVES:

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product
- To enable hands-on experience for active learning

COURSE OUTCOMES:

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

CO1: Apply the problem-solving techniques (Design thinking & system thinking) (Apply)

CO2: Create and validate low fidelity prototype / Experimental proof of concept. (TRL 4) (Apply)

CO3: Demonstrate teamwork, project management, technical report writing and presentation skills (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	-	2	1	1	-
CO2	3	3	3	3	3	3	3	3	3	-	3	2	1	1
CO3	-	-	-	-	2	-	-	2	3	3	3	1	1	1
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

Course conduction:

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor for this design clinic 2 course.
- With the guidance of assigned mentor, the students will find & validate a problem statement, map to UNSGD, identify the skills required for the project and self-learn.
- Applying design thinking & system thinking concept the students will solve the problem and produce the version 1 of prototype. (TRL 4)
- The student will learn teamwork, project management, technical report writing and presentation skills through this course.

Lecture: – Hours Tutorial: – Hours Practical: – Hours Project: 30 Periods

Total: 30 Periods

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EVALUATION PATTERN:

Review 0 (Within 10 days of commencement of semester)	**Review 1** (Between 35th to 40th working day)	**Review 2** (Between 80th to 90th working day)	**Total**
0	**40**	**60**	**100**

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SEMESTER IV

		Category: HSMC				
U21SSG01	SOFT SKILLS – I	L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To inculcate potential skills and to work as a team effectively.
- To develop confidence and enhance interpersonal skills.

COURSE OUTCOMES:

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

CO1: Enhance decision making and negotiation skills (Analyse)

CO2: Maintain open, effective, and Professional Communication (Apply)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I VERBAL COMPETENCE **10**

Verbal Analogy – Spotting Errors – Ordering of Sentences – Cloze Test – Effective Listening – Reading Comprehension

UNIT II EFFECTIVE COMMUNICATION **10**

Overcoming Communication Barriers – Body Language and its Etiquettes – Contextual Communication – 7C's of Communication – Listening to Documentaries

UNIT III INTERPERSONAL SKILLS **10**

Group Decision Making – Paralanguage – Negotiation Skills – Preparation & Planning, Bargaining & Problem Solving – Self Grooming – SWOT Analysis

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 30 Periods

TEXT BOOKS:

1. Prashant Sharma,"Soft Skills: Personality Development for Life Success",1st edition, BPB Publications,2022
2. Suresh Kumar E, Sreehari P and Savithri J, "Communication Skills and Soft Skills: An Integrated Approach", 1st edition, Dorling Kindersley, 2011

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REFERENCES:

1. Jeff Butterfield, "Problem Solving and Decision Making", 2nd edition, Course Technology, 2010
2. Wushow Bill Chou, "Fast-Tracking your Career: Soft Skills for Engineering and IT Professionals", 1st edition, IEEE Press, 2013

EVALUATION PATTERN:

Continuous Internal Assessments	Marks
Test - I	50
Test - II	50
Total	100

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KPRIET Learn Beyond

SEMESTER V

		Category: PCC				
U21AM501	MACHINE LEARNING II	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21AM401 – Machine Learning I

COURSE OBJECTIVES:

- To be able to understand the foundational concepts and methods of unsupervised learning which involves discovering patterns in unlabeled data
- To apply various unsupervised learning algorithms and techniques
- To solve real-world problems using machine learning and understand the challenges and limitations of unsupervised learning

COURSE OUTCOMES:

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

CO1: Understand the basic concepts of clustering techniques in unsupervised learning (Understand)
CO2: Analyze the various dimensionality reduction techniques of unsupervised learning (Apply)
CO3: Apply the data preprocessing techniques for various types of data (Apply)
CO4: Design the various ML Models using PyTorch and TensorFlow frameworks (Apply)
CO5: Develop the AI models using reinforcement techniques for various applications (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	2	2	-	1	1	3
CO2	3	2	3	2	-	-	-	-	2	2	-	-	1	3
CO3	3	2	2	2	-	-	-	-	2	2	-	-	1	3
CO4	3	2	2	2	-	-	-	-	2	2	-	1	1	3
CO5	3	2	2	1	-	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I UNSUPERVISED LEARNING: CLUSTERING 9

Introduction to unsupervised learning – Types of unsupervised learning – Introduction to clustering – Types of clustering algorithms: K-Means, K-Medoid – Hierarchical clustering, DBSCAN – Expectation maximization algorithm – Evaluation of clustering algorithms – Applications of clustering: Customer segmentation, Image segmentation, Outlier detection, Anomaly detection

UNIT II DIMENSIONALITY REDUCTION 9

Introduction to Dimensionality Reduction (DR) – Linear techniques: Principal Component Analysis (PCA) – Linear Discriminant Analysis (LDA) – Independent Component Analysis (ICA) – Nonlinear techniques: Uniform Manifold Approximation and Projection (UMAP) – Singular Value Decomposition (SVD) – Evaluation of DR algorithms – Applications of DR: Data visualization, Feature extraction, Noise reduction

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UNIT III DATA PREPROCESSING TECHNIQUES 9

Introduction to data preprocessing – Four steps – Data cleaning: Missing, Noisy, and Inconsistent data – Data integration – Data transformation/normalization: Min-Max – Z-Score – Decimal Scaling – Data reduction – Feature selection techniques – Hyperparameter tuning

UNIT IV MACHINE LEARNING FRAMEWORKS 9

Tensorflow Introduction, Installation – Eager execution – Tensorflow for object detection and recommender systems – Introduction to PyTorch – Installation and deployment –Packages: TorchAudio, TorchText, TorchVision, TorchArrow and TorchServe, PyTorch for image segmentation

UNIT V REINFORCEMENT LEARNING: MODELS 9

Introduction to Reinforcement Learning elements: Policy, Reward function, Value function, Model of the environment – Markov decision process – Hidden Markov Models (HMM) – Model selection in HMM – Q Learning

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Ankur A. Patel, "Unsupervised Machine Learning: The Comprehensive Guide to Clustering and Dimensionality Reduction", 2022
2. Galeone. P, "Hands-On Neural Networks with TensorFlow 2.0", United Kingdom: Packt Publishing, 2019
3. Raschka, S., Liu, Y., Mirjalili, V., Dzhulgakov, D, "Machine Learning with PyTorch and Scikit-Learn", United Kingdom: Packt Publishing, 2022
4. Sanghi, N, "Deep Reinforcement Learning with Python: with PyTorch, TensorFlow and OpenAI Gym", United States: APress, 2021

REFERENCES:

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 2012
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", 2016
3. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, "Introduction to Data Mining", 2006
4. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", 2011
5. Edwin K. P. Chong and Stanislaw H. Zak, "An Introduction to Optimization", John Wiley & Sons, 2013

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER V

U21AM502	INTERNET AND WEB PROGRAMMING	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the web essentials and website behavior
- To understand client-side application programming like HTML, CSS, JavaScript and Validation
- To understand different types of server-side programming and technologies like Servlet, SpringBoot, NodeJS
- To understand the API development process, Integrating user interface with backend and web hosting

COURSE OUTCOMES:

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

CO1: Understand the web essential of web pages and web 3.0 (understand)

CO2: Implement the interactive client-side application with validation using React (Apply)

CO3: Develop the server-side applications using servlet and spring boot (Apply)

CO4: Implement CRUD operations of different databases using NodeJS (Apply)

CO5: Implement website with Ajax client-server communication and web hosting (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	2	2	-	1	1	3
CO2	3	3	3	2	2	-	-	-	2	2	-	1	1	3
CO3	3	3	3	2	2	-	-	-	2	2	-	1	1	3
CO4	3	3	3	2	2	-	-	-	2	2	-	1	1	3
CO5	3	3	3	2	2	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO WEB DESIGN 9

Web essentials: Web client – Web server – Browser DOM – Protocol essentials: HTTP request message – HTTP response message – Web Technologies: HTML 5.0 -Elements – Attributes – CSS 3.0 – Box model -Types – Selectors – Introduction to Bootstrap - JavaScript Basics: Datatypes - Functions – promises, Async /await – Classes

UNIT II CLIENT-SIDE SCRIPTING 9

Data storage: Cookies – Sessions – DOM elements – UI events – Forms and controls – Document resource loading – Fetch API – Framework: Introduction to React JS – Create react app – React components – States – Props – Router – Forms – Events – Map – HOC – Hooks – Redux

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UNIT III SERVER-SIDE SCRIPTING 9

API: Introduction to rest API – Java servlets: Servlet life cycle – HTTP Get and Post Methods – Spring Boot: Architecture – Life cycle – Spring initializer – Dependencies – Controllers – Spring JDBC – Request response validation

UNIT IV APPLICATION SERVERS AND PACKAGE MANAGER 9

Database: PostgreSQL – MongoDB – NODE JS: Introduction – Environment setup – Modules – NPM – Web server Request and Response – Integrating Postgres and Mongo with NodeJS – CRUD operations

UNIT V AJAX AND WEB HOSTING 9

AJAX: Client-Server architecture – XML HTTP Request and Response – JSON – Arrays – Stringify – Introduction to Django – Web UI Development – Version control: Introduction to GitHub repository – Git desktop setup – Basic Git commands – Hosting website in GitHub repository – Case Study: Building and Hosting web pages in Firebase and WordPress

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Julie C Meloni, Jennifer kyrnin, "HTML, CSS and JavaScript", 1st edition, Pearson, 2019
2. Juha Hinkula, "Hands on Full stack Development with Springboot 2.0 and React", 1st edition, Packt, 2018
3. Sonia Valeja, David Gonzalez, "PostgreSQL for Job seekers", 1st edition, BPB, 2023
4. Bruno Joeseaph D'mello, Mithun Satheesh, Jason Krol, "Web development with Mongo DB and Node", 3rd edition, Packt, 2017

REFERENCES:

1. Thomas A. Powell, "HTML&CSS: The Complete Reference", 5th edition, McGraw-Hill, 2010
2. Mayur Ramjir, "Full Stack Java Development with Spring MVC, Hibernate, Jquery and Bootstrap", 1st edition, Willy, 2020
3. Robert W. Sebesta, "Programming the World Wide Web", 8th edition, Pearson, 2015
4. Steven Holzner, "AJAX: A beginner's guide", 1st edition, McGrawHill, 2009
5. Jayson Falkner, Kevin Jones, "Servlets and Java Server Pages: The J2EE Technology Web Tier II", 1st edition, Addison Wesley, 2003

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER V

U21CSG05	COMPUTER NETWORKS (Common to AM, CB, IT)	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge about protocol layering and physical layer performance
- To describe the functions of data link and network layers
- To outline transport layer services and application layer protocols

COURSE OUTCOMES:

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

CO1: Summarize the network models and functionality of physical layer (Understand)

CO2: Examine Data-Link Layer Protocols and Media Access Control methods (Understand)

CO3: Analyze the IP addresses and routing protocols (Analyze)

CO4: Inspect transport layer protocols and Quality of Services (Understand)

CO5: Interpret the significance of different application layer protocols (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	2	2	2	-	-	1	-
CO2	3	2	2	-	-	-	-	2	2	2	-	-	1	-
CO3	3	3	3	-	-	-	-	2	2	2	-	-	2	-
CO4	3	3	2	-	-	-	-	2	2	2	-	-	1	-
CO5	3	2	2	-	-	-	-	2	2	2	-	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I INTRODUCTION & PHYSICAL LAYER 6

Network cables and Commands – Protocol layering– Layered tasks – OSI Model – TCP/IP Protocol suite – Physical Layer – Performance – Transmission media – Basics of packet, Circuit and virtual circuit switching

UNIT II DATA-LINK LAYER & MEDIA ACCESS 6

Link layer Introduction – DLC Services – Link Layer Protocols – Flow and Error Control Mechanisms – HDLC – PPP – Media Access Control – Wired LANs – Ethernet – Bridges and LAN Switches – Wireless LANs – Bluetooth – Connecting Devices

UNIT III NETWORK LAYER 6

Internet Protocol – Internetworking – IPv4 – Subnetting – IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) – Inter-domain Routing (BGP) – Basics of IP support protocols (ARP, RARP, DHCP, ICMP) – Network Address Translation (NAT)

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UNIT IV TRANSPORT LAYER 6

UDP – TCP – Congestion Control and Resource Allocation – TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service – Integrated Services – Differentiated Services – Network Traffic Analysis

UNIT V APPLICATION LAYER 6

Domain Name System (DNS) – Electronic Mail (SMTP, MIME, IMAP) –Telnet – File Transfer (FTP) – REST– WWW (HTTP, HTTPS) – Multimedia

LIST OF EXPERIMENTS

1. Use commands like traceroute, tcpdump, Ifconfig, netstat, and nslookup. Utilizing a network protocol analyzer, record ping and traceroute PDUs and investigate them.
   a. The tcpdump command examines TCP/IP packets sent across networks when two end systems are connected via a specified interface.
   b. Consider that the laboratory has 60 machines connected to the internet, use netstat commands to monitor incoming and outgoing network connections, view routing tables, interface statistics, etc.
   c. The IP address has information about how to reach a specific host, especially outside the LAN. An IP address is a 32-bit unique address having an address space of 232. Use ipconfig command to identify the IP address of a node in a network and tracert command to show connection details about the path that a packet takes from the computer or device you're on to whatever destination you specify.
2. You are assigned to configure the facility, which has ten computers. Now your job is to configure the network cable In the facility, which has two types of cables (a) cross-through cable and (b) straight-through cable.
   a. First, use the color coding and understand how the cables are jacked with RJ45. You are assigned to crimp the two sides of the cable with a cross-through cable. Observer, understand, and experiment with the crimping process.
   b. Second, use the color coding and understand how the cables are jacked with RJ45. You are assigned to crimp the two sides of the cable with different network end devices through the cable. Observer, understand, and experiment with the crimping process.
3. PC1(192.168.1.2) and PC2 (192.168.1.3) are to be configured to communicate with each other. You are about to use the switch as an intermediate device in this experiment. Configure Cisco 2960 switch with the two PCs mentioned above. Experiment and observe that the data transfer between two computers is reliable.
4. Two computers, PC1(192.168.1.2) and PC2 (192.168.2.3), from different networks must be configured to communicate with each other. In this experiment, you will use the router as an intermediate device. Configure Cisco 1841 ISR router with the two PCs mentioned above. Experiment and observe that the data transfers between two computers are reliable.
5. The communication between LAN and WAN is to be configured through Network Address Translation (NAT) as a border router. Create a NAT topology with three routers, RT1, RT2, and RT3. Configure static NAT on Router 2(RT2) while Router RT1 is configured in LAN and RT3 is configured in WAN. Use the following IP address to configure the router
   - Router 1 (RT1) IP address: 192.168.1.2 (local)
   - Router 3 (RT3) IP address: 110.120.1.2 (local)
   - Router 2 (RT2) IP address: 110.120.1.2 (global)

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After configuring the IP address, check the packet situation by opening debug with the "debug ip icmp" command. Observe and under the displayed.

Now configure the NAT using packet tracer (use the manual to configure). Experiment with different configuration scenarios and check the packet situation between LAN and WAN.

6. The routing information protocol (RIP) is used in this experiment to understand the hop count as a routing metric to find the most suitable route between the source and destination network. Configure RIP across the network and set up end devices to communicate on the network by enabling and verifying RIP commands. Create a routing table consisting of the following parameters: device name, IP address, subnet mask, and default gateway. Assign RIP route to a particular router and verify the network by pinging the IP address of any PC.

7. The client-server communication is studied in this experiment using socket programming to understand the UDP protocol. The server program and client program is executed separately.

   Initially, the UDP socket is created at the server and client sides. The binding is carried with the server address. Ensure that the client initiates the communication. Check the response of the client from the server side. Process the datagram packet and send a reply to the client. Observer that the data transfer between Client and Server occurred.

8. The client-server communication is studied in this experiment using socket programming to understand the TCP protocol. The server program and client program are executed separately.

   Initially, the TCP socket is created on the server and client sides. The binding is carried with the server address. Ensure that the client initiates the communication. Check the response of the client from the server side. Process the packet and send a reply to the client. Observer and ensure that the data transfers between Client and Server are reliable.

9. The active and passive File Transfer Protocol is studied in this experiment to understand the basic communication architecture between client and server. The server and client program with the following IP address should be used

   Server: 127.0.0.1

   Client: 192.168.x.x

   Active FTP: Write the client and server program and ensure that client initiates a session via a command channel request and the server creates a data connection back to the client and begins transferring data. Use Wireshark to snip the data packets. Experiment and observer the above by enabling and disabling the local firewall.

   Passive FTP: Write the client and server program and ensure that server uses the command channel to send the client information to open the data channel and ensure that the transfer has begun. Use Wireshark to snip the data packets. Experiment and observer the above by enabling and disabling the local firewall.

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Behrouz A Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw–Hill, New Delhi, 2015
2. J.F. Kurose, K.W. Ross, "Computer Networking: A Top-Down Approach", 5th Edition, Addison-Wesley, 2017

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REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufmann Publishers Inc., 2012
2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2013
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open-Source Approach", 1st Edition, McGraw Hill Publisher, 2011

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th colspan="2" rowspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I
(Theory)
(100 Marks)</th><th colspan="2">Assessment II
(Practical)
(100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record
(Rubrics Based Assessments)</td><td>Test</td><td rowspan="2">Theory Examinations
(Examinations will be conducted for 100 Marks)</td><td rowspan="2">Practical Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>25</td></tr>
<tr><td colspan="4">50</td><td colspan="2">50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER V

U21AM503	MACHINE LEARNING II LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	2	2	2

PRE–REQUISITES:

- U21CSG02- Python Programming
- U21AM301- Introduction to R Programming
- U21AM401- Machine Learning I

COURSE OBJECTIVES:

- To understand the concepts of machine learning problems such as supervised and unsupervised
- To analyze each unsupervised algorithm and implement the same

COURSE OUTCOMES:

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

CO1: Understand the mathematical and statistical prospects of unsupervised machine learning algorithms (Understand)

CO2: Evaluate the Unsupervised models pre-processed through various feature engineering algorithms by python programming (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	2	2	-	1	1	3
CO2	3	3	3	2	3	-	-	-	2	2	-	1	1	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

LIST OF EXPERIMENTS

In machine learning lab session students will work selected set of problems and case studies on the following topics, tools and techniques with the help of Python/ R

Note: Students are free to use any ML Libraries / R Packages

Python: NumPy (Scientific computing), Pandas (Data manipulation and analysis), Scikit-learn (Classification, Regression, Clustering, and Dimensionality Reduction), PyTorch and TensorFlow, Streamlit, FastAPI

R Studio: ggplot2 / dplyr / tidyr /caret / glmnet

1. Familiarizing with Anaconda and Jupyter for importing modules and dependencies for ML. Get the Iris dataset and inspect it. Find insights in how to recognize flowers.
2. Apply K-Means clustering to a dataset with three features. How does the choice of the number of clusters (k) impact the results.
3. Implement hierarchical clustering on a dataset. Discuss the dendrogram and identify the optimal number of clusters.
4. Use DBSCAN on a dataset with varying densities. Show how the algorithm handles noise and outliers.
5. Apply PCA to reduce the dimensionality of a dataset. Interpret the explained variance of principal components.

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6. Implement the Isolation Forest algorithm for anomaly detection. What types of data are well-suited for this approach?
7. Deploying a Machine Learning Model using Streamlit and fast API
8. Implement Linear Regression with PyTorch and TensorFlow
9. Use a one-class SVM for outlier detection. Explain the role of the kernel function in capturing complex patterns
10. Implement the finite words classification system using Backpropagation algorithm. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. Determine the error that the network made, and how we can optimize the network to reduce this error
    - Put our Neural Network in TensorFlow
    - Determine the error and choose an optimizer
    - Train our network on our data
11. Look at the human brain for inspiration on how computers can learn something and learn how to manually design a Neural Network
    - Know how the human brain works
    - Learn how we can formalize this with math
    - Program the forward pass with Numpy
12. Mini Project

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

REFERENCES:

1. Garrett Grolemund, "Hands-On Programming with R: Write Your Own Functions and Simulations", 2021
2. Matt Dowle and Arun Srinivasan, "Efficient Data Processing with R: A Guide to Loading, Manipulating, and Preparing Data in R", 2021
3. Hadley Wickham and Garrett Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data", 2017
4. Nina Zumel, Jim Porzak, John Mount, "Practical Data Science with R", Dreamtech, 2014
5. Wes McKinny, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" O'Reilly Media, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					**End Semester Examinations**
Assessment I (Practical) (100 Marks)		**Assessment II (Project) (100 Marks)**			**Practical Examinations** **(Examinations will be conducted for 100 Marks)**
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	Review I	Review II	Review III	
75	**25**	**15**	**25**	**60**	
30		**30**			**40**
60					**40**
Total: 100					

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SEMESTER V

		Category: PCC				
U21AM504	INTERNET AND WEB PROGRAMMING LABORATORY	L	T	P	J	C
		0	0	2	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To design and develop interactive client-side webpages using static web technologies
- To implement server-side webpages using dynamic web technologies
- To apply web version control and web hosting technologies on dynamic websites

COURSE OUTCOMES:

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

CO1: Design and construct interactive client-side webpages using static web technologies (Apply)

CO2: Develop server-side webpages utilizing dynamic web technologies (Apply)

CO3: Apply web hosting technologies to deploy and host dynamic websites (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	3	-	-	1	2	2	-	1	2	-
CO2	3	2	3	2	3	-	-	1	2	2	-	1	2	-
CO3	3	2	3	2	3	-	-	1	2	2	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

LIST OF EXPERIMENTS

1. Create a web page with content and style using CSS. Add a simple JavaScript function for interactive elements.
2. Analyze web requests using browser tools, modify headers, and observe server responses.
3. Apply Bootstrap to build a layout adaptable static website to various screen sizes.
4. Implement cookies and sessions for data storage in web applications. Manipulate DOM elements using UI events (e.g., click, input).
5. Analyze document resource loading on a web page. Use the Fetch API to fetch data asynchronously.
6. Create a React app and develop React components using states and props. Implement routing, forms, and event handling within React components.
7. Implement a Java Servlet demonstrating its lifecycle and handling HTTP GET and POST methods.
8. Develop a basic ToDo List application using Spring Boot to manage tasks.

