



**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 Curriculum and Syllabi Regulations – 2021 (Revised)**

**B.E. – CS – 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 the 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 foster the needs of students by providing learner centric teaching environment, continuous learning, research and development to become thriving professionals and entrepreneurs to excel in the field of computer science and contribute to the society.

**Mission**

The Mission of the Department is to

- ❖ Provide holistic education incorporating the state-of-the-art technologies to produce successful professionals
- ❖ Facilitate the students to pursue higher education and research in the areas related to Computer Science and Engineering
- ❖ Promote strong collaborations with the industries and steer the students to nurture their interest in continuous learning to meet the changing needs of the society

**III. Program Educational Objectives (PEOs)**

The Program Educational Objectives (PEOs) of the Computer Science and Engineering (CSE) represent major accomplishments that the graduates are expected to achieve after three to five years of graduation.

**PEO1:** Acquire knowledge and skills on cutting edge technologies in the field of computer science

**PEO2:** Inculcate a passion for continuous learning through further studies and research in the field of computer science and engineering

**PEO3:** Develop innovative ideas upholding the rich value systems to solve the changing


**IV. Program Outcomes (POs)**

Graduates of Computer Science and Engineering will be able to

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

**PO 2 Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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**PO 3 Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO 4 Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO 5 Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**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 team work:** 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.

#### **V. Program Specific Outcomes (PSOs)**

Graduates of Computer Science and Engineering will be able to

**PSO 1:** Solve complex engineering problems by building integrated systems across various domains of Computational Intelligence.

**PSO 2:** Apply technical skills to produce solutions that meets the requirement of the emerging technologies in Computer Science Engineering.

  
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**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	2	2	3	3	2
PEO2	3	3	3	-	-	2	1	2	2	3	3	3
PEO3	3	3	3	3	-	2	2	2	1	3	3	3

  
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VII. Mapping of Course Outcomes with Program Outcomes

SEM	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
SEM I	Heritage of Tamils	-	-	-	-	-	✓	✓	✓	-	✓	-	✓	-	-
	Calculus and Differential Equations	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓	✓
	Basics of Electrical and Electronics Engineering	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	✓
	English for Technologists	-	-	-	-	-	-	-	✓	✓	✓	-	✓	-	-
	Engineering Physics	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
	Engineering Chemistry	✓	✓	-	-	-	✓	-	-	✓	✓	-	✓	-	-
	Problem Solving and C Programming	✓	✓	✓	✓	-	-	-	✓	✓	✓	-	✓	✓	-
	Engineering Graphics	✓	✓	✓	-	✓	-	-	✓	✓	-	✓	✓	-	-
	Tamils and Technology	-	-	-	-	-	-	✓	✓	✓	-	✓	-	-	-
	Fourier Analysis and Partial Differential Equations	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓	✓
SEM II	Numerical Methods	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓	✓
	Material Science	✓	✓	-	-	-	✓	-	-	-	-	-	✓	-	-
	Personality Enhancement	-	-	-	-	-	-	-	✓	✓	✓	-	✓	-	-
	Python Programming	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	✓
	Digital Electronics	✓	✓	✓	✓	-	-	-	✓	✓	✓	-	✓	-	-
	Engineering Studio	✓	✓	-	-	✓	-	-	-	-	✓	-	✓	✓	-
	Discrete Mathematics	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓	✓
SEM III	Computer Organization and Architecture	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	-	✓
	Database Management Systems	✓	✓	✓	-	✓	-	-	-	✓	✓	-	✓	✓	-
	Data Visualization	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	-
	Data Structures	✓	✓	✓	✓	-	✓	-	✓	✓	✓	-	✓	✓	-
		✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	✓	-

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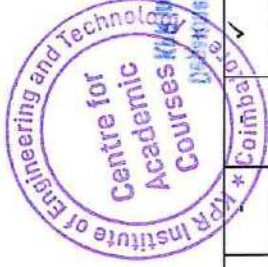