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9. Utilize Springboot JDBC to connect with a database and apply request-response validation in Spring Boot controllers.
10. Integrate the PostgreSQL database with Node.js for performing CRUD operations.
11. Integrate Mongo database with Node.js for performing CRUD operations.
12. Mini Project

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total 60 Periods

REFERENCES:

1. Julie C Meloni, Jennifer Kyrnin, "HTML, CSS and JavaScript", 1st edition, Pearson, 2019
2. Juha Hinkula, "Hands on Full stack Development with Springboot 2.0 and React", 1st edition, Packt, 2018
3. Sonia Valeja, David Gonzalez, "ostgreSQL for Job seekers", 1st edition, BPB, 2023
4. Bruno Joeseaph D'mello, Mithun Satheesh, Jason Krol, "Web development with Mongo DB and Node", 3rd edition, Packt, 2017
5. Web Hosting: https://www.freecodecamp.org/

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (Practical) (100 Marks)		Assessment II (Project) (100 Marks)			Practical Examinations (Examinations will be conducted for 100 Marks)
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	Review I	Review II	Review III	
75	25	15	25	60	
30		30			40
60					40
Total: 100					

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SEMESTER V

		Category: EEC				
U21AM505	**PROTO STUDIO I**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**0**	**2**	**1**

PRE–REQUISITES:

- U21AM302 – Design Studio I

COURSE OBJECTIVES:

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product
- To enable hands-on experience for active learning

COURSE OUTCOMES:

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

CO1: Apply the problem-solving techniques (Design thinking & system thinking) (Apply)

CO2: Create and validate low fidelity prototype / Experimental proof of concept. (TRL 4) (Apply)

CO3: Demonstrate teamwork, project management, technical report writing and presentation skills (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	-	2	1	1	-
CO2	3	3	3	3	3	3	3	3	3	-	3	2	1	1
CO3	-	-	-	-	2	-	-	2	3	3	3	1	1	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

Course conduction:

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor for this design clinic 2 course.
- With the guidance of assigned mentor, the students will find & validate a problem statement, map to UNSGD, identify the skills required for the project and self-learn.
- Applying design thinking & system thinking concept the students will solve the problem and produce version 1 of prototype. (TRL 4)
- The student will learn teamwork, project management, technical report writing and presentation skills through this course.

Lecture: – Hours Tutorial: – Hours Practical: – Hours Project 30 Periods

Total 30 Periods

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EVALUATION PATTERN:

Review 0 (Within 10 days of commencement of semester)	Review 1 (Between 35th to 40th working day)	Review 2 (Between 80th to 90th working day)	Total
0	40	60	100

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SEMESTER V

		Category: HSMC				
U21SSG02	SOFT SKILLS – II	L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the importance of communication and enhance self confidence
- To acquire employability skills

COURSE OUTCOMES:

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

CO1: Actively participate in Group Discussion (Analyze)

CO2: Enhance interview skills and make effective Presentation (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I PRESENTATION SKILLS **10**

Presentation Techniques – Time Management Techniques – Body language – Managerial Skills – Making Effective Presentation

UNIT II GROUP DISCUSSION AND PUBLIC SPEAKING **10**

Introduction to Group Discussion – Understanding Group Dynamics – Group Discussion Strategies– Activities to Improve GD Skills – Public Speaking Techniques – Public Speaking Activiti

UNIT III INTERVIEW SKILLS **10**

Listening to Interviews – Preparation for the Interview – Interview Techniques and Etiquettes – Handling Stress Interview – Mock Interview – Online Interview Techniques

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project – Periods

Total 30 Periods

TEXT BOOKS:

1. Prashant Sharma, "Soft Skills: Personality Development for Life Success", 1st edition, BPB Publications, 2022
2. Leader Interpersonal and Influence Skills: The Soft Skills of Leadership", 1st edition, Routledge Publications, 2014

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REFERENCES:

1. Ghosh B N, "Managing Soft Skills for Personality Development", 1st edition, Tata McGraw-Hill, 2012
2. Nitin Bhatnagar and Mamta Bhatnagar, "Effective Communication and Soft Skills Strategies for Success", 1st edition, Pearson Education, 2012

EVALUATION PATTERN:

Continuous Internal Assessments	Marks
Test - I	50
Test - II	50
Total	100

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SEMESTER VI

U21AM601	OPTIMIZATION TECHNIQUES	Category: PCC				
		L	T	P	J	C
		3	1	0	0	4

PRE–REQUISITES:

- U21AM401 - Machine Learning I
- U21AM501 - Machine Learning II

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of optimization techniques in the context of machine learning and deep learning
- To implement optimization algorithms to address challenges in the field of artificial intelligence

COURSE OUTCOMES:

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

CO1: Understand the purpose of optimization in Machine learning (Understand)

CO2: Implement and analyze gradient descent algorithms (Apply)

CO3: Formulate and solve unconstrained optimization problems (Apply)

CO4: Solve constrained optimization problem using Lagrange multipliers (Apply)

CO5: Determine the optimal solution by applying approximation algorithms (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	2	2	-	1	1	3
CO2	3	2	3	2	-	-	-	-	2	2	-	1	1	3
CO3	3	2	2	2	-	-	-	-	2	2	-	1	1	3
CO4	3	2	2	2	-	-	-	-	2	2	-	1	1	3
CO5	3	2	2	1	-	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I FUNDAMENTALS OF OPTIMIZATION **9+3**

Need for optimization – Loss and error calculation – Introduction to optimization – How backpropagation works for Neural Networks: Weight optimization – Weight initialization methods for Sigmoid, ReLu and Tanh – Weight updation methods – Types of optimization problems (minimization, maximization) – Objective functions and constraints – Local and global optima

UNIT II OPTIMIZATION ALGORITHMS **9+3**

Introduction to Gradient Descent: Batch Gradient Descent (BGD) – Stochastic Gradient Descent (SGD) – Variants of SGD (Momentum, RMSprop, Adam) – Mini-batch Gradient Descent – Convex functions: Definition and properties – Convex sets – Convex optimization algorithms – Convex optimization problems – Examples of convex optimization algorithms (Convex hull, Linear programming)

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UNIT III UNCONSTRAINED OPTIMIZATION **9+3**

Newtons method: Basics of Newtons method – Quasi-Newton methods – Conjugate Gradient Descent line search methods: Armijo rule – Backtracking line search

UNIT IV CONSTRAINED OPTIMIZATION **9+3**

Lagrange multipliers: Formulation of constrained optimization problems – KKT conditions – Interior point methods: Overview of interior point methods – Primal-dual interior point methods

UNIT V ADVANCED OPTIMIZATION TECHNIQUES IN DEEP LEARNING **9+3**

Regularization techniques: Dropout – L1 and L2 regularization – Advanced optimization algorithms: Adaptive learning rate methods (Adagrad, Adadelta) – Nesterov accelerated gradient (NAG) – Adam and its variants

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Leon Bottou, Frank E. Curtis, and Jorge Nocedal, "Optimization Methods for Large-Scale Machine Learning", CRC Press, 2018
2. Mykel J. Kochenderfer, Tim A Wheeler, "Algorithms for Optimization", MIT Press, 2019

REFERENCES:

1. Aurélien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2019
2. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning", 2017
3. Michael Nielsen, "Neural Networks and Deep Learning", 2015
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 2012
5. Stephen Boyd, Lieven Vandenberghe, "Convex Optimization", 1st edition, Cambridge Press, 2004

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER VI

		Category: PCC				
U21AM602	**DEEP LEARNING I**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE–REQUISITES:

- U21AM401 - Machine Learning I
- U21AM501 - Machine Learning II

COURSE OBJECTIVES:

- To understand the computational challenges of building stable representations for high-dimensional data, such as images, text and data.
- To analyze deep learning models from both supervised and unsupervised learning.
- To solve real world applications using Deep learning

COURSE OUTCOMES:

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

CO1: Understand the methods and terminologies involved in Deep neural Network (Understand)

CO2: Identify and apply suitable Deep Learning approaches for given application (Apply)

CO3: Implement various Convolutional Neural Network models for image classification (Apply)

CO4: Develop Object detection and localization models using deep learning (Apply)

CO5: Demonstrate the use of Generative Adversarial Networks Recurrent Neural Networks (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	2	2	-	1	1	3
CO2	3	2	3	2	-	-	-	-	2	2	-	-	1	3
CO3	3	2	2	2	-	-	-	-	2	2	-	-	1	3
CO4	3	2	2	2	-	-	-	-	2	2	-	1	1	3
CO5	3	2	2	1	-	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I MODEL TRAINING 9

Neural Networks basics – Functions in Neural Networks – Activation function, Loss function for classification and clustering problems – Deep networks basics – Shallow neural networks – Bias – Variance – Tradeoffs – Early stopping conditions – Model checkpoints

UNIT II INTRODUCTION TO DEEP LEARNING 9

Introduction to Deep Neural Networks – Forward and back propagation – Parameters – Hyperparameters – Softmax regression – Softmax classifier – Deep learning frameworks – Data augmentation: Text, Image – Advanced techniques: GAN – Under-fitting vs over-fitting

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UNIT III CONVOLUTION NEURAL NETWORKS 9

Foundations of Convolutional Neural Networks (CNN) – CNN operations – CNN architecture – Simple Convolution Network – Deep convolutional models – ResNet, AlexNet, InceptionNet

UNIT IV APPLICATIONS OF CNNS IN COMPUTER VISION 9

Object detection and localization with CNN's (YOLO, Faster R-CNN) – Semantic segmentation with CNNs (U-Net, SegNet) – Image generation and synthesis with CNNs (GANs) – Transfer learning and fine-tuning of CNNs – Recent advances in CNNs (Efficient attention, Sparsity) – Open problems and challenges in CNNs (Robustness, Fairness)

UNIT V GENERATIVE ADVERSARIAL NETWORKS 9

Introduction to GAN – One-shot learning – Segmentation: Instance segmentation, Semantic segmentation – Object detection vs Object recognition vs Image segmentation

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Nikhil Buduma, Nithin Buduma, Joe Papa, "Fundamentals of Deep Learning", O'Reilly Media, Inc., 2nd edition, 2022
2. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 1st edition, 2018

REFERENCES:

1. N D Lewis, "Deep Learning Step by Step with Python", 2016
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
3. Umberto Michelucci, "Applied Deep Learning: A Case-based Approach to Understanding Deep Neural Networks", Apress, 2018
4. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore Neural Networks with Python", Packt Publisher, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER VI

U21AM603	HIGH PERFORMANCE COMPUTING	Category: PCC				
		L	T	P	J	C
		3	0	2	0	4

PRE–REQUISITES:

- U21CS301- Computer Organization and Architecture

COURSE OBJECTIVES:

- To provide basics of parallel architectures
- To understand the high-performance computing and algorithm design
- To apply parallel programming models and problem solving

COURSE OUTCOMES:

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

CO1: Understand the parallel algorithms of underlying architecture (Understand)

CO2: Implement the algorithms using parallel programming models like MPI, Pthreads, OpenMP, CUDA (Apply)

CO3: Analyze the benchmarks of high-performance computing architecture like OpenMP (Analyze)

CO4: Demonstrate the various emerging trends of high-performance computing (Apply)

CO5: Apply GPU computing concepts in problem solving to achieve high performance (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	2	2	-	-	1	3
CO2	3	2	3	2	2	-	-	-	2	2	-	1	1	3
CO3	3	2	2	2	2	-	-	-	2	2	-	1	1	3
CO4	3	2	2	2	2	-	-	-	2	2	-	1	1	3
CO5	3	2	2	1	2	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION AND PARALLEL PROGRAMMING PLATFORMS 9

Overview of parallel computers and High-Performance Computing (HPC) – History of HPC – Numerical and HPC libraries – Performance metrics

UNIT II HPC PARADIGMS 9

Supercomputing – Cluster computing – Grid computing – Cloud computing – Many-core computing – Peta scale systems

UNIT III PARALLEL PROGRAMMING I 9

Introduction to OpenMP – Parallel constructs – Runtime library routines – Work-sharing construct – Scheduling clauses – Data environment clauses – Atomic – Master nowait clause – Barrier construct – Overview of MPI – MPI constructs – OpenMP vs MPI

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UNIT IV JOB MANAGEMENT SYSTEMS 9

Batch scheduling: Condor – Slurm – SGE – PBS – Lightweight task scheduling: Falkon – Sparrow

UNIT V PARALLEL PROGRAMMING II & ACHIEVING PERFORMANCE 9

Introduction to GPU computing – CUDA programming model – CUDA API – Simple matrix multiplication in CUDA – CUDA memory model – Shared memory matrix multiplication – Additional CUDA API features – Measuring performance – Identifying performance bottlenecks partitioning applications for heterogeneous resources – Using existing libraries and frameworks

LIST OF EXPERIMENTS

1. Implement matrix-vector multiplication
2. Implement bubble sort and its variants
3. Implement quicksort
4. Implement bucket and sample sort
5. Implement minimum spanning tree: prim's algorithm
6. Implement single-source shortest paths: dijkstra's algorithm
7. Implement all-pairs shortest paths
8. Implement parallel depth-first search
9. Implement parallel best-first search
10. Implement finding prime numbers
11. Implement finding cumulative sums
12. Implement transforming adjacency matrix

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Zbigniew J. Czech, "Introduction to Parallel Computing", Cambridge University Press, 2016

REFERENCES:

1. Eijkhout V, Chow E, Geijn R, "Introduction to High Performance Scientific Computing", 2nd edition, The Saylor Foundation, 2014
2. Michael Quinn, "Parallel Computing: Theory and Practice", McGrawHill Publishers, 2017
3. Arch Robison, James Reinders, and Michael Macoul, "Structured Parallel Programming: Patterns for Efficient Computation", Elsevier, 2012

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		**Assessment II (Practical) (100 Marks)**		**Theory Examinations (Examinations will be conducted for 100 Marks)**	**Practical Examinations (Examinations will be conducted for 100 Marks)**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test		
40	60	75	25		
25		25		35	15
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER VI

		Category: PCC				
		L	T	P	J	C
U21AM604	DEEP LEARNING I LABORATORY	0	0	2	2	2

PRE–REQUISITES:

- U21CSG02- Python Programming
- U21AM301- Introduction to R Programming
- U21AM401- Machine Learning I

COURSE OBJECTIVES:

- To understand the major deep neural network frameworks and issues in basic neural networks.
- To solve real world applications using Deep learning

COURSE OUTCOMES:

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

CO1: Design and develop CNN architecture for image classification problems (Apply)

CO2: Apply transfer learning concepts for various classification problem (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	-	-	-	1	2	2	-	1	-	2
CO2	3	2	3	2	-	-	-	1	2	2	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

LIST OF EXPERIMENTS

1. Demonstration and implementation of Shallow architecture, using Python, Tensorflow and Keras
2. Hyper parameter tuning and regularization practice - Multilayer Perceptron (BPN) and Mini-batch gradient descent
3. Convolution Neural Network application using Tensorflow and Keras- Classification of MNIST Dataset using CNN
4. Convolution Neural Network application using Tensorflow and Keras- Face recognition using CNN
5. Object detection using Transfer Learning of CNN architectures
6. Image denoising (Fashion dataset) using Auto Encoders for Handling Color Image in Neural Network aka Stacked Auto Encoders (Denoising)
7. Text processing, Language Modeling using RNN
8. Transfer Learning models for classification problems
9. Sentiment Analysis using LSTM
10. Image generation using GAN

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11. Mini Project

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

REFERENCES:

1. N D Lewis, "Deep Learning Step by Step with Python", 2016
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
3. Umberto Michelucci, "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks", Apress, 2018
4. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					**End Semester Examinations**
Assessment I (Practical) (100 Marks)		**Assessment II (Project) (100 Marks)**			**Practical Examinations** **(Examinations will be conducted for 100 Marks)**
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	Review I	Review II	Review III	
75	**25**	**15**	**25**	**60**	
30		**30**			**40**
60					**40**
Total: 100					

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SEMESTER VI

		Category: EEC				
U21AM605	**PROTO STUDIO II**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**0**	**2**	**1**

PRE–REQUISITES:

- U21AM505 – Proto Studio I

COURSE OBJECTIVES:

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product
- To enable hands-on experience for active learning

COURSE OUTCOMES:

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

CO1: Apply the problem-solving techniques (Design thinking & system thinking) (Apply)

CO2: Create Minimum Viable Prototype (TRL 6) (Apply)

CO3: Analyze product to market fit (Apply)

CO4: Develop a business model (Apply)

CO5: Demonstrate teamwork, project management, technical report writing and presentation skills (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	-	2	1	1	-
CO2	3	3	3	3	3	3	3	3	3	-	3	2	-	2
CO3	3	3	3	3	3	3	3	3	3	-	3	2	-	2
CO4	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO5	-	-	-	-	2	-	-	2	3	3	3	1	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

Course conduction:

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor for this design clinic 2 course.
- With the guidance of assigned mentor, the students will find & validate a problem statement, map to UNSGD, identify the skills required for the project and self-learn.
- Applying design thinking & system thinking concept the students will solve the problem and produce the version 1 of prototype. (TRL 4)
- The student will learn teamwork, project management, technical report writing and presentation skills through this course.

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Lecture: – Hours Tutorial: – Hours Practical: – Hours Project 30 Periods

Total 30 Periods

EVALUATION PATTERN:

Review 0 (Within 10 days of commencement of semester)	Review 1 (Between 35th to 40th working day)	Review 2 (Between 80th to 90th working day)	Total
0	40	60	100

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SEMESTER VI

		Category: HSMC				
U21SSG03	**SOFT SKILLS – III**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**2**	**0**	**1**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To improve language adeptness and to enhance fluency in language
- To Gain emotional intelligence and to manage stress

COURSE OUTCOMES:

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

CO1: Write reports and make reasoning and assertions (Apply)

CO2: Overcome stress and attain work-life balance (Analyse)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	1	3	-	-	-	-
CO2	-	-	-	-	-	-	-	1	-	3	-	2	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I LANGUAGE ADEPTNESS **10**

Sentence Completion – Report Writing – Logical Reasoning – Cause and Effect – Assertion and Reasoning – Digital Profiling – Creative Resume

UNIT II STRESS MANAGEMENT **10**

Factors Causing Stress – Positive and Negative Stress – Effects of Stress – Stress Overcoming Techniques – Context Based Tasks

UNIT III EMOTIONAL INTELLIGENCE **10**

Leadership effectiveness – Self-awareness – Self-management – Self-motivation – Empathy and Social Skills

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 30 Periods

TEXT BOOKS:

1. Daniel Goleman, "Emotional Intelligence: Why it Can Matter More Than IQ", 1st edition, Bloomsbury, 2009
2. Alan Barker, "Improve Your Communication Skills: Present with Confidence; Write with Style; Learn Skills of Persuasion",1st edition, Kogan Page, 2010

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REFERENCES:

1. Jeremy Stranks, "Stress at Work: Management and Prevention", 1st edition, Butterworth-Heinemann, 2005
2. Edward J Watson, "Emotional Intelligence: A Practical Guide on How to Control Your Emotions and Achieve Lifelong Social Success", 1st edition, Amazon Digital Services LLC, 2016

EVALUATION PATTERN:

Continuous Internal Assessments	Marks
Test - I	50
Test - II	50
Total	100

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SEMESTER VII

		Category: PCC				
U21AM701	**DEEP LEARNING II**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE–REQUISITES:

- U21AM401 - Machine Learning I
- U21AM501 - Machine Learning II
- U21AM602 - Deep Learning I

COURSE OBJECTIVES:

- To introduce computational challenges of building stable representations for high-dimensional data, such as images, text and data
- To analyze Deep Learning models from both supervised and unsupervised learning

COURSE OUTCOMES:

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

CO1: Understand the various pre-trained models involved in deep neural networks (Understand)

CO2: Identify and improve performance through hyper parameter tuning (Apply)

CO3: Understand the basics of natural language processing through RNN & LSTM (Understand)

CO4: Apply the various attention mechanisms for language modelling (Apply)

CO5: Design and implement the transformers for complex application (Analyse)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	2	2	-	-	1	3
CO2	3	2	3	2	-	-	-	-	2	2	-	-	1	3
CO3	3	2	2	2	-	-	-	-	2	2	-	-	1	3
CO4	3	2	2	2	-	-	-	-	2	2	-	-	1	3
CO5	3	2	2	1	-	-	-	-	1	1	-	-	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I PRETRAINED MODELS 9

Introduction to pre-trained models – ImageNet: ResNet, DenseNet , AlexNet, VGG, Inception, and MobileNet for image classification, Object detection (Mask R-CNN, YOLO, SSD, MobileNet Ripe/unripe tomato classification, Car classification) – Face recognition (VGG-Face Model, 3D Face reconstruction from a single image) – Image Segmentation: Semantic image segmentation (Deeplabv3) – Image captioning

UNIT II TRANSFER LEARNING 9

Introduction to transfer learning – Steps to use transfer learning – Transfer learning for video classification with MoViNet – Transfer learning with hyperparameter tuning: Epochs, Learning rate – Hyperparameter tuning techniques – Boltzmann machines – Autoencoder: Encoder, Decoder – Types

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UNIT III NLP-BASED FEATURE EXTRACTION 9

Introduction to Vector Space Model (VSM) – Words and vectors – Word Embedding using Word2Vec, Doc2Vec – Information extraction types – Recurrent Neural Networks (RNN) – Gated eecurrent units (GRU), Long Short-Term Memory (LSTM), Bidirectional LSTM – Autoencoders: Encoder, Decoder – Types – Introduction to NLP

UNIT IV ATTENTION MECHANISM 9

Introduction to attention – Encoder – Decoder architecture – Attention cues, Attention pooling, Scoring functions, Self-Attention – Weight or Softmax calculation – Attention in Sequence-to-Sequence models – Case study

UNIT V TRANSFORMERS 9

Need for Transformer – Encoder, Decoder, Training – Transformer for Vision – Universal text representations: BERT – Large-scale pretraining with transformers – Introduction on GenAI, Large Language Models (LLM) and MultiLLMs

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Magnus Ekman, "Learning Deep Learning: Theory and Practice of Neural Networks, Computer Vision, NLP, and Transformers using TensorFlow", Addison-Wesley Professional, 2021
2. Dipanjan Sarkar, Raghav Bali, "Hands-On Transfer Learning with Python", Packt publisher, 2018

REFERENCES:

1. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 1st edition, 2018
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Amazon Senior Scientists, "Dive into Deep Learning", Open source and Free Book, 2022
3. Ian Goodfellow Yoshua Bengio Aaron Courville, "Deep Learning", MIT Press, 2017
4. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER VII

		Category: PCC				
U21AM702	CLOUD AND BIG DATA ANALYTICS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21CSG05-Computer Networks

COURSE OBJECTIVES:

- To understand cloud computing and its systematic knowledge of the fundamental technologies, architecture, and security
- To expose frontier areas of Cloud Computing while providing sufficient foundations to enable further study and research
- To study the basic technologies that construct the foundations of Big Data
- To study the programming aspects of cloud computing with a view to rapid prototyping of complex applications

COURSE OUTCOMES:

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

CO1: Articulate the main concepts, key technologies, strengths, and limitations of cloud computing (Understand)

CO2: Identify the various cloud enabling technologies (Understand)

CO3: Explain the core cloud architecture for various distributed problems (Understand)

CO4: Relate the appropriate algorithms and approaches related to bigdata analytics (Apply)

CO5: Demonstrate the working of bigdata in cloud analytics (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	2	2	-	-	2	-
CO2	3	2	3	2	-	-	-	-	2	2	-	-	2	-
CO3	3	2	2	2	-	-	-	-	2	2	-	-	1	-
CO4	3	2	2	2	-	-	-	-	2	2	-	1	1	2
CO5	3	2	2	1	-	-	-	-	1	1	-	1	1	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I CLOUD COMPUTING 9

Cloud origins and influences – Cloud characteristics – Cloud delivery models (Iaas, PaaS, SaaS) – Cloud deployment models – Cloud computing architecture – Cloud computing platforms (AWS, Azure, Google Cloud) – Demonstrations

UNIT II CLOUD ENABLING TECHNOLOGIES 9

Data centre technology – Virtualization technology – Web technology – Multitenant technology – Service technology – Cloud infrastructure mechanisms: Network perimeter – Virtual server – Cloud storage device – Cloud usage monitor – Resource replication

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UNIT III CLOUD ARCHITECTURES 9

Workload distribution architecture – Resource pooling architecture – Dynamic scalability architecture – Elastic resource capacity architecture – Service load balancing architecture – Cloud bursting architecture – Elastic disk provisioning architecture – Redundant storage architecture – Cloud operations: Migration, Static and Dynamic scheduling

UNIT IV BIGDATA ANALYTICS 9

Introduction to Big Data: Big Data processing techniques – Big Data architectures – Big Data tools (Hadoop, Spark) – Introduction to data analytics: Descriptive, Predictive, and Prescriptive analytics – Data visualization techniques – Statistical analysis techniques

UNIT V CLOUD ANALYTICS 9

Big Data analytics on cloud platforms – Cloud-based data warehousing – Cloud-based data processing and analytics tools – Demonstrations

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Mohammed Guller, "Big Data Analytics with Spark", 1st edition, Apress, 2019
2. Amir Vahid Dastjerdi, Rajkumar Buyya, Rodrigo N. Calheiros, "Big Data Principles and Paradigms", 1st edition, Elsevier science, 2016

REFERENCES:

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", 1st edition, PHI Publications, 2013
2. Mustafa Toroman, "Hands-on Cloud Administration in Azure", 1st edition, Packt Publishing, 2018
3. Valliappa Lakshmanan, "Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines", 1st edition, O'Reilly Media, 2018
4. Rajkumar Buyya, Christian Vecchiola, and S.Thamarai Selvi, "Mastering Cloud Computing: Foundations and Applications Programming", 1st edition, Morgan Kaufmann Publishers, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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SEMESTER VII

		Category: PCC				
U21AM703	DEEP LEARNING II LABORATORY	L	T	P	J	C
		0	0	2	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand deep neural network frameworks and learn to implement them
- To learn to use pretrained models effectively and use them to build potential solutions

COURSE OUTCOMES:

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

CO1: Implement various pretrained deep learning models (Apply)

CO2: Perform NLP based feature extraction using LSTM and Bi-LSTM (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	-	-	-	1	2	2	-	-	1	2
CO2	3	2	3	2	-	-	-	1	2	2	-	-	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

LIST OF EXPERIMENTS

1. Working with different data types and file formats
2. Simple Classification Tasks Working with MNIST – IMDB Datasets
3. Training a CNN from Scratch Using pretrained CNNs (AlexNet, ResNet, GoogleNet, etc)
4. Visualizing what CNNs are learning – Intermediate Activations, Convnet Filters, Heatmaps
5. Exploring Multi-Input, Multi-output Models Hyper-parameter Tuning
6. Optimization: XGBoost/AdaBoost
7. Practicing of Stacking Layers in Bidirectional RNNs
8. Transfer Learning models for classification problems Exploring Hugging-face API
9. Text Generation Using LSTM
10. Transformers: Attention, BERT, GPT-2, DistillBERT, T5
11. Mini Project

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

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REFERENCES:

1. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Umberto Michelucci, "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks", Apress, 2018
3. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017

EVALUATION PATTERN:

<table>
<tr><th colspan="5">Continuous Internal Assessments</th><th>End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (Practical) (100 Marks)</th><th colspan="3">Assessment II (Project) (100 Marks)</th><td rowspan="3">Practical Examinations

(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)</td><td>Test</td><td>Review I</td><td>Review II</td><td>Review III</td></tr>
<tr><td>75</td><td>25</td><td>15</td><td>25</td><td>60</td></tr>
<tr><td colspan="2">30</td><td colspan="3">30</td><td>40</td></tr>
<tr><td colspan="5">60</td><td>40</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

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SEMESTER VII

		Category: EEC				
U21AM704	PROJECT WORK PHASE – I	L	T	P	J	C
		0	0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to identify and solve a specific problem in the field of Artificial Intelligence and Machine Learning.
- To train the students in preparing project reports and to face reviews and viva voce examination

COURSE OUTCOMES:

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

CO1: Identify the leading problems related to Computer Engineering, AI and ML (Apply)

CO2: Identify, discuss, and justify the technical aspects of the chosen project with comprehensive and systematic approach (Apply)

CO3: Work as an individual or in a team in development of technical projects (Apply)

CO4: Gain practical professional experience in Computer Engineering (Apply)

CO5: Develop the solution for the problem identified in Computer Engineering, AI and ML (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

STRATEGY:

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.

Lecture: – Hours Tutorial: – Hours Practical: – Hours Project: 60 Periods

Total: 60 Periods

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EVALUATION PATTERN:

Continuous Internal Assessments (100 Marks)			
Review I	**Review II**	**Review III**	**Total Assessment**
30	30	40	100

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SEMESTER VIII

		Category: EEC				
		L	T	P	J	C
U21AM801	PROJECT WORK PHASE – II	0	0	0	16	8

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to identify and solve a specific problem in the field of Artificial Intelligence and Machine Learning.
- To train the students in preparing project reports and to face reviews and viva voce examination

COURSE OUTCOMES:

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

CO1: Practice acquired knowledge within the chosen area of technology for project development (Apply)

CO2: Identify, discuss and justify the technical aspects of the chosen project with comprehensive and systematic approach (Apply)

CO3: Reproduce, improve, and refine technical aspects for engineering projects (Apply)

CO4: Work as an individual or in a team in development of technical projects (Apply)

CO5: Communicate and report effectively project related activities and findings (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO2	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO3	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO4	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO5	3	2	2	3	2	2	2	2	3	3	2	3	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

STRATEGY:

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.

Lecture: – Hours Tutorial: – Hours Practical: – Hours Project: 280 Periods

Total: 280 Periods

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EVALUATION PATTERN:

Continuous Internal Assessments (40 Marks)			End Semester Examination (60 Marks)	
Review I	Review II	Review III	Project Report	Viva-Voice
10	15	15	10	50
Total: 100 Marks				

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

		Category: PEC				
U21ADP01	MATHEMATICAL FOUNDATION FOR DATA SCIENCE	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the basic mathematical concepts relevant to data science
- To apply mathematical skills to solve real-time problems
- To introduce basic data science methods

COURSE OUTCOMES:

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

CO1: Describe the need of mathematical foundations for data science (Understand)

CO2: Illustrate linear algebra concepts required for data science (Understand)

CO3: Describe the basics of probability for data science (Understand)

CO4: Understand the basics of statistics for data science (Understand)

CO5: Describe the basics of optimization techniques for data science (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	1	3	1
CO2	3	2	2	2	-	-	-	-	-	-	-	1	3	2
CO3	3	2	2	2	2	-	-	-	-	-	-	2	3	2
CO4	3	3	3	3	2	-	-	-	2	-	-	2	3	2
CO5	3	3	3	3	3	-	-	-	2	-	-	2	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I BASICS OF DATA SCIENCE 9

Introduction – Typology of problems – Importance of linear algebra, statistics and optimization from a data science perspective – Structured thinking for solving data science problems

UNIT II LINEAR ALGEBRA 9

Solution of system of linear equations, Vector spaces – Linear dependence and independence – Bases and dimensions, Inner product space, Linear transformations – Range, kernel and problems – Eigenvalues and eigenvectors

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UNIT III PROBABILITY 9

Probability – Axioms of probability – Conditional probability – Baye's theorem. Discrete and Continuous random variables – Moments – Moment generating functions – Discrete and Continuous distributions: Binomial, Poisson, Geometric, Uniform, Exponential, and Normal distributions – Joint distributions: Marginal and conditional distributions – Covariance – Correlation and regression

UNIT IV STATISTICS 9

Definition of statistics – Basic objectives – Applications in various branches of science with examples – Collection of Data: Primary and secondary data – Classification and tabulation of data – Frequency distribution – Bar graphs and Pie charts – Histogram – Measures of central tendency – Measures of Variability – Sampling: Sampling distributions – Statistical estimation of parameters – Confidence intervals – Testing of hypothesis: Large and small sample test – Design of Experiments: One way and two-way classifications

UNIT V OPTIMIZATION: UNCONSTRAINED OPTIMIZATION 9

Necessary and sufficiency conditions for optima – Gradient descent methods – Constrained optimization – KKT conditions – Introduction to non-gradient techniques – Introduction to least squares optimization – Optimization view of machine learning

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. G. Strang, "Introduction to Linear Algebra", 5th edition, Wellesley-Cambridge Press, USA, 2016
2. Bendat, J. S. and A. G. Piersol, "Random Data: Analysis and Measurement Procedures" 4th edition, John Wiley & Sons, Inc., USA, 2010

REFERENCES:

1. Montgomery, D. C. and G. C. Runger, "Applied Statistics and Probability for Engineers", 5th edition, John Wiley & Sons, Inc., USA, 2011
2. David G. Luenberger, "Optimization by Vector Space Methods", 1st edition, John Wiley & Sons (NY), 1969
3. Cathy O'Neil and Rachel Schutt, "Doing Data Science", 1st edition, O'Reilly Media, 2013

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

		Category: PEC				
U21ADP02	PATTERN RECOGNITION	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce mathematical foundations of pattern recognition
- To describe different techniques involved in pattern recognition
- To familiarize various clustering techniques

COURSE OUTCOMES:

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

CO1: Describe pattern recognition and its mathematics fundamentals (Understand)

CO2: Understand the pattern recognition process (Understand)

CO3: Explain the pattern recognition models (Understand)

CO4: Describe non-parametric techniques in pattern recognition (Understand)

CO5: Illustrate unsupervised learning and clustering techniques (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	1	2	2
CO2	3	3	3	2	-	-	-	-	-	-	-	1	2	2
CO3	3	3	3	2	-	-	-	-	-	-	-	1	2	2
CO4	3	3	3	2	-	-	-	-	-	-	-	1	2	2
CO5	3	3	3	2	-	-	-	-	-	-	-	1	2	2
Correlation levels:		1: Slight (Low)		2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION 9

Pattern recognition system – Design cycle – Learning and adaptation – Mathematical foundations: Linear algebra – Conditional probability – Expectations, mean and covariance – Gaussian derivatives and integrals – Hypothesis testing

UNIT II BAYESIAN DECISION THEORY 9

Continuous Features – Minimum-Error-Rate classification – Classifiers, discriminant functions and decision surfaces – Normal density – Discrete features – Missing and noisy features – Bayesian belief networks

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UNIT III MODELS 9

Maximum-Likelihood estimation – Bayesian parameter estimation – Principal component analysis – Expectation-Maximization – Hidden Markov models

UNIT IV NON-PARAMETRIC TECHNIQUES 9

Density estimation – Parzen windows – K-Nearest Neighbor estimation – Nearest neighbor rule – Fuzzy classification

UNIT V CLUSTERING TECHNIQUES 9

Unsupervised Bayesian learning – Criterion functions for clustering: Sum-of-Squared-Error – Related minimum variance – Hierarchical clustering: Agglomerative – Step-wise optimal

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Richard O. Duda, P. E. Hart, David G. Stork, "Pattern Classification", 2nd edition, John Wiley, 2006

REFERENCES:

1. Andrew Webb, "Statistical Pattern Recognition", 2nd edition, Arnold publishers, 1999
2. Bishop, Christopher M., "Pattern Recognition and Machine Learning", 1st edition, Springer, 2009
3. S. Theodoridis, K. Koutroumbas, "Pattern Recognition", 4th edition, Academic Press, 2009

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

31.1.24

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

U21ADP03	SPEECH PROCESSING AND ANALYTICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the need for morphological processing and their representation
- To know about the various techniques used for speech synthesis and recognition
- To appreciate the syntax analysis and parsing that is essential for natural language processing
- To learn about the various representations of semantics and discourse
- To have knowledge about the applications of natural language processing

COURSE OUTCOMES:

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

CO1: Identify the basic concepts of speech processing (Understand)

CO2: Describe the speech analysis process (Understand)

CO3: Illustrate speech modeling with examples (Understand)

CO4: Describe speech recognition techniques (Understand)

CO5: Illustrate speech synthesis with examples (Understand)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I SPEECH PROCESSING 9

Phonetics – Articulatory phonetics – Phonological categories – Acoustic phonetics and signals – Speech synthesis – Text normalization – Phonetic and acoustic analysis – Diphone waveform synthesis – Evaluation – Automatic speech recognition – Architecture – Hidden markov model to speech – MFCC vectors – Acoustic likelihood computation – Evaluation – Triphones – Discriminative training – Modeling variation – Computational phonology – Finite-state phonology – Computational optimality theory – Syllabification – Learning phonology and morphology

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UNIT II SPEECH ANALYSIS 9

Features, Feature extraction and Pattern comparison techniques: Speech distortion measures – Mathematical and perceptual – Log spectral distance, Cepstral distances, Weighted cepstral distances and filtering, Likelihood distortions, Spectral distortion using a warped frequency scale, LPC, PLP and MFCC coefficients, Time alignment and normalization – Dynamic time warping, Multiple time – Alignment paths

UNIT III SPEECH MODELING 9

Hidden markov models: Markov processes, HMMs – Evaluation, Optimal state sequence – Viterbi search, Baum-Welch parameter re-estimation, and implementation issues

UNIT IV SPEECH RECOGNITION 9

Large vocabulary continuous speech recognition: Architecture of a large vocabulary – Continuous speech recognition system – Acoustics and language models – N-grams, Context dependent sub-word units – Applications and present status

UNIT V SPEECH SYNTHESIS 9

Text-to-Speech synthesis: Concatenative and waveform synthesis methods, Sub-word units for TTS, Intelligibility, and naturalness – Role of prosody, Applications and present status

Contact Periods:

Lecture: 45 Periods Tutorial: -- Periods Practical: -- Periods Project: -- Periods

Total: 45 Periods

TEXT BOOKS:

1. Jurafsky and Martin, "Speech and Language Processing", 2nd edition, Pearson Prentice Hall, 2008
2. Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition", 1st edition, Pearson Education, 2003

REFERENCES:

1. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", 1st edition, California Technical Publishing.
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", 1st edition, Pearson education
3. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
4. Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 edition

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

		Category: PEC				
U21ADP04	WEB MINING	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To describe web mining and understand the need for web mining
- To differentiate between Web mining and data mining
- To understand the different application areas for web mining
- To understand the different methods to introduce structure to web-based data

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of Web Mining and Data Mining concepts (Understand)

CO2: Apply the Supervised Learning algorithms and its application areas (Apply)

CO3: Formulate the application areas of Unsupervised Learning Algorithms (Apply)

CO4: Apply the information retrieval techniques and the requirements of Web Spamming (Understand)

CO5: Apply the concept of Basic Web crawler algorithms and overview of different web crawlers (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	1	1	1	-	1	-	-	-	-	-	-	-	-	1
CO3	1	1	1	-	1	1	-	-	-	-	-	-	-	1
CO4	1	2	2	2	1	-	-	-	-	-	-	1	-	1
CO5	1	1	-	1	1	1	-	-	-	-	1	1	-	1
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

SYLLABUS:

UNIT I INTRODUCTION TO WEB MINING 9

Introduction to web data mining and data mining foundations, Introduction – World Wide Web (WWW), A brief history of the web and the internet, Web data mining – Data mining foundations – Association rules and sequential patterns – Basic concepts of association rules, Apriori algorithm – Frequent itemset generation, Association rule generation, Data formats for association rule mining, Mining with multiple minimum supports – Mining algorithm, Rule generation, Mining class association rules

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UNIT II SUPERVISED LEARNING 9

Supervised and unsupervised learning: Supervised learning – Basic concepts, Decision tree induction – Classifier evaluation – Rule induction – Classification based on associations, Naïve Bayesian classification, Naïve Bayesian text classification – Probabilistic framework, Naïve Bayesian model – Support Vector machine (SVM) – KNN Learning

UNIT III UNSUPERVISED LEARNING 9

K-Means clustering – Representation of clusters – Hierarchical methods – Distance functions – Data standardization – Handling of mixed attributes – Cluster evaluation

UNIT IV INFORMATION RETRIEVAL AND WEB SEARCH 9

Basic concepts of information retrieval – Information retrieval models – Evaluation measures – Text and web page pre-processing – Inverted index and its compression – Latent semantic indexing – Web spamming

UNIT V WEB CRAWLING 9

A basic crawler algorithm – Universal crawlers – Focused crawlers – Topical crawlers – Crawler ethics and conflicts – Wrapper introduction – Wrapper introduction

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data", 1st edition, Springer Publications, 2011

REFERENCES:

1. Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", 3rd edition, Elsevier Publications, 2012
2. Anthony Scime, "Web Mining: Applications and Techniques", 1st edition, Idea Group Publishing, 2011
3. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", 1st edition, Elsevier Inc.,2003

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

		Category: PEC				
U21ADP05	**EXPLORATORY DATA ANALYSIS AND VISUALIZATION**	**L**	**T**	**P**	**J**	**C**
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the purpose and concepts of data exploration.
- To understand the basics of data visualization.
- To explore the role of R language in data visualization.

COURSE OUTCOMES:

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

CO1: Describe the basics of data explorations (Understand)

CO2: Illustrate Univariate and Multivariate Analysis for Data Exploration (Understand)

CO3: Describe the basics of Data visualization (Understand)

CO4: Illustrate data with graphs discrete and continuous probability distributions (Understand)

CO5: Explore the applications in data visualization (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	3	2	-	-	-	-	-	2	-	3
CO2	3	3	3	-	3	2	-	-	-	-	-	2	-	3
CO3	3	3	3	-	3	2	-	-	-	-	-	2	-	3
CO4	3	3	3	2	3	2	-	-	-	-	-	2	-	3
CO5	3	3	3	2	3	2	-	-	-	-	-	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO DATA EXPLORATORY 9

Introduction to single variable: Distribution variables – Numerical summaries of level and spread – Scaling and standardising – Inequality – Smoothing time series

UNIT II INTRODUCING TWO VARIABLE AND THIRD VARIABLE 9

Relationships between two variables – Percentage tables – Analysing contingency tables – Handling several batches – Scatterplots and resistant lines – Transformations – Introducing a third variable – Causal explanations – Three-variable contingency tables and beyond – Longitudinal data

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UNIT III BASICS OF DATA VISUALIZATIOŃ 9

The seven stages of visualizing data – Getting started with processing – Mapping – Time series – Connections and correlations – Scatterplot maps – Trees, Hierarchies, and Recursion – Networks and graphs – Acquiring data – Parsing data

UNIT IV MISCELLANEOUS GRAPH 9

Basics of histogram, Making multiple histograms from grouped data – Basics of density curve, Making multiple density curves from grouped data – Frequency polygon – Box plot – Violin plot – Multiple dot plots for grouped data – Density plot of two-dimensional data – Correlation matrix – Network graph – Heat map – Three-dimensional scatter plot – Dendrogram – QQ plot an empirical cumulative distribution function – Mosaic plot – map

UNIT V APPLICATIONS OF DATA EXPLORATION AND VISUALIZATION 9

Real world applications of data visualization – The basics of data exploration – Loading data from data sources – Transforming data – Creating tidy data – Basic data exploration techniques – Basic data visualization techniques – Case study: Students performance in theory and practical examinations

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis", 2nd Edition, O'reilly publication, 2014
2. Eric Pimpler, "Free Chapter: Data Visualization and Exploration with R", 1st edition, Geo Spatial Training Service, 2018

REFERENCES:

1. Glenn J. Myatt, Wayne P. Johnson, "Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications", 1st edition, Wiley publication, 2009
2. Claus.O.Wilke, "Fundamentals of Data Visualization, A primer on making informative and compelling Figures", 1st edition, O'Reily Publications, 2019.

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

		Category: PCC				
U21ADP06	PREDICTIVE ANALYTICS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To explain terminology, technology, and applications of predictive analysis
- To apply data preparation techniques and generate appropriate association rules.
- To discuss various descriptive models, their merits, demerits, and application.
- To describe various predictive modelling methods.
- To introduce the text mining tools, technologies and case study which is used in day-today analytics cycle

COURSE OUTCOMES:

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

CO1: Explain data understanding and data visualization (Understand)

CO2: Apply data preparation techniques to effectively interpret big data (Apply)

CO3: Discuss various descriptive models and cluster algorithms. (Understand)

CO4 Describe principles of predictive analytics and apply them to achieve real, pragmatic solutions. (Apply)

CO5: Illustrate the features and applications of text mining. (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	3
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	3
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO PREDICTIVE ANALYTICS 9

Overview of predictive analytics – Setting up the problem – Data understanding – Single variable – Data visualization in one dimension – Data visualization, Two or higher dimensions – The value of statistical significance – Pulling it all together into a data audit

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UNIT II DATA PREPARATION AND ASSOCIATION RULES 9

Data preparation – Variable cleaning – Feature creation – Item sets and association rules – Terminology – Parameter settings – How the data is organized – Measures of interesting rules – Deploying association rules – Problems with association rules – Building classification rules from association rules

UNIT III MODELLING 9

Descriptive modelling – Data preparation issues with descriptive modelling – Principal Component Analysis (PCA) – Clustering algorithms – Interpreting descriptive models – Standard cluster model Interpretation

UNIT IV PREDICTIVE MODELLING 9

Decision trees – Logistic regression – Neural network model – K-Nearest neighbours – Naive Bayes – Regression models – Linear regression – Other regression algorithms

UNIT V TEXT MINING 9

Motivation for text mining – A predictive modelling approach to text mining – Structured vs. unstructured data – Why text mining is hard – Data preparation steps – Text mining features – Modeling with text mining features – Regular expressions – case studies: Survey analysis

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Dean Abbott, "Applied Predictive Analytics-Principles and Techniques for the Professional Data Analyst", 1st edition, Wiley publications, 2014
2. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, 3rd edition, Elsevier, 2012

REFERENCES:

1. Conrad Carlberg, "Predictive Analytics: Microsoft Excel", 1st edition, Que Publishing, 2012.
2. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", 1st edition, Wiley publications, 2014
3. Anasse Bari, Mohammad Chaouchi, Tommy Jung, "Predictive Analytics for Dummies, 2nd edition, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

		Category: PEC				
U21ADP07	**TIME SERIES ANALYSIS AND FORECASTING**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To equip students with various forecasting techniques
- To impart knowledge on modern statistical methods for analyzing time series data.