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	Soft Skills – III	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
SEM VII	Human Values and Ethics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Internet Security Practices	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Project Work Phase – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Project Work Phase – II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Vertical I Data Science	Mathematical Foundation for Data Science	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Pattern Recognition	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Speech Processing and Analytics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Web Mining	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Exploratory Data Analysis and Visualization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Predictive Analytics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Time Series Analysis and Forecasting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Health care Analytics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Knowledge Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Soft computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Vertical II Artificial Intelligence and Machine Learning	Deep Neural Networks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Reinforcement Learning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Computer Vision		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Feature Engineering		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Object Detection & Face Recognition		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Text and Visual Analytics		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Vertical III Cloud	Foundations of Cloud Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Data Storage and Management in Cloud	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

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Computing and Data Processing Technologies	Virtualization Techniques	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																		
Vertical IV Networking and Cyber Security	Security and Privacy in Cloud	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓															
	Data Analysis in Cloud Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓														
	Edge Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												
	Cloud Service Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												
	Big Data Integration and Processing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												
	Parallel and Distributed Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												
	Mobile Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												
	Wireless Sensor Networks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓											
Vertical V Full Stack Development	Software Defined Networks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
	Cyber Security	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							
	Internet Security	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
	Ethical Hacking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	Digital Forensics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	UI / UX Design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
	Python Web Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Vertical V Full Stack Development	App Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	JavaScript frameworks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	Webservices and API Design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	SOA and Microservices	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Cloud Native Applications Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	Devops	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Next Generation Networks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

*[Signature]*

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Computer - 041 003  
 Department of Engineering and Technology  
 Head of the Department



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Vertical VI	Game Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	-	
IT and IT Enabled Services (ITeS)	Blockchain Technologies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Augmented Reality /Virtual Reality	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Quantum Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Graphics Processing Unit	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Agile Methodologies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Software Testing Tools and Techniques	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Introduction to Innovation, IP Management and Entrepreneurship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	IT Project Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	E – Business Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Recommender Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Industrial Psychology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Marketing Research and Marketing Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Human Resource Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Financial Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Comprehension Electives	Comprehension – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Comprehension – II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vertical VII		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

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**B.E. COMPUTER SCIENCE AND ENGINEERING**

**REGULATIONS – 2021 (Revised)**

**For the students admitted 2022 onwards**

**CHOICE BASED CREDIT SYSTEM**

**CURRICULUM FOR I - VIII SEMESTERS**

**SEMESTER I**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C	
<b>THEORY COURSES</b>									
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	
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>									
4	U21EN101	English for Technologist	HSMC	1	0	2	0	2	
5	U21PH101	Engineering Physics	BSC	2	0	2	0	3	
6	U21CY101	Engineering Chemistry	BSC	2	0	2	0	3	
7	U21CSG01	Problem Solving and C Programming	ESC	2	0	2	0	3	
<b>LABORATORY COURSES</b>									
8	U21MEG01	Engineering Graphics	ESC	0	0	4	0	2	
<b>MANDATORY NON CREDIT COURSES</b>									
9	U21MYC01	Induction program	MNC	Three Weeks					
<b>TOTAL</b>				<b>14</b>	<b>1</b>	<b>12</b>	<b>0</b>	<b>21</b>	

**SEMESTER II**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21GEG02	Tamils and Technology	HSMC	1	0	0	0	1
2	U21MA203	Fourier Analysis and Partial Differential Equations	BSC	3	1	0	0	4
3	U21MA207	Numerical Methods	BSC	3	1	0	0	4
4	U21PH201	Material Science	BSC	2	0	0	0	2
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
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
<b>LABORATORY COURSES</b>								
8	U21ECG03	Engineering studio	ESC	0	0	4	0	2
<b>MANDATORY NON CREDIT COURSES</b>								
9	U21MYC02	Environmental Sciences	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>15</b>	<b>2</b>	<b>10</b>	<b>0</b>	<b>21</b>

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## SEMESTER III

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21MAG02	Discrete Mathematics	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
<b>THEORY COURSE WITH PROJECT COMPONENT</b>								
4	U21CS303	Data Visualization	PCC	2	0	0	4	4
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
5	U21CSG03	Data Structures	PCC	2	0	2	0	3
6	U21CSG04	Java Programming	PCC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
7	U21CS304	Database Management Systems Laboratory	PCC	0	0	4	0	2
8	U21CS305	Design Studio I	EEC	0	0	0	2	1
<b>MANDATORY NON CREDIT COURSES</b>								
9	U21MYC03	Essence of Indian Traditional Knowledge	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>16</b>	<b>1</b>	<b>8</b>	<b>6</b>	<b>23</b>