COURSE OUTCOMES:

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

CO1: Describe the concept of forecasting and regression analysis (Understand)

CO2: Illustrate multiple linear regression models (Understand)

CO3: Describe Time series regression and its features (Understand)

CO4: Classify non seasonal modeling techniques and forecasting (Understand)

CO5: Illustrate Box Jenkins Methods (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	P6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	-	1	1
CO2	3	2	2	1	-	-	-	-	-	-	-	-	1	1
CO3	3	2	2	1	-	-	-	-	-	-	-	-	1	1
CO4	3	2	2	1	-	-	-	-	-	-	-	-	1	1
CO5	3	2	2	1	-	-	-	-	-	-	-	-	1	1
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO FORECASTING **9**

Forecasting and data – Forecasting methods – Errors in forecasting – Choosing a forecasting technique – An overview of quantitative forecasting techniques – Regression analysis: The simple linear regression model – The least squares point estimates – Point estimates and point predictions – Model assumptions and the standard error – Testing the significance of the slope and y intercept

UNIT II MULTIPLE LINEAR REGRESSIONS **9**

The linear regression model – The least squares estimates and point estimation and prediction – The mean square error and the standard error – Model utility: R2, Adjusted R2, and the overall F test – Model building and residual analysis: Model building and the effects of multicollinearity – Residual analysis in simple regression – Residual analysis in multiple regression – Diagnostics for detecting outlying and influential observations

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UNIT III TIME SERIES REGRESSION 9

Modelling trend by using polynomial functions – Detecting autocorrelation – Types of seasonal variation – Modelling seasonal variation by using dummy variables and trigonometric functions – Growth curves – Handling first-order autocorrelation – Decomposition methods: Multiplicative decomposition – Additive decomposition

UNIT IV NON-SEASONAL BOX-JENKINS MODELLING AND THEIR TENTATIVE IDENTIFICATION 9

Stationary and nonstationary time series – The sample autocorrelation and partial autocorrelation functions: The SAC and SPAC – An introduction to non-seasonal modelling and forecasting – Tentative identification of non-seasonal box-jenkins models – Estimation, diagnostic checking, and forecasting for non-seasonal box-jenkins models: Estimation – Diagnostic checking – Forecasting – A case study – Box-jenkins implementation of exponential smoothing

UNIT V BOX-JENKINS METHODS 9

Transforming a seasonal time series into a stationary time series – Examples of seasonal modelling and forecasting – Box-jenkins error term models in time series regression – Advanced box-jenkins modelling: The general seasonal model and guidelines for tentative identification – Intervention models

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods
Total: 45 Periods

TEXT BOOKS:

1. Bruce L. Bowerman, Richard O'Connell, Anne Koehler, "Forecasting, Time Series, and Regression", 4th edition, Cengage Unlimited Publishers
2. Enders W, "Applied Econometric Time Series", John Wiley & Sons, Inc., 1995

REFERENCES:

1. Mills, T.C., "The Econometric Modelling of Financial Time Series", Cambridge University Press, 1999
2. Andrew C. Harvey, "Time Series Models", Harvester wheatsheaf, 1993
3. P. J. Brockwell, R. A. Davis, "Introduction to Time Series and Forecasting", Springer, 1996
4. Cryer, Jonathan D. Chan, Kung-sik, "Time series analysis: with applications in R", Springer, 2008

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL I (DATA SCIENCE)

		Category: PCC				
U21ADP08	HEALTH CARE ANALYTICS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To Understand the health data formats, health care policy and standards
- To Learn the significance and need of data analysis and data visualization
- To Understand the health data management frameworks
- To Learn the use of machine learning and deep learning algorithms in healthcare
- To Apply healthcare analytics for critical care applications

COURSE OUTCOMES:

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

CO1: Describe the basics of health care analytics (Understand)

CO2: Illustrate the machine learning fundamentals required for health care data analysis (Understand)

CO3: Illustrate the health care data management using IoT and associated techniques (Understand)

CO4: Describe the role of deep learning in health care analytics (Apply)

CO5: Discuss real time applications in health care analytics (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	3	-	-	-	-	-	-	-	3	3
CO2	3	3	3	-	3	-	-	-	-	-	-	-	3	3
CO3	2	2	2	-	3	-	-	-	-	-	-	-	3	3
CO4	2	2	2	-	3	-	-	-	-	-	-	-	3	3
CO5	2	2	2	-	3	-	-	-	-	-	-	-	3	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO HEALTHCARE ANALYTICS 9

Overview – History of healthcare analysis parameters on medical care systems – Health care policy – Standardized code sets — Data formats — Machine Learning foundations: Tree like reasoning, Probabilistic reasoning and Bayes Theorem, Weighted sum approach

UNIT II ANALYTICS ON MACHINE LEARNING 9

Machine learning pipeline – Pre-processing – Visualization – Feature selection – Training model parameter – Evaluation model: Sensitivity, Specificity, PPV, NPV, FPR, Accuracy, ROC,

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Precision recall curves, Valued target variables – Python: Variables and types, Data structures and containers, Pandas data frame: Operations – Scikit Learn: Pre-processing, Feature selection

UNIT III HEALTH CARE MANAGEMENT 9

IOT- Smart sensors – Migration of healthcare relational database to NoSQL cloud database – Decision support system – Matrix block cipher system – Semantic framework analysis – Histogram bin shifting and RC6 encryption – Clinical prediction models – Visual analytics for healthcare

UNIT IV HEALTHCARE AND DEEP LEARNING 9

Introduction on deep learning – DFF network CNN – RNN for sequences – Biomedical image and signal analysis – Natural Language Processing and Data mining for clinical data – Mobile imaging and analytics – Clinical decision support system

UNIT V CASE STUDIES 9

Predicting mortality for cardiology practice – Smart ambulance system using IOT – Hospital acquired conditions (HAC) program – Healthcare and emerging technologies – ECG Data analysis

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Vikas Kumar, "Health Care Analytics Made Simple", 1st edition, Packt Publishing, 2018
2. Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatt, "Health Care Data Analysis and Management", 1st edition, Academic Press, 2018

REFERENCES:

1. Hui Jang, Eva K.Lee, "HealthCare Analysis: From Data to Knowledge to Healthcare Improvement", 1st edition, Wiley, 2016
2. Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, "Big Data Analytics in HealthCare", 1st edition, Springer, 2020

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

U21AMP01	KNOWLEDGE ENGINEERING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basics of Knowledge Engineering methodologies and Development
- To design and develop ontologies
- To apply reasoning with ontologies and rules
- To understand learning and rule learning

COURSE OUTCOMES:

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

CO1: Understand the basics of knowledge engineering (Understand)

CO2: Apply methodologies and modelling for agent design and development (Apply)

CO3: Design and develop ontologies (Apply)

CO4: Apply reasoning with ontologies and rules (Apply)

CO5: Differentiate the learning and rule learning in knowledge engineering (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	1	2	3
CO2	3	2	3	2	1	-	-	-	1	1	-	1	2	3
CO3	3	2	3	2	2	-	-	-	1	1	-	1	2	3
CO4	3	2	3	1	1	-	-	-	1	1	-	1	2	3
CO5	3	2	2	1	1	-	-	-	1	1	-	1	2	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I REASONING UNDER UNCERTAINTY **9**

Introduction to reasoning – 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 – Knowledge graphs

UNIT II METHODOLOGY AND MODELING **9**

Conventional design and development – Development tools and reusable ontologies – Agent design and development using learning technology – Problem solving through analysis and synthesis – Inquiry-driven analysis and synthesis – Evidence-based assessment – Believability assessment – Drill-down analysis, Assumption-based reasoning, and What-if scenarios

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UNIT III ONTOLOGIES – DESIGN AND DEVELOPMENT 9

Concepts and instances – Generalization hierarchies – Object features – Defining features – Representation – Transitivity – Inheritance – Concepts as feature values – Ontology matching – Design and development methodologies – Steps in ontology development – Domain understanding and concept elicitation – Modelling-based ontology specification

UNIT IV REASONING WITH ONTOLOGIES AND RULES 9

Production system architecture – Complex ontology – Based concepts – Reduction and synthesis rules and the inference engine – Evidence-based hypothesis analysis – Rule and ontology matching – Partially learned knowledge – Reasoning with partially learned knowledge

UNIT V LEARNING AND RULE LEARNING 9

Machine learning concepts – Generalization and specialization rules, Types – Formal definition of generalization – Modelling, learning and problem solving – Rule learning and refinement – Rule generation and analysis – Hypothesis learning

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum," Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning", 1st edition, Cambridge University Press, 2016
2. Ela Kumar," Knowledge Engineering", 1st edition, I.K.International Publisher House, 2018

REFERENCES:

1. Ronald J. Brachman, Hector J. Levesque, "Knowledge Representation and Reasoning", 1st edition, Morgan Kaufmann, 2004
2. John F. Sowa, "Knowledge Representation: Logical, Philosophical, and Computational Foundations", 1st edition, Thomson Learning, 2000
3. King, "Knowledge Management and Organizational Learning", 1st edition Springer,2009
4. Jay Liebowitz, "Knowledge Management Learning from Knowledge Engineering," 1st edition, CRC Press,2001

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

		Category: PEC				
U21AMP02	**SOFT COMPUTING**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the concepts of neural networks and advanced neural networks
- To understand the fundamentals of fuzzy sets and fuzzy logic
- To establish basic knowledge about optimization techniques in soft computing
- To choose appropriate genetic operators for use in a genetic algorithm.

COURSE OUTCOMES:

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

CO1: Understand the basic concepts of soft computing (Understand)

CO2: Explain the concepts of Artificial Neural Networks and its architecture (Understand)

CO3: Classify the fundamentals of fuzzy sets and fuzzy logic (Understand)

CO4: Implement the various evolutionary computing algorithms (Apply)

CO5: Apply ANN, genetic algorithm, and fuzzy logic for engineering problems (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	1	2
CO2	3	2	1	1	-	-	-	-	1	-	-	1	1	2
CO3	3	2	1	1	-	-	-	-	1	-	-	1	1	2
CO4	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO5	3	2	2	1	1	-	-	-	1	1	-	1	1	3
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO NEURAL NETWORKS **9**

Introduction – Artificial Intelligence – Artificial Neural Networks (ANN) – History, Mathematical model of a neuron, ANN architectures, Learning rules – Paradigms – Perceptron network – Backpropagation network, Backpropagation learning and its applications

UNIT II ADVANCED NEURAL NETWORKS **9**

Backpropagation Neural Networks – Associative memory: Autocorrelation, Hetero correlation, Exponential BAM – Applications – Adaptive Resonance Theory: Vector quantization, ART1, ART2, Applications

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UNIT III FUZZY SETS AND RELATIONS 9

Introduction – Uncertainty and imprecision – Chance vs ambiguity – Fuzzy sets – Fuzzy relations – Membership functions – Properties of membership functions – Fuzzification and defuzzification – Classical logic and Fuzzy logic – Fuzzy rule-based systems – Fuzzy decision making – Fuzzy classification

UNIT IV GENETIC ALGORITHMS 9

Introduction to evolutionary computation: Biological and artificial evolution – Evolutionary computation – Simple genetic algorithm – Search operators: Crossover, Mutation, Crossover and Mutation Rates – Selection schemes: Fitness proportional selection and Fitness scaling – Ranking – Tournament selection – Selection pressure and its impact on evolutionary search.

UNIT V HYBRID SYSTEMS 9

Hybrid systems – Optimization and decision support techniques – Swarm intelligence – Ant colony optimization – Particle swarm optimization – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", 1st edition, PHI Learning Pvt. Ltd., 2017
2. Sivanandam S.N., Deepa S.N., "Principles of Soft Computing", 1st edition, Wiley India Pvt. Ltd., 2012

REFERENCES:

1. Jang J.S.R., Sun C.T. and Mizutani E., "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", 1st edition, PHI Learning Private Limited, New Delhi, 2014
2. K. Sundareswaran, "A Learner's Guide to Fuzzy Logic Systems", 1st edition, Jaico Publishing House, 2006
3. Padhy N.P, "Artificial Intelligence and Intelligent System, 1st edition, Oxford University Press, 2005

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

		Category: PEC				
U21AMP03	DEEP NEURAL NETWORKS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature-based alignment and motion estimation
- To develop skills on 3D reconstruction and image-based rendering, recognition

COURSE OUTCOMES:

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

CO1: Understand the basic concepts of soft computing (Understand)

CO2: Implement the various image processing techniques (Apply)

CO3: Apply feature-based based image alignment, segmentation, and motion estimations (Apply)

CO4: Interpret 3D image reconstruction techniques (Apply)

CO5: Develop innovative image processing and computer vision applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	1	2
CO2	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO3	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO4	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO5	3	2	2	2	1	-	-	-	1	1	-	1	1	3
Correlation levels:		1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)							

SYLLABUS:

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Introduction to artificial intelligence, Machine learning, Deep learning – Neural networks – Basics of CNN architecture: Convolution, Pooling, Activation functions – Convolutional layers: Filters, Strides, Padding – Pooling layers: Max pooling, Average pooling – Activation functions: ReLU, Sigmoid, Tanh – Loss Functions – Backpropagation in CNNs

UNIT II CNN ARCHITECTURES AND MEMORY COMPUTATION 9

Popular CNN architectures: LeNet, AlexNet, VGGNet, GoogLeNet, ResNet – Understanding memory computation in CNNs: Parameter sharing, Weight sharing, Receptive fields – Calculating the number of parameters in CNNs – Trade-offs between model complexity and memory requirements – Efficient architectures for memory – Constrained environments

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UNIT III TRAINING AND FINE-TUNING IN CNN 9

Loss functions for classification tasks: Cross-entropy loss, Softmax activation – Optimization algorithms: Stochastic Gradient Descent (SGD), Adam, RMSprop – Regularization techniques: Dropout, Weight decay – Transfer learning and fine-tuning: Using pretrained models, Freezing layers, Adapting to new tasks

UNIT IV EVALUATION PARAMETERS OF CNN 9

Performance evaluation metrics for classification tasks: Accuracy, Precision, Recall, F1 score – Confusion matrix and its interpretation – Receiver Operating Characteristic (ROC) curve and Area Under the Curve (AUC) – Evaluation metrics for object detection and localization tasks: Intersection over Union (IoU), Mean Average Precision – Handling class imbalance – Evaluation challenges

UNIT V ADVANCED CNN ARCHITECTURES 9

Convolutional layers with different receptive field sizes: Dilated convolutions, Atrous convolutions – Attention mechanisms in CNNs: Self-attention, Spatial attention – Advanced CNN architectures for specific tasks: Semantic segmentation, Instance segmentation and Image captioning

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Charu C. Aggarwal, "Neural Networks and Deep Learning A Textbook", 1st edition, Springer International Publishing, 2018.
2. Hasmik Osipyan, Bosede Iyiade Edwards, Adrian David Cheok, "Deep Neural Network Applications", 1st edition, CRC Press, 2022.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", 1st edition, MIT Press, 2016

REFERENCES:

1. Katy Warr, "Strengthening Deep Neural Networks Making AI Less Susceptible to Adversarial Trickery", 1st edition, O'Reilly Media, 2019.
2. Information Resources Management Association, "Deep Learning and Neural Networks: Concepts, Methodologies, Tools, and Applications", 1st edition, IGI Global, 2020.
3. Aston Zhang, Zack C. Lipton, Mu Li, and Alex J. Smola, "Dive into Deep Learning", 1st edition, Cambridge University Press, 2023
4. Coursera Course: https://www.coursera.org/learn/neural-networks-deep-learning

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

		Category: PEC				
U21AMP04	REINFORCEMENT LEARNING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- Affords foundational ideas on modern reinforcement learning
- Develop an instinctive understanding on reinforcement learning
- Implementation and testing of complete decision-making systems

COURSE OUTCOMES:

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

CO1: Explain the knowledge of machine learning in reinforcement learning (Apply)

CO2: Classify the MDP models in reinforcement learning (Understand)

CO3: Experiment the value of a state or an action when similar circumstances occur (Apply)

CO4: Evaluate artificial neural networks that helps software agents to reach goals (Apply)

CO5: Examine the hierarchical reinforcement learning techniques. (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	1	2
CO2	3	2	2	2	1	-	-	-	1	1	-	1	1	3
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CO4	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO5	3	2	1	1	-	-	-	-	1	-	-	-	1	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO REINFORCEMENT LEARNING **9**

Introduction to Reinforcement Learning (RL) – RL framework and application – Immediate Reinforcement Learning – Bandit algorithm: Introduction, Upper Confidence Bound (UCB), PAC algorithm, Bandit optimality – Value function – Based method – Policy gradient

UNIT II MDP MODELS **9**

Full RL introduction – Return, Values function – Introduction to MDP model – Bellman equation – Optimization of bellman equation – Cauchy sequence and green equation – Banach fixed point theorem – Convergence proof

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UNIT III FUNCTION APPROXIMATION 9

Approximation – Value prediction and control – Gradient Descent methods – Linear methods – Control with Function Approximation – Artificial Neural Network-based approximation – DQN and Fitted Q iterations – Policy Gradient Approach – Policy Gradient approach with function approximation

UNIT IV DEEP REINFORCEMENT LEARNING 9

Dynamic Programming – Monte Carlo – Components – Control in Monte Carlo – LPI convergence, Value iteration, Policy iteration – QLearning – QLearning with deep networks – Double QLearning – Replay memory – Deep Neural Network Architectures for RL

UNIT V HIERARCHICAL REINFORCEMENT LEARNING 9

Hierarchical reinforcement learning – Types of optimality – Semi MDP model – Options – Learning with options – Hierarchical abstract machines – Partially observable markov decision process

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd edition, The MIT Press, 2020
2. CsabaSzepesvári, "Algorithms for Reinforcement Learning", 1st edition, Morgan & Claypool, 2013

REFERENCES:

1. Kevin Murphy, "Machine Learning - A Probabilistic Perspective", 1st edition, MIT press, 2012
2. Christopher Bishop, "Pattern Recognition and Machine Learning", 1st edition, Springer, 2006

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

		Category: PEC				
U21AMP05	COMPUTER VISION	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing
- To learn feature detection, matching, and detection
- To become familiar with feature-based alignment and motion estimation
- To develop skills in 3D reconstruction and image-based rendering, recognition

COURSE OUTCOMES:

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

CO1: Understand the basic concepts of computer vision in image processing. (Understand)

CO2: Implement various image enhancement and filtering techniques. (Apply)

CO3: Apply feature-based based image alignment, segmentation, and motion estimations. (Apply)

CO4: Execute feature extraction and its matching techniques. (Apply)

CO5: Develop innovative image processing and computer vision applications. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	1	-	-	-	1	2
CO2	3	2	2	2	2	-	-	-	1	1	-	1	1	3
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CO4	3	2	2	2	3	-	-	-	1	1	-	1	1	3
CO5	3	2	2	2	3	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION TO COMPUTER VISION 9

Overview of computer vision – Applications – Image representation – Digital image fundamentals – Image formation and acquisition – Image processing techniques for computer vision – Introduction to image processing libraries – OpenCV

UNIT II IMAGE ENHANCEMENT AND FILTERING 9

Introduction to image enhancement techniques – Histogram equalization, Contrast stretching – Spatial domain filtering – Mean filter, Median filter – Frequency domain filtering – Fourier Transform, High pass filter, Low pass filter – Image denoising techniques – Gaussian filtering, Bilateral filtering

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UNIT III IMAGE SEGMENTATION AND OBJECT DETECTION 9

Introduction – Image segmentation algorithms – Thresholding, region-based segmentation – Edge detection techniques – Sobel, Canny – Contour detection and object representation – Introduction to object detection algorithms – Haar cascades, SSD, YOLO

UNIT IV HANDCRAFTED FEATURE EXTRACTION TECHNIQUES 9

Introduction – Feature Extraction – Feature extraction techniques – SIFT, SURF, ORB – Local feature descriptors – HoG, LBP – Feature matching algorithms – Brute-force matching, FLANN – Feature tracking and optical flow

UNIT V DEEP LEARNING FOR COMPUTER VISION 9

Introduction to deep learning and neural networks – Convolutional Neural Networks (CNNs) for image classification – Transfer learning and pre-trained models – Object detection using CNNs - Faster R-CNN, SSD – Semantic segmentation using CNNs - FCN, U-Net – Familiarity with popular libraries such as OpenCV and PyTorch

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd edition, Springer- Texts in Computer Science, 2022
2. D. A. Forsyth, J. Ponce,"Computer Vision: A Modern Approach", 2nd edition, Pearson Education, 2015
3. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3rd edition, Pearson Education, 2017

REFERENCES:

1. E.R.Davies, "Computer and Machine Vision", 4th edition, Academic Press, 2012
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st edition, Springer, 2006
3. Richard Hartley,Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd edition, Cambridge University Press,2004
4. Adrian Kaehler, Gary Bradski, "Learning OpenCV 4: Computer Vision with Python", 3rd edition, O'Reilly Media ,2019
5. Adrian Rosebrock, "Deep Learning for Computer Vision with Python",1st edition, Pyimage Search, 2020

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

		Category: PEC				
U21AMP06	FEATURE ENGINEERING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of feature engineering principles.
- To ensure data quality by scaling, normalizing, and transforming raw data before using it in a machine learning model.
- To understand the techniques, and applications, equipping with the skills to effectively preprocess and engineer features for machine learning tasks.

COURSE OUTCOMES:

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

CO1: Understand the basic concepts of feature engineering. (Understand)

CO2: Learn techniques for handling the missing data (Understand)

CO3: Describe feature creation and transformation in feature engineering (Understand)

CO4: Execute the anomaly detection and outlier detection (Apply)

CO5: Implement feature selection and dimensionality reduction using feature engineering (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	1	2
CO2	3	2	2	2	1	-	-	-	1	1	-	1	1	2
CO3	3	2	1	1	-	-	-	-	1	-	-	-	1	2
CO4	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO5	3	2	2	2	1	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION TO FEATURE ENGINEERING 9

Overview of feature engineering – Importance in machine learning – Types of features: Numerical, Categorical, Text – Feature representation and feature vectors – Evaluation metrics for feature engineering

UNIT II DATA PREPROCESSING AND HANDLING MISSING DATA 9

Introduction to data preprocessing – Techniques for handling missing data: Deletion, Imputation, Interpolation – Strategies for dealing with different types of missing data – Handling noisy data: Smoothing filters, Denoising algorithms – Data scaling and normalization techniques

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UNIT III FEATURE CREATION AND TRANSFORMATION 9

Polynomial features and interaction terms – Binning and discretization techniques – Feature hashing and feature embedding – Logarithmic, Exponential, Power transformations

UNIT IV ANOMALY DETECTION AND OUTLIER DETECTION 9

Introduction to anomaly detection and outlier detection – Statistical methods for anomaly detection: Z-score, Mahalanobis distance – Density-based methods: Local Outlier Factor (LOF), Isolation Forest One-class SVM for outlier detection – Deep feature extraction: Visual Geometry Group (VGG), Residual Networks (ResNet)

UNIT V FEATURE SELECTION AND DIMENSIONALITY REDUCTION 9

Univariate feature selection methods: Chi-square test, ANOVA – Recursive Feature Elimination (RFE) – Feature importance using ensemble methods (e.g., Random Forest, XGBoost) – Principal Component Analysis (PCA) for dimensionality reduction

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Sinan Ozdemir, "Feature Engineering Bookcamp", 1st edition Manning Publications, 2022
2. Alice Zheng and Amanda Casari, "Feature Engineering for Machine Learning: Principles and Techniques", 1st edition, O'Reilly Media, 2018

REFERENCES:

1. Alice Zheng and Amanda Casari, "Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists", 1st edition, O'Reilly Media, 2018
2. Sinan Ozdemir and Divya Susarla, "Feature Engineering Made Easy: Identify Unique Features from Your Dataset in Just 30 Minutes", 1st edition, Packt Publishing, 2018
3. Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, "Introduction to Statistical Learning: With Applications in R", 1st edition, Springer,2013

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

		Category: ESC				
U21AMP07	OBJECT DETECTION & FACE RECOGNITION	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basics of image processing techniques for computer vision
- To learn the techniques used for image pre-processing
- To discuss the various object detection techniques
- To understand the various face recognition mechanisms

COURSE OUTCOMES:

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

CO1: Understand the basics of image processing techniques for computer vision. (Understand)

CO2: Explain the techniques used for image pre-processing. (Understand)

CO3: Develop various object detection techniques. (Apply)

CO4: Apply various face recognition mechanisms. (Apply)

CO5: Implement algorithms for object detection and face recognition. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	1	2
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CO3	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO4	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO5	3	2	2	2	1	-	-	-	1	1	-	1	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION TO OBJECT DETECTION **9**

Computer Vision – Image representation and image analysis tasks – Image representations – digitization – properties – color images – Data structures for Image Analysis - Local pre-processing – Image smoothing – Edge detectors – Canny edge detection – Line detection by local pre-processing operators – Image restoration- Evaluation metrics for object detection systems

UNIT II ONE-STAGE & TWO STAGE DETECTORS **9**

Introduction to one – stage object detectors (e.g., YOLO, SSD) – Single shot detection strategies for object localization and classification – Design principles and network architectures – Implementation and optimization techniques – Introduction to two-stage object detectors – RCNN, Fast RCNN, Faster RCNN) – Region proposal methods for generating candidate object regions

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UNIT III REGION-BASED CNN, FAST R-CNN & FASTER R-CNN 9

R-CNN architecture for object detection – Selective search algorithm for region proposals – Feature extraction using CNN – Training and inference processes of R-CNN – Fast R-CNN architecture: RoI pooling, Shared convolutional layers – Study of faster R-CNN framework – Region Proposal Network (RPN) for efficient region proposal generation – End to end training and inference in Faster R-CNN

UNIT IV FACE & FACIAL EXPRESSION RECOGNITION 9

Introduction – Face Recognition and challenges – Face detection using Haar cascades – Face alignment and normalization – Face representation using deep learning (e.g., FaceNet, ArcFace) facial expression recognition – Facial feature extraction methods (e.g., Geometric, Appearance-based) – Representation – Deep learning architectures for facial expression analysis – Realtime facial expression recognition and emotion detection

UNIT V BIOMETRIC RECOGNITION 9

Overview of biometric recognition- biometric modalities (e.g., face, fingerprint, iris, voice) – Challenges (e.g., variability, spoof attacks) – Biometric Verification and Identification-Evaluation metrics – Temporal Analysis in Biometrics: Handling temporal variations in biometric data – Feature extraction techniques for capturing temporal dynamics – Temporal modeling approaches

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Vaibhav Verdhan, "Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras", 1st edition, Apress, 2021
2. Joseph Howse, Prateek Joshi ,"Object Detection and Recognition Using Deep Learning in OpenCV",1st edition, Packt Publishing, 2020
3. Rafael C. Gonzalez, David A. Forsyth, and Christopher R. Dance , "Deep Learning for Object Detection and Recognition",1st edition Cambridge University Press , 2019

REFERENCES:

1. Rajalingappaa Shanmugamani , "Deep Learning for Computer Vision: Expert Techniques to train advanced neural networks using TensorFlow and Keras",1st edition Packt Publishing, 2021
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4th edition, Thomson Learning, 2014
3. E. R. Davies, "Computer & Machine Vision", 4th edition, Academic Press, 2012
4. Kelleher, John D., Tierney, Brian and Pacheco, Aoife, "Applied Machine Learning: From Classification to Object Detection Using Python", 1st edition, Springer, 2021

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL II (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

		Category: PEC				
U21AMP08	TEXT AND VISUAL ANALYTICS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce students to the fundamentals of text and visual analytics
- To provide an overview of different techniques and tools for text and visual data analysis
- To perform text and visual analytics using programming languages and software tools
- To apply text and visual analytics techniques to real-world problems

COURSE OUTCOMES:

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

CO1: Understand the principles and concepts of text and visual analytics (Understand)

CO2: Analyze text data using sentiment analysis, topic modeling, and clustering (Apply)

CO3: Evaluate the effectiveness of different text and visual analytics techniques (Apply)

CO4: Apply text and visual analytics techniques to various real-world problems (Apply)

CO5: Use programming languages and software tools for text and visual analytics (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	1	2
CO2	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO3	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO4	3	2	2	2	1	-	-	-	1	1	-	1	1	3
CO5	3	2	1	1	-	-	-	-	1	-	-	-	1	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I NATURAL LANGUAGE BASICS **9**

Foundations of natural language processing – Language Syntax and structure – Text preprocessing and wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for text representation – Bag of words model – Bag of N-Grams model – TF-IDF model

UNIT II TEXT CLASSIFICATION **9**

Vector semantics and embeddings – Word embeddings – Word2Vec model – Glove model – FastText model – Overview of deep learning models – RNN – Transformers – Overview of text summarization and Topic models

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UNIT III QUESTION ANSWERING AND DIALOGUE SYSTEMS 9

Information retrieval – IR-based question answering – Knowledge-based question answering – Language models for QA – Classic QA models – Chatbots – Design of dialogue systems – Evaluating dialogue systems

UNIT IV VISUAL ANALYTICS 9

Overview of visual analytics and its applications – Techniques for visualizing text data – Interactive visualizations for exploratory analysis – Evaluation of visual analytics models

UNIT V SENTIMENT ANALYSIS 9

Understanding sentiment analysis and its applications – Techniques for sentiment analysis: Rule-based, Machine Learning and Deep Learning – Sentiment lexicons and resources – Evaluation of sentiment analysis models

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 3rd edition, Pearson Prentice Hall, 2022
2. Nan Cao, Weiwei Cui, "Introduction to Text Visualization", 1st edition, Atlantis Press, 2016

REFERENCES:

1. Steven Struhl, "Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence", 1st edition, Kogan Page Limited, 2016
2. Bing Liu, "Sentiment Analysis: Mining Opinions, Sentiments, and Emotions", 1st edition, Cambridge University Press, 2020
3. Tamara Munzner, "Visualization Analysis and Design", 1st edition, CRC press, 2015.
4. Dan Jurafsky and James H. Martin, "Speech and Language Processing", 1st edition, Prentice Hall, 2009
5. Li Bai, Alfred Kobsa, and Jinah Park,"Visual Analytics and Interactive Technologies: Data, Text and Web Mining Applications", 1st edition, IGI Global, 2011

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

		Category: PEC				
U21CSP01	FOUNDATIONS OF CLOUD COMPUTING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the architecture and features of different cloud models
- To acquire basic knowledge on virtualization, cloud applications and cloud storage
- To learn security issues and cloud computing platforms

COURSE OUTCOMES:

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

CO1: Describe the types of cloud models and services. (Understand)

CO2: Analyze the types of virtualization techniques and Opensource Platforms. (Analyze)

CO3: Interpret the best features to move to the cloud and categorize the cloud storage types. (Apply)

CO4: Identify the cloud security concerns. (Apply)

CO5: Utilize various cloud computing platforms. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO2	3	3	1	1	3	-	-	-	-	-	-	2	-	3
CO3	3	2	1	1	3	-	-	-	-	-	-	2	-	3
CO4	3	2	1	1	-	-	-	-	-	-	-	2	-	3
CO5	3	2	1	1	3	-	-	-	-	-	-	2	-	3
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

SYLLABUS:

UNIT I CLOUD COMPUTING BASICS 9

Introduction to cloud computing – Evolution of cloud computing – Cloud types – Cloud characteristics – NIST reference cloud architecture – Architectural design challenges – Cloud computing stack – Deployment models – Service models – Benefits of cloud computing

UNIT II VIRTUALIZATION AND PLATFORMS 9

Abstraction and virtualization – Virtualization structures and mechanisms – Virtualization of CPU – Memory and I/O devices – Types of CPU virtualization – Virtualization support and disaster recovery – Cloud platforms – Features of cloud platforms – Overview of open-source platforms – Eucalyptus and OpenNebula – An Insight into OpenStack architecture and components

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UNIT III CLOUD STORAGE AND CONTAINERS 9

Introduction to cloud storage – Digital universe – Provisioning cloud storage – Unmanaged and managed cloud storage – Creating cloud storage systems – Cloud backup types and features – Cloud attached backup and solutions – Cloud storage interoperability, CDMI, OCCI – Introduction to containers – Kubernetes – Heroku and Docker containers

UNIT IV CLOUD SECURITY 9

Cloud security defense strategies – Securing the cloud & data – Distributed intrusion and anomaly detection – Data and software protection techniques – Data security in the cloud – Current state and future trends in the cloud – Cloud security risks – The cloud, Digital identity, and Data security standards – Establishing identity and presence in cloud

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – Map reduce – Google App Engine (GAE) – Programming environment for GAE – Open stack – Federation in the cloud – Four levels of federation – Federated services and applications – Future of federation – Introduction to fog computing – Introduction to edge computing

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Dac–Nhuong Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, "Cloud Computing and Virtualizaton", 2nd edition, Wiley Publishers, 2018
2. Nick, Gillam, Lee, "Cloud Computing – Principles, Systems and Applications", 2nd edition, Springer, 2017

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering the Cloud Computing", 1st edition, Morgan Kaufmann,2013
2. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation "Management, and Security", 1st edition, CRC Press, 2016
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", 1st edition, Morgan Kaufmann Publishers, 2012
4. Barrie Sosinsky, "Cloud Computing Bible", 1st edition, Wiley Publishing, 2015

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

		Category: PEC				
U21CSP02	DATA STORAGE AND MANAGEMENT IN CLOUD	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the Importance of Data and Storage
- To gain knowledge on storage services and network connectivity
- To understand the concepts of securing and managing storage infrastructure

COURSE OUTCOMES:

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

CO1: Elucidate the concepts of data storage system and network connectivity. (Understand)

CO2: Illustrate the storage services and network security ideas. (Understand)

CO3: Explain the challenges and techniques for storage security. (Understand)

CO4: Identify tools for storage management and communication. (Apply)

CO5: Analyze the concepts for securing and managing storage infrastructure. (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	2	-	2
CO2	2	1	1	1	-	-	-	-	-	-	-	2	-	3
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CO4	3	2	2	1	3	-	-	-	-	-	-	2	-	3
CO5	3	3	2	1	-	-	-	-	-	-	-	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I STORAGE SYSTEM **9**

Importance of data and storage – Business issues and it challenges – Server and storage I/O fundamentals – Virtualization and storage services – Data and storge access – Infrastructure and resource management – Data movement and migration – I/O connectivity and networking fundamentals

UNIT II STORAGE SERVICES AND NETWORK CONNECTIVITY **9**

Storage services and functionalities – Storage reliability – Availability and serviceability – Storage system architectures – Storage virtualization and virtual storage – Server virtualization – Networking challenges – Converged and unified networking – Local networking – Enabling mans and wans – Configuring networks

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UNIT III DATA STORAGE SECURITY 9

Data protection challenges – Protect, Preserve, and Serve information services – SLO and SLAS – Virtual, Physical and Cloud data protection – Modernizing data protection and Backup – Checklist – Data footprint reduction techniques – Compression and compaction – Data de–duplication – DFR and RAID configurations

UNIT IV MANAGEMENT TOOLS 9

Data management in libraries – Airtable – Google sheets– Data visualization in cloud – Tableau – Cloud tools for project management – Trello – Asana – Communication in cloud – Microsoft teams – Library management systems in cloud – FOLIO

UNIT V SECURING AND MANAGING STORAGE INFRASTRUCTURE 9

Securing the storage infrastructure framework – RISK triad – Domains – Security implementations for FC – SAN, IP SAN, and NAS environments – Security in virtualized and cloud environments Managing the storage infrastructure – Monitoring – Management activities – Challenges – Information lifecycle management – Storage tiering

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Greg Schulz, "Cloud and Virtual Data Storage Networking", 1st Edition, CRC Press, 2011
2. Kayla Kipps, Allison Kaiser Jones, "Collection Management in the Cloud, A Guide for Using Cloud Computing Technologies in Libraries", 1st Edition, 2022

REFERENCES:

1. Somasundaram Gnanasundaram, Alok Shrivastava, "Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments", 2nd edition, EMC Educations Services, Wiley, 2012
2. Robert Spalding, "Storage Networks: The Complete Reference", 1st edition, ata McGraw Hill, Osborne, 2003
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller–Friedt, Rainer Wolafka, Nils Haustei, "Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE", 2nd edition, Wiley, 2011

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

		Category: PEC				
U21CSP03	VIRTUALIZATION TECHNIQUES	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the virtualization concepts and its types
- To learn WAN 0026 VLAN architecture and its virtualization
- To acquire knowledge on virtualization technologies

COURSE OUTCOMES:

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

CO1: Illustrate a virtual machine and virtual network. (Understand)

CO2: Describe various virtual machine products. (Understand)

CO3: Perform server virtualization. (Apply)

CO4: Implement the concept of network virtualization. (Apply)

CO5: Carryout various tasks in storage virtualization. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	2	1	1	1	-	-	-	-	-	-	-	2	-	3
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CO4	3	2	2	1	3	-	-	-	-	-	-	2	-	3
CO5	3	3	2	1	-	-	-	-	-	-	-	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I VIRTUALIZATION CONCEPTS 9

System architectures – Virtual machine basics – Process virtual machines – System virtual machines – Taxonomy of virtual machines – Emulation: Basic interpretation – Binary translation – Full and para – Virtualization – Types of hypervisors – Types of virtualization

UNIT II SERVER VIRTUALIZATION 9

Server virtualization – Partitioning techniques – Hardware virtualization – Virtual hardware – Types of server virtualization – Business cases for server virtualization – Uses of virtual server consolidation – Selecting server virtualization platform

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UNIT III NETWORK VIRTUALIZATION 9

Design of scalable enterprise networks – Virtualizing the campus – WAN design – WAN architecture – WAN virtualization – Virtual enterprise transport virtualization – VLANs and scalability – Theory network device virtualization layer 2 – VFIS virtual firewall contexts

UNIT IV STORAGE VIRTUALIZATION 9

Hardware devices – SCSI – SCSI communication – Using SCSI buses – Fiber channel – Fiber channel cables – Fiber channel hardware devices – iSCSI architecture – Securing iSCSI SAN backup & recovery techniques – RAID – Classic storage model – SNIA

UNIT V APPLYING VIRTUALIZATION 9

Comparison of virtualization technologies: Shared kernel – Enterprise solutions: VMware server first edition – ESXi – Citrix XenServer – Microsoft virtual PC – Microsoft hyper V – Virtual box – Case study: Migration to open–source based messaging service (Exim, Dovecot and SOGo)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", 2nd edition, Elsevier/Morgan Kaufmann Publishers, 2015
2. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", 2nd edition, Berkeley, Apress, 2016
3. Gerardus Blokdyk, "Virtualization Technology - A Complete Guide",1st edition, Emer, 2020

REFERENCES:

1. William von Hagen, "Professional Xen Virtualization", 1st edition, Wrox Publications, 2014
2. Matthew Portnoy, "Virtualization Essentials", 2nd edition, Wiley, 2015
3. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", 6th edition, Addison–Wesley, Publications, 2012

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

31.1.24

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

		Category: PEC				
U21CSP04	SECURITY AND PRIVACY IN CLOUD	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the virtualization concepts and its types
- To learn WAN 0026 VLAN architecture and its virtualization
- To acquire knowledge on virtualization technologies

COURSE OUTCOMES:

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

CO1: Illustrate a virtual machine and virtual network. (Understand)

CO2: Describe various virtual machine products. (Understand)

CO3: Perform server virtualization. (Apply)

CO4: Implement the concept of network virtualization. (Apply)

CO5: Carryout various tasks in storage virtualization. (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I CLOUD COMPUTING, SECURITY AND PRIVACY FOUNDATIONS **9**

Cloud computing services – Deployment models – Cloud security goals – Concepts – Security standards – NIST cloud reference model – Cloud security issues – Security requirements for privacy – Privacy issues in cloud – Key privacy concerns

UNIT II THREAT MODEL AND SECURITY TECHNIQUES **9**

Threat model – Attack types – Taxonomy of attacks – Intrusion detection – Classification– Intrusion detection techniques – Attack tools – Security tools – Virtual machine introspection – Hypervisor introspection – Threat model in containerized environment

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UNIT III CLOUD INFRASTRUCTURE MANAGEMENT AND SECURITY 9

Data asset management – Tagging cloud resources – Protecting data in cloud – Cloud asset types – Asset management pipeline – Procurement leaks – Identity and access management – Lifecycle – Authentication – Authorization – Revalidate

UNIT IV VULNERABILITY MANAGEMENT AND NETWORK SECURITY 9

Vulnerable areas – Finding and fixing vulnerabilities – Agentless, Agent-based configuration management – Vulnerability management metrics – Network security features – VPCS – Address translation – Encryption in motion – Firewalls and network segmentation – Administrative access

UNIT V STRATEGIES AND PRACTICES 9

strategies and best practices security controls – Limits, Best practices, Monitoring security criteria – Assessing risk factors in clouds – SAAS, PAAS, IAAS availability management security as a service – Trust management for security – Governance and administration patterns

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Preeti Mishra, Emmanuel S Pilli, RC Joshi, "Cloud Security - Attacks, Techniques, Tools, and Challenges", 1st Edition, CRC Press, 2022
2. Chris Dotson, "Practical Cloud Security – A Guide for Secure Design and Deployment", 1st Edition, Oreilly, 2019

REFERENCES:

1. Vic (J.R.) Winkler, "Securing the Cloud: Cloud Computer Security Techniques and Tactics", 1st edition, Elsevier, 2011
2. Riyan Ko, Kim Kwang Raymond Choo, "The Cloud Security Ecosystem, Technical, Legal, Business and Management Issues", 1st edition, Elsevier, 2015
3. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy", 1st edition, Oreilly, 2009

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

		Category: PEC				
U21CS05	DATA ANALYSIS IN CLOUD COMPUTING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basic concepts of data mining
- To acquire basic knowledge on cloud-based data analysis, scalable data analytics
- To learn security of sensitive data in cloud and research trends

COURSE OUTCOMES:

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

CO1: Describe the basic concepts of data mining. (Understand)

CO2: Examine the techniques for cloud-based data analysis. (Apply)

CO3: Utilize the idea of scalable data analytics. (Apply)

CO4: Integrate the concept of securing sensitive data in cloud. (Apply)

CO5: Employ various research trends related to data analytics in cloud. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	-	-	-	2	-	2
CO2	3	2	1	1	3	-	-	-	-	-	-	2	-	3
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CO4	3	2	2	1	1	-	-	-	-	-	-	2	-	3
CO5	3	2	2	1	3	-	-	-	-	-	-	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I DATA MINING 9

Data Mining Concepts – Classification – Clustering–Association Rules – Parallel and Distributed Data Mining – machine Learning Approach to Data Analysis – Data Formats – Data Cleaning – Data Visualization – Problem Solving Approach

UNIT II CLOUD BASED DATA ANALYSIS 9

Mathematical and Parallel Techniques – MapReduce for Data Analysis – MapReduce Paradigm – MapReduce Frameworks – MapReduce Algorithms and Applications – Data Analysis Workflows – Work Flow Programming – Work Flow Management System – Work Flow Management System for Cloud – NoSQL Models for Data Analysis

21.1.22

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UNIT III SCALABLE DATA ANALYTICS 9

Data Analysis System for Clouds – Amazon Athena – Amazon FinSpace – Swift – Spark – BigML – Mahout– Microsoft Azure Machine Learning – Design of Scalable Data Analysis Framework in Cloud – Workflow based Data Analysis

UNIT IV SECURITY OF SENSITIVE DATA IN CLOUD 9

Data in Cloud – Data Lie Cycle – Security Challenges in Cloud Computing for Data – Protection of Data – Tighter IAM Controls – Classical Cryptography for Cloud Computing – Homomorphic Crypto System

UNIT V RESEARCH TRENDS 9

Data – Intensive Exascale Computing – Massive Social Network Analysis – Key Research Areas – Data Analysis Case Studies – Trajectory Mining Workflow using VL4Cloud – Ensemble Learning workflow using JS4 Cloud – Parallel Classification using Swift

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Domenico Talia, Paolo Trunfio, Fabrizio Marozzo, "Data Analysis in the cloud, Models, Techniques and Applications", 1st edition, Elsevier, 2016.
2. Sachi Nandhan Mohanty, Jyotir Moy Chtterjee, Monika mangla, Suneetha Sathpathy, Sirisha Potluri, "Machine Learning Approach for Cloud Data Analytics in IoT",1st edition, Wiley, 2021

REFERENCES:

1. Nick, Gillam, Lee, "Cloud Computing – Principles, Systems and Applications", 2nd edition, Springer, 2017
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering the Cloud Computing", 1st edition,Morgan Kaufmann, 2013
3. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation "Management, and Security", 1st edition,CRC Press, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
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40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

		Category: PEC				
U21CSP06	EDGE COMPUTING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge on Cloud Computing and enabling technologies.
- To explore the need for Edge Computation.
- To impart the knowledge to log the sensor data and to perform further data analytics.

COURSE OUTCOMES:

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

CO1: Illustrate the principles and architectures of fog computing. (Understand)

CO2: Interpret the communication and management of edge computing. (Understand)

CO3: Analyze the storage and computation of fog. (Analyze)

CO4: Examine the performance of the applications developed using fog architecture. (Apply)

CO5: Identify the security and privacy issues of edge computing. (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I EDGE COMPUTING PARADIGMS 9

Introduction to Edge Computing scenarios and Use cases Eg. Healthcare – Edge Computing hardware and architectures – Edge platforms, Edge vs Fog Computing, Communication Models – Edge, Fog and M2M Fog and Edge Computing completing the cloud – Hierarchy of Fog and Edge computing – Business models – Opportunities and challenges

UNIT II CHALLENGES IN FEDERATING EDGE RESOURCES 9

Introduction – Methodology – Integrated C2F2T Literature by modeling technique – Integrated C2F2T Literature by Use–case Scenarios – Integrated C2F2T Literature by metrics – Resources –

deployment of edge nodes, public usability of edge nodes, Modelling – mobility modeling, Network resource modeling

UNIT III MANAGEMENT OF NETWORK 9

Introduction – Background – Network slicing – Network slicing in software – Defined Clouds – Network slicing management in Edge – Internet of Vehicles: Architecture, Protocol and Security – Seven layered model architecture for the Internet of Vehicles – IoV: Network models, challenges and future aspects.

UNIT IV MIDDLEWARE FOR EDGE COMPUTING: DESIGN ISSUES 9

Need for Edge Computing Middleware – Design Goals – State–of–the–Art Middleware Infrastructures – System Model – Middleware for Edge Cloud Architecture – Data Management for Fog Computing – Predictive analysis to support Fog Application Deployment.