## SEMESTER IV

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21MA403	Probability and Queuing Theory	BSC	3	0	0	0	3
2	U21CS401	Design and Analysis of Algorithms	PCC	3	0	0	0	3
3	U21CS402	Theory of Computation	PCC	3	0	0	0	3
4	U21CS403	Operating Systems	PCC	3	0	0	0	3
5	U21AMG05	AI Fundamentals and Machine Learning	PCC	3	0	0	0	3
6		Open Elective – I	OEC	3	0	0	0	3
<b>LABORATORY COURSE</b>								
7	U21SSG01	Soft Skills - I	HSMC	0	0	2	0	1
8	U21CS404	Operating Systems Laboratory	PCC	0	0	2	0	1
9	U21CS407	Design Studio II	EEC	0	0	0	2	1
<b>LABORATORY COURSES WITH PROJECT COMPONENT</b>								
10	U21AMG06	AI Fundamentals and Machine Learning Laboratory	PCC	0	0	2	2	2
<b>MANDATORY NON CREDIT COURSES</b>								
11	U21MYC04	Indian Constitution	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>19</b>	<b>0</b>	<b>6</b>	<b>4</b>	<b>23</b>




## SEMESTER V

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21MA501	Linear Algebra and Number Theory	BSC	3	0	0	0	3
2	U21CS501	Web Technologies	PCC	3	0	0	0	3
3	U21CS502	Compiler Design	PCC	3	0	0	0	3
4		Professional Elective - I	PEC	3	0	0	0	3
5		Professional Elective - II	PEC	3	0	0	0	3
6		Open Elective - II	OEC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
7	U21CSG05	Computer Networks	PCC	2	0	2	0	3
8	U21CS503	Mobile Application Development	PCC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
8	U21SSG02	Soft Skills - II	HSMC	0	0	2	0	1
9	U21CS505	Proto Studio I	EEC	0	0	0	2	1
<b>LABORATORY COURSE WITH PROJECT COMPONENT</b>								
10	U21CS504	Web Technologies Laboratory	PCC	0	0	2	2	2
<b>MANDATORY NON CREDIT COURSES</b>								
11	U21MYC05	Cyber Security Essentials	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>23</b>	<b>0</b>	<b>8</b>	<b>4</b>	<b>28</b>

## SEMESTER VI

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21CS601	Cryptography Techniques	PCC	3	0	0	0	3
2	U21CS602	Object Oriented Software Engineering	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
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
6	U21ECG04	Internet of Things and its applications	PCC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
7	U21SSG03	Soft Skills - III	HSMC	0	0	2	0	1
8	U21CS605	Proto Studio II	EEC	0	0	0	2	1
<b>LABORATORY COURSE WITH PROJECT COMPONENT</b>								
9	U21CS604	Object Oriented Software Engineering Laboratory	PCC	0	0	2	2	2
<b>MANDATORY NON CREDIT COURSES</b>								
10	U21MYC06	Introduction to UN SDGs: An Integrative Approach	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>6</b>	<b>4</b>	<b>22</b>

  
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## SEMESTER VII

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21CBG701	Human Values and Ethics	HSMC	3	0	0	0	3
2		Professional Elective - V	PEC	3	0	0	0	3
3		Professional Elective - VI	PEC	3	0	0	0	3
4		Open Elective - IV	OEC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
5	U21CS704	Internet Security Practices	PCC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
6	U21CS703	Project work phase - I	EEC	0	0	0	4	2
<b>TOTAL</b>				<b>14</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>17</b>

## SEMESTER VIII

<b>LABORATORY COURSES</b>								
1	U21CS802	Project work phase - II	EEC	0	0	0	16	8
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>8</b>

<b>LABORATORY COURSES</b>								
1	U21CSI01	Industrial Training / Internship *	EEC	0	0	0	0	2
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>