UNIT V APPLICATIONS AND ISSUES 9

Exploiting Fog Computing in Health Monitoring – Surveillance Video Stream Processing at the Edge for Real–Time Human Objects Tracking – Fog Computing Model for Evolving Smart Transportation Applications – Testing Perspectives of Fog – Based IoT Applications – Legal Aspects of Operating IoT Applications in the Fog

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Buyya, Rajkumar, and Satish Narayana Srirama, eds, "Fog and edge computing: principles and paradigms", 1st Edition, John Wiley & Sons, 2019. John Mutumba
2. Bilay, Peter Gutsche, Mandy Krimmel and Volker Stiehl, "SAP Cloud Platform Integration: The Comprehensive Guide", 2nd Edition, Rheinwerg publishing, 2019

REFERENCES:

1. Bahga, Arshdeep, and Vijay Madisetti. Cloud computing: A hands–on approach, 1st edition, CreateSpace Independent Publishing Platform, 2013
2. Ovidiu Vermesan, Peter Friess, "Internet of Things – From Research and Innovation to Market Deployment", 1st edition, River Publishers, 2014
3. Michael Missbach, Thorsten Staerk, Cameron Gardiner, Joshua McCloud, Robert Madl, Mark Tempes, George Anderson, "SAP on Cloud", 1st edition, Springer, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

U21CSP07	CLOUD SERVICE MANAGEMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge on cloud Enabling Technologies and Architecture
- To learn Cloud Service Models
- To understand Resource Management and Security Management

COURSE OUTCOMES:

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

CO1: Describe the cloud enabling technologies and architecture. (Understand)

CO2: Outline the concepts related to Infrastructure as a Service Management. (Understand)

CO3: Utilize Platform as a Service models and its management. (Apply)

CO4: Analyze the working model of Software as a Service Model and its service providers. (Analyze)

CO5: Examine the cloud security management and administrative techniques. (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	-	-	-	2	-	2
CO2	2	1	1	1	1	-	-	-	-	-	-	2	-	2
CO3	3	2	2	2	2	-	-	-	-	-	-	2	-	3
CO4	3	3	3	2	2	-	-	-	-	-	-	2	-	3
CO5	3	3	2	2	2	-	-	-	-	-	-	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I CLOUD ENABLING TECHNOLOGIES AND ARCHITECTURE **9**

Cloud Enabling Technologies – Cloud Fundamentals – Architecture – Applications – Deployment Models – Service Models – Scalability – Virtualization – Issues – architectures – Internals of Virtual Machine Monitors/Hypervisors – Interfaces for Virtualization Management

UNIT II INFRASTRUCTURE AS A SERVICE MANAGEMENT **9**

Infrastructure as a Service – Cloud Native Infrastructure–Applications – Designing Infrastructure Applications– Testing Cloud Native Infrastructure – Managing Cloud native Applications – Implementing Cloud Native Infrastructure

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UNIT III PLATFORM AS A SERVICE MANAGEMENT 9

Platform as a Service (PaaS) – Common Features – On–Premises PaaS – Development WorkFlow – Architecture – Automated Testing – Creating Sample and Advanced Applications– PaaS Providers – PaaS Software Tools

UNIT IV SOFTWARE AS A SERVICE MANAGEMENT 9

SaaS – Advantages – Multiple Facets of the SaaS Model – Functional – Operational – Security and Financial –Working Model of SaaS Business – Transition to SaaS – Functional Blocks – SaaS Providers – Applications of SaaS – Management of SaaS

UNIT V CLOUD SECURITY MANAGEMNT 9

Vulnerable Areas – Finding and Fixing Vulnerabilities – Agentless, Agent Based Configuration Management – Vulnerability Management Metrics – Network Security features – VPCs– Address Translation – Encryption in Motion – Firewalls and Network Segmentation – Administrative Access and Techniques

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, "Cloud Computing Principles and Paradigms", 2nd edition, Wiley Publishers, 2015
2. Justin Garrison & Kris Nova, "Cloud Native Infrastructure Patterns for Scalable Infrastructure and Applications in a Dynamic Environment" 1st edition, Orielly, 2017

REFERENCES:

1. Michael P McGarth, "Understanding PaaS", 1St edition, Orielly, 2012
2. Robert Michon, "The Complete Guide to Software as a Service Everything You Need to Know About Saas", 1st edition, CreateSpace Independent Publishing Platform, 2017
3. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", 1st edition, O'Reilly, 2010

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td></td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL III (CLOUD COMPUTING AND DATA PROCESSING TECHNOLOGIES)

		Category: PEC				
U21CSP08	BIG DATA INTEGRATION AND PROCESSING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basics concepts of Managing Big data in cloud storage
- To acquire basic knowledge on retrieving big data
- To learn big data integration and processing, analytics

COURSE OUTCOMES:

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

CO1: Describe the basic concepts for managing Big data in cloud storage. (Understand)

CO2: Implement the techniques for retrieving Big data. (Apply)

CO3: Integrate the knowledge on Big Data into cloud storage (Apply)

CO4: Apply processing techniques of Big Data. (Apply)

CO5: Perform the process of Big Data analytics using Spark. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO5	3	2	2	1	3	-	-	-	-	-	-	3	3	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I MANAGING BIG DATA IN CLOUD STORAGE 9

Big Data Modelling and Management – Orientation of data in clusters and cloud storage – Browsing Tables in Metastore – Browsing Files in HDFS – S3 – Apache Hive and Apache Impala Interoperability – Loading Data into Cloud Storage – Storage Engines

UNIT II RETRIEVING BIG DATA 9

Significance of Big Data Processing – Retrieving Big Data – Querying JSON Data with MongoDB – Aggregation Function – Querying Aerospike

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UNIT III BIG DATA INTEGRATION 9

Overview of Information Integration – Data Integration Scenario – Integration for Multi-Channel Analytics – Industry Examples for Big data integration and Management – Big data management and processing using Splunk and Diameter

UNIT IV PROCESSING BIG DATA 9

Big Data Processing Pipelines – High level processing operations – Aggregation Operations in Big Data Pipelines – Typical analytical operations in Big data pipelines – Over view of Big Data Processing Systems – Work Flow Management – Integration and processing Layer Pipe Line and Tools

UNIT V BIG DATA ANALYTICS 9

Big Data Analytics using Spark – Programming in Spark using RDDS in Pipelines – Spark Core Transformations– Spark Eco System – Spark SQL – Streaming – Spark MLLib – Data Processing Spark–Use case–Analyzing sensor data with Spark streaming

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Xin Luna Dong, Divesh Srivastava, "Big data Integration and Management in Cloud", 1st edition, Morgan & Claypool Publishers, 2015
2. Course Era, "Big Data Integration and Processing", University of California San Diego

REFERENCES:

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper"Big Data for Dummies", 1st edition, John Wiley & Sons, 2013
1. Pelin Yildirim Taser, "Emerging Trends in IoT and Integration with Data Science, Cloud Computing, and Big Data Analytics",1st edition, IGI Global, 2021

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
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Total				40	60
				100	

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

		Category: PEC				
U21ITP01	PARALLEL AND DISTRIBUTED COMPUTING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the technologies, system architecture, and communication architecture that propelled the growth of parallel and distributed computing systems
- To understand the basics of communication and communication modes in parallel and distributed systems
- To understand the basics of consistency control in parallel and distributed systems

COURSE OUTCOMES:

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

CO1: Explain the foundational principles behind parallel programming and distributed systems (Understand)

CO2: Apply the various design principles of parallel algorithms (Apply)

CO3: Recognise the effectiveness of parallel algorithms in considering elements like scalability, load balancing, and synchronisation (Understand)

CO4: Illustrate the techniques for designing scalable and high-performance distributed systems (Understand)

CO5: Comprehend the importance of distributed systems communication, consistency control, fault tolerance, and recovery procedures. (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO4	2	1	2	1	-	-	-	-	-	-	-	2	1	-
CO5	2	1	1	1	-	-	-	-	-	-	-	2	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I MESSAGE PASSING INTERFACE 9

Functional parallelism: The Single Program Multiple Data (SPMD) model, Processor identification – Parallel computer memory architectures – Parallel programming models

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UNIT II DESIGNING PARALLEL ALGORITHMS 9

Methodical design – Partitioning, Domain decomposition, Functional decomposition, Partitioning design checklist – Communication, local and global communication, Unstructured and dynamic communication – Asynchronous communication, Agglomeration – Mapping, Load-balancing algorithms, Task-scheduling algorithms

UNIT III COMMUNICATION MODES AND COMMUNICATORS 9

Communication modes: Persistent, Partitioned, Synchronous and asynchronous, local and nonlocal operations, Buffered communication – Communicators: Basic communicators, Duplicating communicator, Sub communicators, splitting a communicator, Communicator and groups, Inter communicators

UNIT IV DISTRIBUTED SYSTEMS 9

Types of distributed systems – Architectures, System architecture and styles, Middleware organization – Processes, Threads, Client and server – Distributed file systems: Scalable performance, Load balancing, and Availability.

UNIT V COMMUNICATION AND CONSISTENCY CONTROL 9

Inter process communication – Remote invocation – Indirect communication – Consistency control: Data centric consistency – Client centric consistency – Replica management – Consistency protocols – Fault tolerance and recovery – Cast study: CORBA, Google spanner

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Vick Eijkhout, "Parallel Programming in MPI and OpenMP", 2nd edition, McGraw-Hill Education, 2022
2. Ian Foster, "Designing and Building Parallel Programs – Concepts and tools for Parallel Software Engineering", 1st edition, Pearson Education, 2019
3. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "Distributed Systems: Concepts and Design", 5th edition, Pearson Education, 2017

REFERENCES:

1. FokkinkW, "Distributed Algorithms: an Intuitive Approach", 2nd edition, MIT Press, 2018
2. Peter Pacheco, "An Introduction to Parallel Programming", Illustrated edition, Morgan Kaufmann, 2011

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

U21ITP02	MOBILE COMPUTING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamentals of mobile computing
- To describe the various protocols used in MANETs.
- To explore the operating systems used in mobile computing and e-commerce

COURSE OUTCOMES:

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

CO1: Explain the basic concepts and technologies used in mobile communication (Understand)
CO2: Outline the importance of MAC, Mobile Internet Protocol and DHCP in MANETs (Understand)
CO3: Illustrate the working of transport layer and databases in mobile computing (Understand)
CO4: Describe the basics of Mobile Adhoc networks and the various possible security issues in MANETs (Understand)
CO5: Demonstrate suitable operating systems for mobile computing and the basic principles of mobile commerce (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I COMMUNICATION TECHNOLOGIES 9

Mobile handsets, Wireless communications, and server applications – Cell phone system – Types of telecommunication networks – LAN architectures – Components of a wireless communication systems – Architecture of a mobile telecommunication system – Wireless networking standards – WLANs – Bluetooth technology - Mobile computing - Mobile computing applications - Structure of mobile computing application – Cellular mobile communication – GSM – GPRS – UMTS – Mobile phone and human boy

UNIT II MAC AND MOBILE IP 9

Properties of MAC protocols – Issues in wireless MAC protocols – Taxonomy of MAC protocols – Fixed assignment schemes – Random assignment schemes – Reservation-based schemes – The802.11 MAC Standard – MAC protocols for Ad hoc networks – Mobile Internet Protocol: Mobile

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IP terminologies – Packet delivery - Features of mobile IP – Key mechanism in mobile IP – Route optimization – Dynamic Host Configuration Protocol (DHCP)

UNIT III MOBILE TRANSPORT LAYER AND DATABASES 9

TCP/IP – Architecture of TCP/IP – Operation of TCP – Application layer protocols of TCP – TCP/IP versus ISO/OSI model – Adaptation of TCP window – Improvement in TCP performance – Issues in transaction processing – Transaction processing environment - Data dissemination – Transaction processing in mobile environment – Data replication – Mobile transaction models – Rollback process – Two-phase commit protocol – Query processing – Recovery

UNIT IV MOBILE ADHOC NETWORKS 9

Characteristics of MANETs – Applications of MANETs – MANET design issues – Routing – Essentials of traditional routing protocols - Routing in MANETs: MANET routing protocols – Vehicular Ad Hoc Networks (VANETs) – MANET vs. VANET – Security issues in a MANET – Attacks on Ad Hoc networks – Security attack countermeasures

UNIT V OPERATING SYSTEMS FOR MOBILE COMPUTING AND MOBILE COMMERCE 9

Mobile operating systems – Constraints and requirements of mobile operating systems – Commercial mobile operating systems – Operating systems for sensor networks – Applications of M-Commerce – Business-to-Consumer (B2C) Applications – Business-to-Business (B2B) Applications – Structure of mobile commerce – Pros and Cons of M-Commerce – Mobile payment systems – Security issues

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Prasant Kumar Pattnaik, RajibMall, "Fundamentals of Mobile Computing", PHI Learning, 1st edition, 2019

REFERENCES:

1. Schiller J, "Mobile Communication", 2nd edition, Pearson Education, 2023
2. Raj Kamal, "Mobile Computing", 3rd edition, Oxford University press Inc, 2019
3. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing Technology, Applications and Service Creation", 2nd edition, McGraw Hill, 2018
4. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", 1st edition, Wiley, 2014

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

		Category: PEC				
U21ITP03	WIRELESS SENSOR NETWORKS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basic concepts and functionalities of MAC and routing algorithms in sensor network
- To choose appropriate solutions for network management and Middleware services.
- To describe the various applications of WSN

COURSE OUTCOMES:

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

CO1: Explain the concepts of sensor network using WSN architecture (Understand)
CO2: Describe the concepts of physical and MAC layer protocols for WSN (Understand)
CO3: Elucidate the functionalities of routing algorithms in sensor networks (Understand)
CO4: Use appropriate solutions for network management and middleware services in WAN (Apply)
CO5: Demonstrate various applications in wireless sensor networks (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	1	-	-	-	-	-	-	1	1	-
CO3	2	1	2	-	2	-	-	-	-	-	-	2	1	-
CO4	3	2	2	2	2	-	-	-	-	-	-	2	1	-
CO5	3	2	2	2	3	-	-	-	-	-	-	2	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I WSN ARCHITECTURES 9

Single-node architecture – Hardware components – Energy consumption of sensor nodes – Operating systems and execution environments – Sensor network scenarios - Optimization goals – Design principles for WSNs – Service interfaces of WSNs – Gateway concepts

UNIT II MEDIUM ACCESS CONTROL PROTOCOLS 9

Wireless channel and communication fundamentals – Physical layer and transceiver design considerations in WSNs – Fundamentals of wireless MAC protocols – Low duty cycle protocols and wakeup concepts – Contention-based protocols - Schedule-based protocols – Random access-based protocols – Case study: Sensor-MAC IEEE 802.15.4 LR-WPANs Standard

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UNIT III ROUTING AND DATA GATHERING PROTOCOLS 9

Routing challenges and design issues in wireless sensor networks – Routing strategies in wireless sensor networks – Data-centric networking – Data-centric routing – Data aggregation – Data-centric storage

UNIT IV NETWORK MANAGEMENT 9

Middleware principle, Middleware architecture – Existing middleware – Network management requirements, Traditional network management models – Network management design issues, Operating system design issues – WSN design issues- Performance modelling of WSN, Case study: Computation of the system life span

UNIT V APPLICATIONS 9

Home control – Building automation – Industrial automation – Medical applications – Reconfigurable sensor networks – Highway monitoring – Military applications – Civil and environmental engineering applications – Wildfire instrumentation – Habitat monitoring - Nanoscopic sensor applications – Case study: Target detection and tracking – Contour/edge detection

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. KazemSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks Technology, Protocols, and Applications", 2nd edition, Wiley, 2016
2. Abbas Jamalipour, JunZheng, "Wireless Sensor Networks: A Networking Perspective", 1st edition, Wiley, 2014
3. Hossam Mahmoud Ahmad Fahmy, "Wireless Sensor Networks: Concepts, Applications, Experimentation and Analysis", 1st edition, Springer, 2018

REFERENCES:

1. Zhao, Feng,Guibas, Leonidas, "Wireless Sensor networks : An information processing approach", 2nd edition, Elsevier, 2016
2. Mohammad Ilyas, "The Handbook of Ad Hoc Wireless Networks", 1st edition, CRC Press, 2017
3. ImadMahgoub, MohammadIlyas, "Sensor Network Protocols", 1st edition, CRC Press, 2018

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

U21ITP04	SOFTWARE DEFINED NETWORKS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To utilize the concepts of open flow and SDN controllers to provide services
- To identify and build SDN framework to model and deploy services for data centres
- To explain SDN applications using open SDN controllers

COURSE OUTCOMES:

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

CO1: Explain the evolution of software defined networking to understand network programmability (Understand)

CO2: Outline the concepts of open flow and SDN controllers to provide services for realizing a distributed control plane (Understand)

CO3: Identify SDN solutions for data centers using different kinds of SDN controllers (Apply)

CO4: Build the SDN Frameworks to model and deploy services for ensuring syntactic and semantic correctness (Apply)

CO5: Build SDN applications using open SDN controllers for different environments (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	1	1	1	1	-	-	-	-	-	-	1	1	-
CO3	3	2	2	2	1	-	-	-	-	-	-	2	1	-
CO4	3	2	2	2	1	-	-	-	-	-	-	2	1	-
CO5	3	2	2	1	2	-	-	-	-	-	-	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I INTRODUCTION 9

History of Software Defined Networking (SDN) – Modern data center – Traditional switch architecture – Purpose of SDN – Evolution of SDN – Working of SDN – Control plane and data plane

UNIT II OPEN FLOW AND SDN CONTROLLERS 9

Open flow specification – Drawbacks of open SDN - SDN via APIs – SDN via hypervisor based overlays – SDN via Networking device – SDN controllers: VMware, Nicira, Openflow related

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UNIT III DATA CENTERS 9

Multitenant and virtualized multitenant data center – SDN solutions for the data center network – Virtual local area network VLANs – Ethernet VPN – Virtual extensible LAN – Network Virtualization using Generic Routing Encapsulation

UNIT IV SDN FRAMEWORK 9

SDN Frameworks – Open daylight controller – Floodlight controller – Bandwidth calendaring – Data center orchestration.

UNIT V SDN APPLICATIONS AND OPEN SOURCE 9

SDN in other environments – SDN applications – SDN open source: open-source environment, OpenFlow source code, Network virtualization, Simulation, Testing, and Tools, Open-source cloud software

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods
Total 45 Periods

TEXT BOOKS:

1. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", 1st edition, O'Reilly Media, 2013
2. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", 2nd edition, Morgan Kaufmann, 2016

REFERENCES:

1. Siamak Azodolmolky, "Software Defined Networking with Open Flow", 2nd edition, Packet Publishing, 2017
2. VivekTiwari, "SDN and Open Flow for Beginner", 1st edition, M.M. D.D. Multimedia LLC, 2013
3. Fei Hu, "Network Innovation through Open Flow and SDN: Principles and Design", 1st edition, CRC Press, 2014

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

		Category: PEC				
U21ITP05	CYBER SECURITY	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To discuss cybersecurity evolution, policy and law
- To describe the cyber security metrics and issues
- To explore the attacking and defensing techniques

COURSE OUTCOMES:

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

CO1: Elucidate the cyber security evolution and its policy to handle cyber threats (Understand)
CO2: Describe the cyber security metrics and guidance for management of cyber issues (Understand)
CO3: Explain the cyber security issues faced by decision makers for understanding cyber security (Understand)
CO4: Illustrate the attacking techniques and exploitation to detect cyber-attacks (Understand)
CO5: Identify the different category of malicious code to defend cyber-attacks (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	1	-	2	-	2	-	-	-	2	2	-
CO2	2	1	-	1	-	2	-	2	-	-	-	2	2	-
CO3	2	1	-	1	-	2	-	2	-	-	-	2	2	-
CO4	2	1	-	2	3	2	-	3	-	-	-	2	2	-
CO5	3	2	-	2	3	2	-	3	-	-	-	3	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I INTRODUCTION 9

Cyber security – Cyber security policy – Domain of cyber security policy: Laws and regulations, Enterprise policy, Technology operations, Technology configuration – Strategy versus policy – IT Act – Cyber security evolution: Productivity, Internet-commerce, Counter measures, Challenges

UNIT II CYBERSECURITY OBJECTIVES AND GUIDANCE 9

Cyber security metrics – Security management goals – Counting vulnerabilities – Security frameworks: E-commerce systems, Industrial control systems, Personal mobile devices – Security policy objectives – Guidance for decision makers - Cyber security management – Catalog approach

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UNIT III CYBERSECURITY ISSUES 9

Cyber governance issues: Net neutrality, Internet names, and numbers, Copyright and trademarks, Email and messaging – Cyber user issues: Malvertising, Impersonation, Appropriate use, Cybercrime, Geolocation, Privacy - Cyber conflict issues: Intellectual, Property theft, Cyber espionage, Cybersabotage, Cyber welfare

UNIT IV ATTACKER TECHNIQUES AND EXPLOITATION 9

Antiforensics, Tunneling techniques, Fraud techniques, Threat infrastructure – Techniques to gain a foothold, Misdirection, Reconnaissance, and Disruption methods

UNIT V MALICIOUS CODE AND DEFENSE 9

Self - replicating malicious code, Evading detection and elevating privileges, Stealing information and exploitation – Defence and analysis techniques

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods
Total 45 Periods

TEXT BOOKS:

1. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs , Jeffrey Schmidt, Joseph Weiss, "Cyber Security Policy Guidebook", 1st edition, John Wiley & Sons, 2012
2. James Graham, Rick Howard, Ryan Olson, "Cyber Security Essentials", 1st edition, CRC Press, Auerbach Publication, 2016

REFERENCES:

1. "National Cyber Crime Reference – Handbook-I", National Cyber Safety and Security Standards, India, 2014
2. "National Cyber Defence Reference – Handbook-II", National Cyber Safety and Security Standards, India, 2016
3. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics", 2nd edition, Tata McGraw -Hill, 2006
4. https://www.sans.org/white-papers

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

31.1.24

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

		Category: PEC				
U21ITP06	INTERNET SECURITY	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To describe intrusion detection techniques, IP security and Web security protocols
- To study e-mail security and wireless security protocols
- To acquire the security services needed in cloud environment

COURSE OUTCOMES:

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

CO1: Describe intrusion detection techniques and firewalls for preventing security attacks (Understand)
CO2: Explore IP security and web security protocols for providing data security services (Apply)
CO3: Demonstrate the use of security protocols for securing e-mail services (Apply)
CO4: Illustrate the various wireless security protocols for protecting data in a wireless environment (Understand)
CO5: Infer the security services needed in cloud environment for secure data sharing (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	-	-	-	2	1	-
CO2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO3	2	1	2	2	-	-	-	-	-	-	-	1	1	-
CO4	2	1	2	2	-	-	-	-	-	-	-	1	1	-
CO5	2	1	2	2	-	-	-	-	-	-	-	2	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I INTRODUCTION 9

Threats in networks – Network security controls – Intruders – Intrusion detection – Password management – Malicious software – Firewalls: Characteristics – Types – Firewall basing – Firewall location and configurations

UNIT II IP AND WEB SECURITY 9

IP security: IP security policy, Encapsulating security payload – Web security: Secure socket layer, Transport layer security – HTTPS – Secure shell (SSH)

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UNIT III ELECTRONIC MAIL SECURITY 9

Store and forward – Security services – Source authentication – Message integrity – Non - repudiation – Proof of submission and delivery – Pretty Good Privacy (PGP) – Secure/Multipurpose Internet Mail Extension (S/MIME)

UNIT IV WIRELESS NETWORK SECURITY 8

IEEE 802.11 wireless LAN overview – IEEE 802.11i wireless LAN security – Wireless application protocol – Wireless transport layer security – WAP end – to-end security

UNIT V CLOUD SECURITY 9

Cloud information security objectives – Cloud security services – Cloud security design principles – Penetration testing tools and techniques – Cloud computing risk issues: CIA triad, privacy and compliance risks – Threats to infrastructure – data, and access control – Cloud service provider risks

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security – Principles and Practice", Pearson Education, 7th edition, 2017
2. Ronald L Krutz and Russell Dean Vines, "Cloud Security- A Comprehensive Guide to Secure Cloud Computing", 1st edition, Wiley, 2016

REFERENCES:

1. J Bernard Menezes, "Network Security and Cryptography", 2nd edition, Cengage Learning, 2014
2. Chalie Kaufman, Radia Perlman, Mike Speciner, "Network Security: Private Communication in a Public World", 2nd edition, Pearson Education, 2022
3. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms and Source Code in C", 20th edition, John Wiley and Sons, 2015
4. https://training.apnic.net/wp-content/uploads/sites/2/2016/12/TSEC01.pdf

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
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Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

31.1.24

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

		Category: PEC				
U21ITP07	ETHICAL HACKING	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- Demonstrate penetration and port scanning tools
- Understand vulnerability assessment and network sniffing attacks
- Explore remote exploitation, wireless and web hackings

COURSE OUTCOMES:

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

CO1: Explain the concepts of penetration testing methodologies and tools to identify cyber threats
CO2: Demonstrate port scanning tolls to detect vulnerable ports (Apply)
CO3: Explain vulnerability assessment and network sniffing tools to predict cyber threats (Understand)
CO4: Describe possible remote exploitation using network protocols and servers (Understand)
CO5: Experiment wireless and web hacking to detect cyber threats and attacks (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	2	-	2	-	-	-	2	2	-
CO2	2	1	1	1	2	2	-	2	-	-	-	2	1	-
CO3	3	2	1	1	1	2	-	2	-	-	-	2	2	-
CO4	2	1	1	2	3	2	-	2	-	-	-	2	1	-
CO5	3	2	2	2	3	2	-	2	-	-	-	3	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I PENETRATION TESTING **9**

Important terminologies – Penetration testing: Methodologies – Categories of penetration test – Penetration testing report – Information gathering techniques: Active information gathering – Passive information gathering – Sources of information gathering – NeoTrace – Cheops-ng – Intercepting a Response – WhatWeb – Netcraft

UNIT II PORT SCANNING TECHNIQUES **9**

Scanning for open ports and services – Types of port scanning – TCP flags – Port status types – TCP SYN scan – TCP connect scan – UDP port scan – IDLE scan – Scanning for a vulnerable host – Performing an IDLE scan with NMAP – OS fingerprinting

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UNIT III VULNERABILITY ASSESSMENT AND NETWORK SNIFFING 9

Vulnerability scanners – Vulnerability assessment with Nmap – Nessus vulnerability scanner – Types of sniffing – MITM attacks – ARP protocol – ARP attacks – Denial of service attacks, Dsnif – Sniffing the traffic with Dsnif – Sniffing with wireshark – Using ARP spoof to perform MITM Attacks – Hijacking session with MITM attack – Sniffing session cookies with wireshark – DNS spoofing – DHCP spoofing

UNIT IV REMOTE EXPLOITATION 9

Network protocols – Server protocols – Attacking network remote services – Common target protocols – Cracking services with hydra – OpenSSH username discovery bug – Cracking SSH with edusa – Attacking SQL servers – Metasploit: commands – reconnaissance – port scanning – Metasploit databases – Useful scans with Metasploit

UNIT V WIRELESSHACKING AND WEB HACKING 9

Aircrack-ng – Uncovering hidden SSIDs – Monitoring beacon frames on wireshark – Determining the target with airodump-ng – Cracking a WPA/WPA2 wireless network using aircrack-ng – Capturing packets – Attacking the authentication – Brute force and dictionary attacks SQL injection attacks – Testing for SQL injection

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Baloch, R, "Ethical Hacking and Penetration Testing Guide", 1st edition, CRC Press, 2015

REFERENCES:

1. Sagar Rahalkar, "Quick Start Guide to Penetration Testing with NMAP, OpenVAS and Metasploit", APress, 1st edition, 2019
2. Alan T Norman, "Kali Linux and Wireless Hacking Ultimate Guide with Security and Penetration Testing Tools, Practical Step by Step Computer Hacking Book", 1st edition, CB-India, 2018

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL IV (NETWORKING AND CYBER SECURITY)

		Category: PEC				
U21ITP08	**DIGITAL FORENSICS**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- Describe the knowledge requirement for computer forensics and documenting the evidence
- Understand the process of online investigations
- Explore the different category of cyber forensics

COURSE OUTCOMES:

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

CO1: Explain the scope for computer forensics and file system for digital crime investigations (Understand)

CO2: Explain the scope for computer forensics and file system for digital crime investigations (Understand)

CO3: Illustrate the process of online investigations to resolve security disputes (Understand)

CO4: Perform network and mobile forensics in the field of digital communication (Apply)

CO5: Perform digital photographic forensics to resolve crime disputes (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	2	-	1	-	-	-	-	1	-
CO2	2	1	1	1	-	2	-	1	-	-	-	-	1	-
CO3	2	1	1	1	-	2	-	1	-	-	-	-	1	-
CO4	3	2	2	2	3	2	-	2	-	-	-	-	1	-
CO5	3	2	2	2	3	2	-	2	-	-	-	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I INTRODUCTION 9

Scope of computer forensics: Introduction – Types of evidence – Investigator skills – Importance, – History of computer forensics – Law enforcement training – Physical and logical storage – Boot process – Windows registry

UNIT II ACQUIRING EVIDENCE AND DOCUMENTATION 9

Hard disk – Cloning hard disk – Removable memory – Lab requirements – Private sector computer forensics laboratories – Computer forensics laboratory requirements – Extracting evidence from a device – Documenting the investigation

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UNIT III ONLINE INVESTIGATIONS 9

Working undercover – Website evidence – Background searches on a suspect – Online crime – Capturing online communications

UNIT IV NETWORK AND MOBILE FORENSICS 9

Tools, Networking devices – Understanding the OSI model – Advanced persistent threats – Investigating a network attack – Cellular network – Handset specifications – Mobile operating systems – Handling handset evidence – Handset forensics.

UNIT V MAC AND PHOTOGRAPH FORENSICS 9

Macintosh file systems – forensic examination of a MAC – Mac operating systems – Apple mobile devices, Digital photography – Examining picture files – Evidence admissibility – Case studies.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Darren R. Hayes, "A Practical Guide to Digital Forensics Investigations", 2nd edition, Pearson, 2020

REFERENCES:

1. "National Cyber Crime Reference – Handbook-I", National Cyber Safety and Security Standards, India, Cyber House, 2014.
2. "National Cyber Defence Reference – Handbook – II", National Cyber Safety and Security Standards, India, 2016.
3. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", 6th Edition, Cengage learning, 2020.
4. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics", 2nd Edition, BCS, The Chartered Institute for IT, 2018.
5. https://www.sans.org/white-papers

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP09	UI/UX DESIGN	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental concepts of UI/UX Design
- To understand prototyping, analyzing and testing an application
- To learn to develop real time applications

COURSE OUTCOMES:

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

CO1: Interpret the concepts of UI/UX Design. (Understand)
CO2: Discover different methods for organizing the contents. (Understand)
CO3: Describe the knowledge on different heuristics and design interaction for an application. (Understand)
CO4: Elucidate the process of prototyping, analyzing and testing an application (Apply)
CO5: Apply real time product designing using design thinking. (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I INTRODUCTION 9

Fundamentals of graphics design – Principles of visual design – Mental Model – Cognitive Model in UX – Means to an End – Basics of User Research– Patterns– Project Ecosystem – Project Objectives and approach – Four Tenets of UX Strategy – user research – Personas

UNIT II ORGANIZING THE CONTENT 9

Information Architecture and Application Structure: Big Picture – Content Patterns – Picture Manager – Dashboard – Canvas Plus Palette – Wizard – Settings Editor – Alternative Views – Many Workspaces– Multi–Level Help

UNIT III HEURISTICS AND INTERACTION DESIGN 9

Navigational Models – Defining to designing – Design Principles – Site maps and Task Flows – Wireframes and Annotations – Interaction Patterns – Core Responsive Design

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UNIT IV PROTOTYPING, ANALYSING AND TESTING 9

Prototyping – Paper Prototyping – Digital Prototyping – Wireframe vs. Realistic Prototypes – HTML vs. WYSIWYG Editors– Additional Tools for Prototyping – Prototype Examples– Conducting Competitive Analysis – Design Testing with Users – Usability Evaluation – Heuristic Evaluation

UNIT V PRODUCT DESIGN 9

Design Thinking Life Cycle– Types of products & solutions– Design Psychology for e–commerce sites – Design and testing of social media site and online shopping site

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Jaime Levy, UX Strategy, O'Reilly, 1st edition, 2015.
2. Russer Unger, Carolyn Chandler, A Project Guide to UX Design, 2nd edition, New Riders

REFERENCES:

1. William Redwell, Kritina Holden, Jill Butler, "Universal Principles of Design", Rockport, 2010
2. Jesse James Garrett, "The Elements of User Experience: User–Centered Design for the Web and Beyond – Voices That Matter", AIGA NEW RIDERS, 2010
3. Marcin Treder , "UX Design for startups", UXpin, 2013

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP10	PYTHON WEB DEVELOPMENT	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the object-oriented structure and user interface programming through Python
- To gain knowledge of web development using Flask Framework
- To learn to deploy the software in Linux and Windows platforms

COURSE OUTCOMES:

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

CO1: Describe the object–oriented concepts in Python. (Understand)
CO2: Identify the UI applications in Python. (Apply)
CO3: Utilize the use of flask framework for web development. (Apply)
CO4: Develop real time web applications using flask and MangoDB (Apply)
CO5: Implement the steps to deploy the developed web applications. (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I OBJECT ORIENTED APPROACH IN PYTHON 9

Classes – Class Coding Basics: Instances – Behavior Methods – Operator Overloading – Customizing Behavior Methods – Constructors – Polymorphism – Inheritance

UNIT II USER INTERFACE APPLICATIONS IN PYTHON 9

Wxpython installation – Menus and Toolbars – Layout Management – Wxpython Events – Wxpython Dialogs – Widgets – Graphics

UNIT III FLASK FRAMEWORK FOR WEB DEVELOPMENT 9

Flask Basics – Routes – Templates – Control Flow – Inheritance – Forms – Modules – Connection with Databases – Relational Database versus NoSQL – Modeling – Mapping Classes to Mongodb – Building Data Layer with Mongo Engine

UNIT IV REAL TIME DEVELOPMENT OF WEB APPLICATION 9

Develop Web Applications with Flask and MongoDB – Example Applications – Blogs – Forums – Social media applications – Twitter clone – Instagram clone – Auto Evaluation of Student Assignments

UNIT V DEPLOYMENT OF APPLICATIONS 9

Collaborative Version Control Systems – Git Commands – Real Time Usage of Git Commands – Deployment Using AWS – Google Cloud and Heroku

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Mark Lutz, "Learning Python", 5th edition, O' Reilly 2013
2. Miguel Grinberg, "Flask Web Development Developing Web Applications with Python", 1st edition, OReilly, 2014

REFERENCES:

1. Karl Seguin, "The Little Mongo DB Book", https://github.com/karlseguin/the–little–mongodb–book
2. Gareth Dwyer, "Flask by Example", Packt Publishers, 2016
3. https://aws.amazon.com/education/awseducate/
4. http://packaging.ubuntu.com/html/packaging–new–software.html
5. Scott Chacon and Ben Straub, "Pro Git", Free e–book under Creative commons, 2nd edition, Apress, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP11	APP DEVELOPMENT	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn development of native applications with basic GUI Components
- To develop applications with location and data storage capabilities
- To implement cross platform applications with basic GUI and event handling

COURSE OUTCOMES:

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

CO1: Describe the Native applications with GUI Components (Understand)
CO2: Examine hybrid applications with basic event handling (Apply)
CO3: Integrate the cross–platform applications with location and data storage capabilities (Apply)
CO4: Employ the cross–platform applications with basic GUI and event handling (Apply)
CO5: Identify the web applications with cloud database access (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT

Basics of Web and Mobile application development – Native App – Hybrid App – Cross–Platform App – What is Progressive Web App – Responsive Web design

UNIT II NATIVE APP DEVELOPMENT USING JAVA 9

What is Native Web App – Benefits of Native App – Scenarios to create Native App – Tools for creating Native App – Cons of Native App – Popular Native App Development Frameworks – Java & Kotlin for Android – Swift & Objective–C for iOS – Basics of React Native – Native Components – JSX, State, Props

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UNIT III HYBRID APP DEVELOPMENT 9

What is Hybrid Web App – Benefits of Hybrid App – Criteria for creating Native App – Tools for creating Hybrid App – Cons of Hybrid App – Popular Hybrid App Development Frameworks – Ionic – Apache Cordova

UNIT IV CROSS–PLATFORM APP DEVELOPMENT USING REACT–NATIVE 9

What is Cross-platform App – Benefits of Cross-platform App – Criteria for creating Cross-platform App – Tools for creating Cross-platform App – Cons of Cross-platform App – Popular Cross-platform App Development Frameworks – Flutter – Xamarin – React–Native – Basics of React Native – Native Components – JSX, State, Props

UNIT V NON–FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS 9

Comparison of different App frameworks – Build Performance – App Performance – Debugging capabilities – Time to Market – Maintainability – Ease of Development – UI/UX, Reusability

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Dawn Griffiths, "Headfirst Android Development", O'Reilly, 1st edition, 2015
2. Anthony Accomazzo, HousseinDjirdeh, Sophia Shoemaker, Devin Abbott, "Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native", 1st edition, FullStack publishing, 2019

REFERENCES:

1. Android Programming for Beginners, John Horton, Packt Publishing, 2nd edition, 2018
2. Apache Cordova 4 Programming, John M Wargo, 1st edition, 2015
3. React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition, 2019
4. Apache Cordova in Action, Raymond K. Camden, Manning, 1st edition, 2015

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

31.1.24

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP12	JAVASCRIPT FRAMEWORKS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the various components of full stack development
- To learn the basics of java script frameworks
- To learn application development using MongoDB

COURSE OUTCOMES:

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

CO1: Describe the various stacks available for web application development. (Understand)
CO2: Utilize the use of Node.js for application development. (Apply)
CO3: Implement the function of MongoDB. (Apply)
CO4: Employ the role of Angular and Express for web development. (Apply)
CO5: Illustrate the features of React. (Understand)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I BASICS OF FULL STACK **9**

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**

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

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UNIT III MONGO DB 9

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

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

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: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Node.js, MongoDB and Angular Web Development, Brad Dayley, Brendan Dayley, Caleb Dayley, 2nd edition, Pearson Education, Inc, 2018
2. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, Apress, 1st edition, 2017

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", 2nd edition, Addison Wesley Professional, 2018
3. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage", 3rd edition, O'Reilly publication, 2019

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

31.1.24

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP13	WEB SERVICES AND API DESIGN	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the types of web services, resources, APIs and their architectures
- To develop, deploy RESTful web service APIs in JAVA
- To understand the security concerns of web services

COURSE OUTCOMES:

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

CO1: Describe Web Services architectural pattern for a given design problem. (Understand)
CO2: Examine the types of resources and suitable design patterns for development. (Apply)
CO3: Adopt Restful API Design Patterns. (Apply)
CO4: Utilize RESTful API web services. (Apply)
CO5: Evaluate the performance and security aspects of web services. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	3	2	2	2	2	-	-	-	-	-	-	2	1	-
CO3	3	2	2	2	2	-	-	-	-	-	-	2	1	-
CO4	3	2	2	2	2	-	-	-	-	-	-	2	1	-
CO5	3	2	2	2	2	-	-	-	-	-	-	2	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I INTRODUCTION **9**

Web Services – Building Blocks, Types; Service Oriented architectures – resource-oriented architectures, API architectures, Micro services and architectures, HATEOAS, REST, URI, Code on Demand

UNIT II RESOURCES AND DESIGN PATTERNS **9**

Resources – Identification, Resource Relations, Representations, Parameters, types, methods, Requirements for APIs, Architectural Patterns. Basic and Advanced RESTful API patterns

UNIT III RESTFUL API DESIGN PRINCIPLES **9**

API front End Design, API back-end Design, Identifier Design, Interaction Design with HTTP, Metadata Design, Representation Design, URI design, REST constraints, Best Practices

UNIT IV DEVELOPMENT AND DEPOLYMENT 9

Frameworks, Standard Languages, API Description Languages, Handover points, Development and Deployment of RESTful web service applications in Java, microservice API, Best Practices

UNIT V PERFORMANCE AND SECURITY 9

Performance and availability – caching – Traffic shaping – Evolution and versioning, Security concerns – Mechanisms, Authentication, Validation, Access Control, Token Based Authentication, Authorization

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Matthias Biehl, "RESTful API Design, API University Series, 1st edition, CreateSpace Independent Publishing Platform, 2016
2. "RESTful web APIs", 1st edition, Packt Publishing. 2019

REFERENCES:

1. JJ Geewax, "API Design Patterns", 1st edition, Manning Publications, 2021
2. Bogunuva Mohanram Balachandar, "Restful Java Web Services: A pragmatic guide to designing and building RESTful APIs using Java, 3rd edition, Ingram Short Title, 2017
3. Mark Masse, "REST API Design Rulebook: Designing Consistent RESTful Web Service Interfaces", 1st edition, O' Reilly, 2011
4. Pethuru Raj, Harihara Subramanian, "Hands–On RESTful API Design Patterns and Best Practices: Design, develop, and deploy highly adaptable, scalable, and secure", Packt Publications, 2019

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP14	SOA & MICRO SERVICES	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand service–oriented architecture and microservices
- To learn the basics of DevOps practices
- To integrate DevOps with Cloud

COURSE OUTCOMES:

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

CO1: Describe SOA and micro services architecture. (Understand)
CO2: Elucidate the Implementation of micro services applications. (Understand)
CO3: Outline the features of SOA. (Understand)
CO4: Integrate various elements of Cloud and Devops. (Apply)
CO5: Execute the ways to work with third party APIs. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	-
CO3	2	1	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	2	-
CO5	3	2	2	2	2	-	-	-	-	-	-	2	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I SOA AND MICROSERVICE ARCHITECTURE BASICS 9

Need for Software Architecture – Architecting process for software applications – Software applications in enterprises – Platforms – Cloud computing platforms – SOA and MSA – Basics – Evolution of SOA & MSA – Drivers for SOA – Dimensions, Standards and Guidelines for SOA – Emergence of MSA

UNIT II MICROSERVICE BASED APPLICATIONS 9

Implementing Microservices with Python – Microservice Discovery Framework – Coding, Testing & Documenting Microservices – Interacting with Other Services – Monitoring and Securing the Services – Containerized Services – Deploying on Cloud

UNIT III SERVICE ORIENTED ARCHITECTURE 9

Enterprise–wide SOA – Service oriented applications – Service oriented analysis and design – Technologies for SOA – SOA Implementation and Governance

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UNIT IV CLOUD AND DEVOPS 9

Origin of DevOps – The developers versus operations dilemma – Key characteristics of a DevOps culture – Deploying a Web Application – Creating and configuring an account – Creating a web server – Managing infrastructure with Cloud Formation – Adding a configuration management system

UNIT V 9

Working with Third Party APIs: Overview of interconnectivity in cloud ecosystems. Working with Twitter API, Flickr API, Google Maps API. Advanced use of JSON and REST

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Shankar Kambhampaty, "Service–oriented Architecture & Microservice Architecture: For Enterprise, Cloud, Big Data and Mobile", 3rd edition, Wiley, 2018
2. Tarek Ziade, "Python Microservices Development", 1st edition, O'REILLY publication,2017

REFERENCES:

1. Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect"s Perspective", 1st edition, Pearson Education, 2016
2. Nathaniel Felsen, "Effective DevOps with AWS", 1st edition, Packt Publishing, 2017
3. Jim Webber, SavasParastatidis, Ian Robinson, "REST in Practice" 1st edition, O'Reilly Media, 2010

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP15	CLOUD NATIVE APPLICATIONS DEVELOPMENT	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To Introduce Cloud Environments and cloud native fundamentals
- To introduce the Docker environment
- To understand container orchestration and continuous integration and development

COURSE OUTCOMES:

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

CO1: Define the characteristics of various cloud environments. (Understand)
CO2: Describe the concepts of cloud native fundamentals. (Understand)
CO3: Employ docker for cloud native development. (Apply)
CO4: Implement container orchestration techniques. (Apply)
CO5: Practice the features of continuous integration and development. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	-	-	-	1	2	-
CO2	2	1	1	1	1	-	-	-	-	-	-	1	2	-
CO3	3	2	2	2	3	-	-	-	-	-	-	2	3	-
CO4	3	2	2	2	1	-	-	-	-	-	-	2	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	2	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I CLOUD ENVIRONMENTS **9**

Cloud Service Providers, AWS, Azure, CP, Cloud Technology Ecosystems, Procurement in the Cloud, Cloud Marketplaces Application Virtualization, Virtual clusters and Resource Management, Containers vs. Virtual Machines

UNIT II CLOUD NATIVE FUNDAMENTALS **9**

Basics of the cloud native ecosystem – CNCF (Cloud Native Computing Foundation) –Cloud native tooling – Choosing monolith or microservice based–Architecture for an application – Evaluating the involved trade–Offs for monoliths and microservices

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UNIT III DOCKER 9

Introduction to Docker, Docker Components, Docker Container, Docker Images and Repositories. Cloud Native application design, Containers, Data Management in Cloud, Web – Queue – Worker, Serverless computing

UNIT IV CONTAINER ORCHESTRATION 9

Using Docker to package an application and distribute it via DockerHub – Bootstrap a Kubernetes cluster using k3s – Explore Kubernetes resources for an application deployment – Differentiate between declarative and imperative Kubernetes management techniques

UNIT V CONTINUOUS INTEGRATION AND DEVELOPMENT 9

Continuous Integration fundamentals using GitHub – Continuous Delivery fundamentals using ArgoCD – Basics of Helm, as a configuration template manager – Kubernetes basics – Deploying an application using ArgoCD and a Helm chart

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Michael J Kavis, "Architecting the Cloud – Design Decisions for Cloud Computing", 1st edition, Wiley publication, 2014
2. Tom Laszewski, Kamal Arora, Eric Farr, Piyum Zanooz, "Cloud Native Architectures: Design high–availability and cost–effective applications for the cloud", 1st edition, Packt publishing, 2018

REFERENCES:

1. Bill Wilder, Cloud Architecture Patterns: Using Microsoft Azure, 1st edition, O'Reilly Media, 2012
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", 1st edition, Morgan Kaufmann Publishers, 2012.
3. James Turnbull, "The Docker Book", 1st edition, O'Reilly Publishers, 2014

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL V (FULL STACK DEVELOPMENT)

		Category: PEC				
U21CSP16	DEVOPS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)

COURSE OUTCOMES:

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

CO1: Explain different actions performed through Version control tools like Git. (Understand)
CO2: Describe Automated Continuous Deployment. (Understand)
CO3: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle. (Apply)
CO4: Illustrate configuration management using Ansible. (Understand)
CO5: Use Cloud–based DevOps tools. (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	-	-	-	-	-	-	1	1	-
CO2	2	1	1	1	2	-	-	-	-	-	-	1	1	-
CO3	3	2	2	2	3	-	-	-	-	-	-	2	2	-
CO4	3	2	2	2	2	-	-	-	-	-	-	2	1	-
CO5	3	2	2	2	3	-	-	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I INTRODUCTION TO DEVOPS **9**