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

  
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**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
				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)	Vertical VII Management and Marketing
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	U21CBP01 - Introduction to Innovation, IP Management and Entrepreneurship
U21ADP02 - Pattern Recognition	U21AMP02 - Soft computing	U21CSP02-Data Storage and Management in Cloud	U21ITP02- Mobile Computing	U21CSP10-Python Web Development	U21ITP10-Game Development	U21CBP02 - IT Project Management
U21ADP03 - Speech Processing and Analytics	U21AMP03 - Deep Neural Networks	U21CSP03- Virtualization Techniques	U21ITP03 - Wireless Sensor Networks	U21CSP11-App Development	U21ITP11-Blockchain Technologies	U21CBP03 - E – Business Management
U21ADP04 - Web Mining	U21AMP04 - Reinforcement Learning	U21CSP04-Security and Privacy in Cloud	U21ITP04 - Software Defined Networks	U21CSP12- JavaScript frameworks	U21ITP12-Augmented Reality /Virtual Reality	U21CBP04 - Recommender Systems
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	U21CBP05 - Industrial Psychology
U21ADP06 - Predictive Analytics	U21AMP06 - Feature Engineering	U21CSP06-Edge Computing	U21ITP06 - Internet Security	U21CSP14-SOA and Microservices	U21ITP14-Graphics Processing Unit	U21CBP06 - Marketing Research and Marketing Management
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	U21CBP07 - Human Resource Management
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	U21CBP08 - Financial Management

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**Registration of Professional Elective Courses from Verticals:**

Professional Elective Courses will be registered in Semesters V to 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.



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**PROFESSIONAL ELECTIVE COURSES: VERTICALS****VERTICAL I: 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 II: 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

  
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**VERTICAL III: 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

**VERTICAL IV: 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



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**VERTICAL V: 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 VI: 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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**VERTICAL VII: MANAGEMENT AND MARKETING**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21CBP01	Introduction to Innovation, IP Management and Entrepreneurship	PEC	3	0	0	0	3
2	U21CBP02	IT Project Management	PEC	3	0	0	0	3
3	U21CBP03	E – Business Management	PEC	3	0	0	0	3
4	U21CBP04	Recommender Systems	PEC	3	0	0	0	3
5	U21CBP05	Industrial Psychology	PEC	3	0	0	0	3
6	U21CBP06	Marketing Research and Marketing Management	PEC	3	0	0	0	3
7	U21CBP07	Human Resource Management	PEC	3	0	0	0	3
8	U21CBP08	Financial Management	PEC	3	0	0	0	3

**COMPREHENSION ELECTIVES**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21CSP17	Comprehension – I	PEC	3	0	0	0	3
2	U21CSP18	Comprehension – II	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	U21CSX01	Database Systems	OE	3	0	0	0	3
2	U21CSX02	Cloud Computing Essentials	OE	3	0	0	0	3

#### OPEN ELECTIVES – II (SEMESTER: V)

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21CSX03	Computational Thinking	OE	3	0	0	0	3
2	U21CSX04	Block Chain Fundamentals	OE	3	0	0	0	3

#### OPEN ELECTIVES – III (SEMESTER: VI)

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21GEX01	Digital Engineering	OE	3	0	0	0	3
2	U21CSX05	User Interface Design	OE	3	0	0	0	3

#### OPEN ELECTIVES – IV (SEMESTER: VII)

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21CSX06	Foundations of AR/VR	OE	3	0	0	0	3
2	U21CSX07	Foundations of Multimedia and Animations	OE	3	0	0	0	3

  
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**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	3	-	12
2.	Basic Science Courses (BSC)	10	10	4	3	3	-	-	-	30
3.	Engineering Science Courses (ESC)	8	8	-	-	-	-	-	-	16
4.	Professional Core Courses (PCC)	-	-	18	15	14	11	3	-	61
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	2
9.	Mandatory Non-Credit Course (MNC)	-	-	-	-	-	-	-	-	-
<b>Total</b>		<b>21</b>	<b>21</b>	<b>23</b>	<b>23</b>	<b>28</b>	<b>22</b>	<b>17</b>	<b>10</b>	<b>165</b>

*[Signature]*  
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## SEMESTER I

U21GEG01	HERITAGE OF TAMILS	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

- To learn the extensive literature of classical tamil
- To review the fine arts heritage of tamil culture
- To realise the contribution of tamils in Indian freedom struggle

## COURSE OUTCOMES:

**CO1:** To understand the extensive literature of tamil and its classical nature (Understand)

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

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

**CO4:** Realisation of thinal concepts, trade and victory chola dynasty (Understand)

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

## CO-PO MAPPING:

COs \ POs	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

  
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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. பொருளை - 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) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.