Devops Essentials – Introduction To AWS, GCP, Azure – Version control systems: Git and Githu

UNIT II COMPILE AND BUILD USING MAVEN & GRADLE **9**

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III CONTINUOUS INTEGRATION USING JENKINS 9

Install & Configure Jenkins, Jenkins Architecture Overview, creating a Jenkins Job, configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV CONFIGURATION MANAGEMENT USING ANSIBLE 9

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V BUILDING DEVOPS PIPELINES USING AZURE 9

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure– Pipelines. Yaml file

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Roberto Vormittag, —A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step–By–Step Exercisesll, 2nd edition, Kindle Edition, 2016.
2. Jason Cannon, —Linux for Beginners: An Introduction to the Linux Operating System and Command Linell, Kindle edition, 2014

REFERENCES:

1. Mitesh Soni, "Hands–On Azure Devops: Cicd Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops and Microsoft Azure" (English Edition) Paperback – 1 January 2020
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humansll", 1st edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOpsll", 2nd edition, 2016.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

		Category: PEC				
U21ITP09	NEXT GENERATION NETWORKS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concept of small cells in 5G mobile networks
- To learn the mobile clouds and security issues in 5G networks
- To understand the role of cognitive radios in 5G networks

COURSE OUTCOMES:

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

CO1: Compare the 5G network with older generations of networks (Understand)
CO2: Identify suitable small cells for different applications of 5G networks (Understand)
CO3: Describe the importance of MAC protocol in wireless network (Understand)
CO4: Demonstrate an application with 5G network support and mobile cloud (Apply)
CO5: Analyze the security risks in 5G networks (Analyze)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I PERVASIVE CONNECTED WORLD AND 5G INTERNET **9**

Historical trend of wireless communications – Evolution of LTE technology to beyond 4G – 5G roadmap – Ten pillars of 5G – Internet of things and context awareness – Networking reconfiguration and virtualization support – Mobility – Quality of service control – Emerging approach for resource over provisioning

UNIT II SMALL CELLS FOR 5G MOBILE NETWORKS **9**

Small cells – Capacity limits and achievable gains with densification – Mobile data demand – Demand vs. capacity – Small cell challenges

UNIT III COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS **9**

Cooperative diversity and relaying strategies: Cooperation and network coding – Cooperative ARQ MAC protocols – PHY layer impact on MAC protocol analysis: Impact of fast Fading and shadowing

on packet reception for QoS guarantee – Impact of shadowing spatial correlation – Study: NCCARQ, PHY layer impact

UNIT IV MOBILE CLOUDS AND COGNITIVE RADIO 9

The mobile cloud – Mobile cloud enablers – Network coding – Overview of cognitive radio technology in 5G wireless – Spectrum optimization using cognitive radio – Relevant spectrum optimization literature in 5G – Cognitive radio and carrier aggregation – Energy efficient cognitive radio technology

UNIT V SECURITY AND SELF ORGANISING NETWORKS 9

5G communications system architecture – Security issues and challenges in 5G communications systems – Self organising networks: Introduction – Self organising networks in UMTS and LTE – The need for self-organising networks in 5G – Evolution towards small cell dominant HetNets

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", 1st edition, Wiley, 2015

REFERENCES:

1. Yin Zhang, Min Chen, "Cloud Based 5G Wireless Networks – Springer Briefs in Computer Science", 1st edition Springer, 2016
2. Athanasios G. Kanatas, Konstantina S. Nikita, Panagiotis (Takis) Mathiopoulos, "New Directions in Wireless Communications Systems: From Mobile to 5G", 1st edition, CRC Press, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	**100**
Total				40	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

		Category: PEC				
U21ITP10	GAME DEVELOPMENT	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the notion of a game, its solutions concepts, and other basic notions and tools of game theory
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory
- To draw the connections between game theory, computer science, and economics, emphasizing the computational issues

COURSE OUTCOMES:

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

CO1: Discuss the notion of a strategic game, equilibria, and characteristics of main applications (Understand)
CO2: Explain the use of Nash equilibrium for various games (Understand)
CO3: Identify the key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real-world situation (Apply)
CO4: Apply Bayesian games for suitable gaming applications (Apply)
CO5: Implement a typical virtual business scenario using game theory (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	3	2	1	2	3	-	-	-	-	-	-	3	1	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	-	2
CO5	3	2	2	2	3	-	-	-	-	-	-	2	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I INTRODUCTION 9

Basics of games – Strategy – Preferences – Payoffs – Mathematical basics – Game theory –Rational choice – Basic solution concepts – Non-cooperative games – Cooperative games – Basic computational issues – Finding equilibria and learning in games

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UNIT II GAMES WITH PERFECT INFORMATION 9

Strategic games – Prisoner's dilemma, Matching pennies – Nash equilibria – Theory and illustrations – Cournot's and Bertrand's models of oligopoly – Auctions – Mixed strategy equilibrium – Zero-sum games – Extensive games with perfect information – Repeated games (prisoner's dilemma)

UNIT III GAMES WITH IMPERFECT INFORMATION 9

Bayesian games – Motivational examples – General definitions – Information aspects – Illustrations – Extensive games with imperfect – Information – Strategies – Nash equilibrium – Beliefs and sequential equilibrium – Illustrations – Repeated games – Prisoner's dilemma – Bargaining

UNIT IV NON-COOPERATIVE GAME THEORY 9

Self-interested agents – Games in normal form – Analyzing games: from optimality to equilibrium – Computing solution concepts of Normal-Form games – Computing Nash equilibria of two-player – zero-sum games – Computing Nash equilibria of two player, general-sum games – Identifying dominated strategies

UNIT V MECHANISM DESIGN 9

Aggregating preferences – Social choice – Formal model – Voting – Existence of social functions – Ranking systems – Protocols for strategic agents: Mechanism design – Unrestricted preferences-Efficient mechanisms – Vickrey and VCG mechanisms – Applications of mechanism design – Computer science – eBay auctions – K-armed bandits

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, "Algorithmic Game Theory" 1st edition (Revised), Cambridge University Press, 2011

REFERENCES:

1. M. Machler, E. Solan, S. Zamir, "Game Theory", 1st edition, Cambridge University Press, 2020
2. A.Dixit and S. Skeath, "Games of Strategy", 2nd edition, W W Norton & Co Inc, 2015
3. YoavShoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations", 4th edition, Cambridge University Press, 2008
4. Zhu Han, DusitNiyato, WalidSaad, Tamer Basar and Hjorungnes, "Game Theory in Wireless and Communication Networks", 1st edition, Cambridge University Press, 2012

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

21.1.24

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

		Category: PEC				
U21ITP11	BLOCKCHAIN TECHNOLOGIES	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the importance of decentralization
- To know the concepts of currency and smart contracts in ethereum network
- To become familiar with the model of alternative blockchain technology and its challenges

COURSE OUTCOMES:

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

CO1: Describe the significance of decentralization using blockchain. (Understand)
CO2: Distinguish the concepts of crypto currency and Bitcoin (Understand)
CO3: Recognise the importance of the Ethereum framework's components and tools (Understand)
CO4: Describe the concept of distributed ledger using Hyperledger fabric for a web3 application (Understand)
CO5: Identify the challenges and trends using various blockchain projects (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	-	-	-	-	-	-	2	1	-
CO2	2	1	1	2	2	-	-	-	-	-	-	2	1	-
CO3	2	1	1	2	2	-	-	-	-	-	-	2	1	-
CO4	2	1	1	2	2	-	-	-	-	-	-	2	1	-
CO5	3	2	3	3	3	-	-	-	-	-	3	3	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I FUNDAMENTALS OF BLOCKCHAIN **9**

History of blockchain – Types of blockchain – Consensus – Decentralization using blockchain – Methods of decentralization – Blockchain and full ecosystem decentralization – Platforms for decentralization – Decentralized autonomous organization

UNIT II CRYPTO CURRENCY AND SMART CONTRACTS **9**

Private key vs public key – Hash function – Secure hash algorithms – Bitcoin – Digital keys and addresses – Transactions – Mining – Bitcoin networks and payments – Wallets – Alternative coins – Theoretical limitations – Bitcoin limitations– Smart contracts – Ricardian contracts

UNIT III ETHEREUM 9

The Ethereum Network – Components of Ethereum ecosystem – Ethereum development tools and frameworks– Solidity language

UNIT IV WEB3 AND HYPERLEDGER 9

Web3 – Contract deployment – POST requests – Development frameworks – Hyperledger as a protocol – The reference architecture – Hyperledger fabric – Distributed ledger

UNIT V ALTERNATIVE BLOCKCHAINS AND CHALLENGES 9

Kadena – Ripple – Rootstock – Quorum – Multichain – Scalability – Privacy – Emerging trends – Other challenges – Blockchain research – Case Study: Supply chain management

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Elad Elrom, "The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects", 1st edition, Apress, 2019
2. Chandramouli Subramanian, Asha A George, Abhilash K A, "Blockchain Technology", 1st edition, Universities Press, 2020

REFERENCES:

1. Elad Elrom, "The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects", 1st edition, Apress, 2019
2. Chandramouli Subramanian, Asha A George, Abhilash K A "Blockchain Technology", 1st edition, Universities Press, 2020

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

		Category: PEC				
U21ITP12	AUGMENTED REALITY / VIRTUAL REALITY	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To describe the fundamentals of XR, virtual reality architecture and modeling
- To develop virtual reality applications
- To understand the design principles of augmented reality applications

COURSE OUTCOMES:

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

CO1: Describe the fundamentals of extended reality (XR) with example applications (Understand)
CO2: Outline the virtual reality architecture and modeling for real time applications (Understand)
CO3: Develop the virtual reality applications by using appropriate tools. (Apply)
CO4: Explain the basics of augmented reality with real time examples (Understand)
CO5: Apply the design principles and practices of augmented reality for industrial sectors (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I XR OVERVIEW **9**

Introduction – XR spectrum – Definitions - Augmented reality – Virtual reality – Mixed reality – History – Challenges – XR and business – Applications: Retail, Training, Education, Healthcare, Entertainment, Sports, Manufacturing, Military

UNIT II VR IO, MODELING **9**

VR definition – Input devices: Trackers, navigation and gesture interfaces – Output devices: Graphics, Three-dimensional sound and haptic displays – Computer architecture for VR – Modelling

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UNIT III VR APPLICATION ENVIRONMENT 9

Enabling VR Environment – Building: Steam VR, Oculus rift, Windows gear VR, Oculus Go, Google VR, setting up for android devices – 3D walkthrough, Object grabbing, Transformation, Hand avatar manipulation, World space menu creation

UNIT IV AR PRINCIPLES 9

AR Definition, Displays: Multimodal displays, Spatial display model, Visual displays, Tracking, Calibration and registration - Mobile sensors - Computer vision for AR

UNIT V AR APPLICATION DEVELOPMENT 9

Mobile application for image tracking, Image dataset generation, setting up AR environment, Animation and transformation (Scale, Move, Rotate, Transform), Build generation for iOS and Android. Case study: Picture puzzle

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Berbard Marr, " Extended Reality in Practice: Augmented, Virtual and Mixed Reality Explored", 1st edition, Wiley, 2021
2. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd edition, John Wiley & Son, 2014
3. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", 1st edition, Addison-Wesley, 2017

REFERENCES:

1. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technology Applications, and Human Factors for AR and VR", 1st edition, Addison-Wesley, 2016
2. Robert Scoble, Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything", 1st edition, Patrick Brewster Press, 2016
3. Jesse Glover, Jonathan Linowes, "Complete Virtual Reality and Augmented Reality Development with Unity",1st edition, Packt, 2019

EVALUATION PATTERN:

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

U21ITP13	QUANTUM COMPUTING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn the fundamentals of quantum information science
- To become familiar with 1-qubit and 2-qubit gate operations and gain the ability to build simple quantum circuits
- To familiar with quantum algorithms and their analysis

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of quantum information science (Understand)

CO2: Distinguish the concepts of quantum bits and classical bits (Understand)

CO3: Illustrate the basic quantum logical operations and algorithms for processing quantum information (Understand)

CO4: Implement simple quantum algorithms and information channels in the quantum circuit model (Apply)

CO5: Employ the basic error correction methods and tools in quantum computing (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	2	1	2
CO2	2	1	1	1	-	-	-	-	-	-	-	2	-	2
CO3	2	1	1	1	-	-	-	-	-	-	-	2	-	2
CO4	3	2	2	2	3	-	-	-	-	-	-	2	-	3
CO5	3	2	2	2	3	-	-	-	-	-	-	3	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I SINGLE AND MULTIPLE QUBIT QUANTUM SYSTEMS **9**

Quantum building blocks, Single qubit systems: Quantum mechanics of photon polarization – Single qubit measurement – Quantum key distribution protocol – The state space of single qubit system – Multiple qubit systems: Tensor products – State space of n-qubit system – Entangled states – Quantum key distribution using entangled states

UNIT II MEASUREMENT OF MULTIPLE-QUBIT STATES AND QUANTUM STATE TRANSFORMATIONS 9

Dirac's Bra/Ket Notation – Projection operators for measurement – Hermitian operator formalism for measurement – EPR paradox and Bell's theorem – Quantum state transformations: Unitary transformations – Simple quantum gate – Applications of simple gates – Realizing unitary transformations as quantum circuits

UNIT III CLASSICAL COMPUTATIONS AND ALGORITHMS 9

From reversible classical computations to quantum computations – Reversible implementations of classical circuits – Language for quantum implementations – Example programs for arithmetic operations – Introduction to quantum algorithms: Computing with superpositions – Notions of complexity – Deutsch's problem – Quantum subroutines – Few simple quantum algorithms

UNIT IV SHOR'S FACTORING ALGORITHM AND GENERALIZATION 9

Classical reduction to period-finding – Shor's factoring algorithm – The efficiency of Shor's algorithm – Generalizations: The discrete logarithm problem – Hidden subgroup problems

UNIT V ERROR CORRECTION AND TOOLS 9

Quantum code that corrects single bit-flip errors – Code for single-qubit phase-flip errors – Code for all single-qubite errors – QISKit – AWS braket – QCSim

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods
Total 45 Periods

TEXT BOOKS:

1. Ray LaPierre, "Introduction to Quantum Computing", 1st edition, Springer, 2021
2. Eleanor Rieffel, Wolfgang Polak, "Quantum Computing: A Gentle Introduction",1st edition, MIT Press, 2011
3. Bernhardt, Chris, "Quantum Computing for Everyone" 1st edition, MIT Press, 2019

REFERENCES:

1. David J Griffiths, "Introduction to Quantum Mechanics", 1st edition, Cambridge, 2016
2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 1st edition, 2013
3. Michael A. Nielsen, Isaac L. Chuang, "Quantum Computation and Quantum Information", 10th edition, Cambridge University Press, 2011

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

		Category: PEC				
U21ITP14	**GRAPHICS PROCESSING UNIT**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the organization of threads computation
- To describe the performance of computations efficiently
- To describe the use of available hardware resources effectively to improve the system performance

COURSE OUTCOMES:

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

CO1: Describe the common GPU architectures and programming models (Understand)

CO2: Implement efficient algorithms for common application kernels (Apply)

CO3: Make use of synchronization and functions to develop an efficient parallel algorithm for solving real world problems (Apply)

CO4: Develop an efficient and correct code to solve it, analyze its performance (Understand)

CO5: Apply the advanced techniques used in parallel computing for image processing (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	2	1	-
CO2	3	2	2	2	1	-	-	-	-	-	-	2	3	-
CO3	3	2	2	2	2	-	-	-	-	-	-	2	3	-
CO4	3	2	2	1	1	-	-	-	-	-	-	2	1	-
CO5	3	2	2	1	1	-	-	-	-	-	-	2	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)								3: Substantial (High)		

SYLLABUS:

UNIT I INTRODUCTION 9

GPU architecture – Clock speeds – CPU / GPU comparisons – Heterogeneity – Accelerators – Parallel programming – CUDA OpenCL / OpenACC – Kernels launch parameters – Thread hierarchy – Warps / Wavefronts – Threadblocks / Workgroups – Streaming multiprocessors – 1D / 2D / 3D thread mapping – Device properties, Simple programs

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UNIT II MEMORY 9

Memory hierarchy – DRAM / global, local / shared, private / local, textures – Constant memory – Pointers – Parameter passing – Arrays and dynamic memory – Multi-dimensional arrays – Memory allocation – Memory copying across devices – Programs with matrices – Performance evaluation with different memories

UNIT III SYNCHRONIZATION AND FUNCTIONS 9

Synchronization: Memory consistency – Barriers (local versus global) – Atomics – Memory fence – Prefix sum – Reduction – Programs for concurrent data structures such as worklists, Linked-lists – Synchronization across CPU and GPU Functions: Device functions – Host functions – Kernels functions – Using libraries (such as thrust), and developing libraries.

UNIT IV SUPPORT AND STREAMS 9

Support: Debugging GPU programs – Profiling, Profile tools – Performance aspects streams: Asynchronous processing, Tasks – Task-dependence – Overlapped data transfers – Default stream – Synchronization with streams – Events, Event-based synchronization – Overlapping data transfer and kernel execution – Pitfalls

UNIT V PARALLELISM 9

Dynamic parallelism – Unified virtual memory – Multi-GPU processing – Peer access – Heterogeneous processing – Case study: Image processing

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. David Kirk, Wen-mei Hwu, "Programming Massively Parallel Processors: A Hands-On Approach", 2nd edition, Morgan Kaufman, 2013
2. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", 1st edition, Elsevier, 2013

REFERENCES:

1. Avimanyu Bandyopadhyay, "Hands on GPU Computing with Python", 1st edition, Packt, 2019
2. Brian Tuomanen, "Hands-On GPU Programming with Python and CUDA", 1st edition, Packt, 2018

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

		Category: PEC				
U21ITP15	AGILE METHODOLOGIES	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand agile development processes and the principles behind the agile manifesto
- To understand the business value of adopting agile approaches
- To apply design principles and refactoring to achieve agility

COURSE OUTCOMES:

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

CO1: Elucidate agile software development and related methodologies (Understand)

CO2: Describe the importance of interacting with business stakeholders in determining the requirements for a software system (Understand)

CO3: Recognize the agile process and requirement management in industry (Understand)

CO4: Implement test driven development to increase quality in agile process (Apply)

CO5: Apply the impact of social aspects on software development success (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I AGILE METHODOLOGY 9

Theories for agile management – Agile software development – Traditional model vs. agile model - Classification of agile methods – Agile manifesto and principles – Agile project management – Agile team interactions – Ethics in agile teams - Agility in design – testing – Agile documentations – Agile drivers – Capabilities and values

UNIT II AGILE PROCESSES 9

Lean production – SCRUM, Crystal – Feature Driven Development – Adaptive software development – Extreme Programming: Method overview – Lifecycle – Work products, Roles and practices

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT 9

Agile information systems – Agile decision making - Earl_s schools of KM – Institutional knowledge evolution cycle – Development, Acquisition, Refinement, Distribution, Deployment, leveraging – KM in software engineering – Managing software knowledge – Challenges of migrating to agile methodologies – Agile knowledge sharing – Role of story-cards – Story-card Maturity Model (SMM)

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING 9

Impact of agile processes in RE – Current agile practices – Variance – Overview of RE using agile – Managing unstable requirements – Requirements elicitation – Agile requirements abstraction model – Requirements management in agile environment – Agile requirements prioritization – Agile requirements modelling and generation – Concurrency in agile requirements generation.

UNIT V AGILITY AND QUALITY ASSURANCE 9

Agile Interaction Design – Agile product development – Agile metrics – Feature driven development (FDD) – Financial and production metrics in FDD – Agile approach to quality assurance - Test driven development – Pair programming: issues and challenges – Agile approach to global software development.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. John C.pasture, "Project Management the Agile Way Making It Work in the Enterprise", 2nd edition, Cengage Learning, 2016
2. Orit Hazzan, Yael Dubinsky, "Agile Software Engineering", 2nd edition, Springer, 2014

REFERENCES:

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), "Agile Software Development, Current Research and Future Directionsll",1st edition, Springer, 2010
2. Karl Weigers, John Beatty, "Software Requirement", 3rd edition, Microsoft Press US,2013

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose anyone / two components based on the nature of the course.

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PROFESSIONAL ELECTIVES

VERTICAL VI (IT AND IT ENABLED SERVICES (ITES))

		Category: PEC				
U21ITP16	SOTWARE TESTING TOOLS AND TECHNIQUES	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamentals of software testing and developing test cases for real time problems
- To describe the various testing strategies to improve the quality
- To explore the selenium tool for building test cases

COURSE OUTCOMES:

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

CO1: Explain the testing levels for various test cases using graph theory and basics of discrete mathematics (Understand)

CO2: Describe the variants of unit testing with the help of case studies (Understand)

CO3: Describe the importance of waterfall, agile and integration tesing strategies (Understand)

CO4: Demonstrate the functionalities of selenium tool for software testing (Apply)

CO5: Apply the selenium tool for real time test cases (Apply)

CO-PO MAPPING:

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

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I INTRODUCTION **9**

Basic definitions – Test cases – Insights from a venn diagram – Identifying test cases – Fault taxonomies – Levels of Testing – Discrete math for testers – set theory – Functions – Relations – Propositional logic – Graph theory for testers – Graphs – Directed graphs – Graphs for testing

UNIT II UNIT TESTING **9**

Boundary value testing – Robust boundary value testing – special value testing – Examples – Random testing – Equivalence class testing – Equivalence classes – Traditional equivalence class testing – Improved equivalence class testing – Decision table-based testing – Decision tables – Decision table techniques – Case study: Triangle problem and NextDate function

UNIT III TESTING STRATEGIES 9

Life cycle-based testing – Traditional waterfall testing – Testing in iterative lifecycles – Agile testing – Integration testing: Decomposition based integration – Call graph-based integration – Path based integration – Model based integration testing

UNIT IV AUTOMATION TESTING 9

Automation testing, Advantages and disadvantages, History of selenium, Why selenium – Difference between selenium and other tools – Components – Variables and datatypes – Control statements – Arrays – Strings and functions – Classes and objects – Inheritance and polymorphism – Exception handling – Collections and File Handling

UNIT V IFRAMES IN WEB DEVELOPMENT 9

Generating scripts – Wait commands – Validation commands – Store commands – Limitations – Sample program – Navigation – Radio buttons and checkbox – Drop down list – File upload – Drag and drop – Error and alert messages – Multiple windows – Iframes – Web table and calendar – types and use of framework – Execution of programs – Checking reports – Implementing listeners – Run group test cases

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods
Total 45 Periods

TEXT BOOKS:

1. Paul C.Jorgensen, Byron Devries, "Software Testing: A craftsman's Approach", 5th edition, CRC Press, 2021
2. Navneesh Garg, "Test Automation using Selenium WebDriver with Java: Step by Step Guide" 1st edition, AdactIn Group, 2014

REFERENCES:

1. Ralf Bierig, Stephen brown, Edgar Galvan, Joe Timoney, "Essentials of Software Testing", 1st edition, Cambridge University Press, 2022
2. Gerard O'Regan, "Concise Guide to Software testing", 1st edition, Springer Nature, 2019
3. William E.Lewis, David D.Dobbs, Gunasekaran Veerapillai, "Software Testing and Continuous Quality Improvement",3rd edition, CRC press, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
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Total				40	60
				100	

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