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U21GEG01	தமிழர் மரபு	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

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

- To learn the extensive literature of classical tamil
- To review the fine arts heritage of tamil culture
- To realise the contribution of tamils in Indian freedom struggle

**COURSE OUTCOMES:**

**CO1:** To understand the extensive literature of tamil and its classical nature (Understand)

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

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

**CO4:** Realisation of thinaï concepts, trade and victory chola dynasty (Understand)

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

**CO-PO MAPPING:**

COs \ POs	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:**

**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

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**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 திருவள்ளூர் 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, கையெழுத்துப்படிிகள் - தமிழ்ப் புத்தகங்களின் அச்ச 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. பொருளை - 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) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book



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SEMESTER I

U21MA101	<b>CALCULUS AND DIFFERENTIAL EQUATIONS</b> (Common to AD, BM, CE, CH, CS, CS(AIML), EC, IT, ME, MI)	Category: BSC				
		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:**

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

**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

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**UNIT III MULTIPLE INTEGRALS**

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", 10<sup>th</sup> Edition, Wiley India Pvt Ltd, New Delhi, 2018.
2. Grewal B S, "Higher Engineering Mathematics", 44<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2017.

**REFERENCES:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
Individual Assignment / Seminar / MCQ	Written Test	Individual Assignment / Seminar / 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 any one / two components based on the nature of the course.



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U21EEG01	<b>BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING</b> (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:**

COs \ POs	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	1	1
CO5	3	2	1	-	-	-	-	-	-	-	-	1	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      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)

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**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", McGraw–Hill Education, New Delhi, 5<sup>th</sup> Edition, Jul 2017.
2. R.K.Rajput, "Electrical Machines", Laxmi Publications, 6<sup>th</sup> Edition, Jan 2016.
3. V.K Metha and Rohit Metha, "Principles of Electronics", S.Chand Publications, 12<sup>th</sup> Edition, 2020.

**REFERENCES:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
*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 any one / two components based on the nature of the course.


  
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U21EN101	ENGLISH FOR TECHNOLOGISTS (Common to AD, BM, CH, CE, CS, CS(AIML), EE, EC, ME, MI, IT)	Category: HSMC				
		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:**

Cos \ POs	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

**Module:3 Opinion Paragraph**

Activity: Note making, analyzing and writing a review

**UNIT II      CAREER ENHANCEMENT****Module:4 Reading Comprehension**


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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

**TEXT BOOKS:**

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



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**REFERENCES:**

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

**EVALUATION PATTERN:**

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

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



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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<sub>2</sub> laser – Semiconductor laser – Material Processing – Selective laser Sintering – Hologram – Medical applications (Ophthalmology)

**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**

Properties of ultrasonic waves – Piezoelectric 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", 2<sup>nd</sup> Edition, Oxford University Press, Chennai, 2017
2. Marikani A, "Engineering Physics", 3<sup>rd</sup> Edition, PHI publishers, Chennai, 2021

**REFERENCES:**

1. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", 2<sup>nd</sup> 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", 2<sup>nd</sup> Edition, S Chand Publishing, New delhi, 2018
3. Thyagaran K, Ajoy Ghatak, "Lasers – Fundamantals and Applications", 2<sup>nd</sup> Edition, Laxmi Publications Pvt Limited, New delhi, 2019
4. <https://nptel.ac.in/downloads/104104085/>
5. <https://nptel.ac.in/courses/122107035/8/>



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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					

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



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U21CY101	ENGINEERING CHEMISTRY (Common to all BE./B.Tech. courses)	Category: BSC				
		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:**

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

**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", 16<sup>th</sup> Edition, Dhanpat Rai Publishing Company, Pvt. Ltd., New Delhi, 2015
2. Vairam S, Kalyani P and Suba Ramesh, "Engineering Chemistry", 2<sup>nd</sup> Edition, Wiley India Pvt. Ltd, New Delhi, 2014



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**REFERENCES:**

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

**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	
<b>Total: 100</b>					

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



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U21CSG01	PROBLEM SOLVING AND C PROGRAMMING (Common to All Branches)	Category: PCC				
		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	-	-
CO2	2	1	1	2	-	-	-	1	2	2	-	2	2	-
CO3	3	2	2	2	-	2	-	1	2	2	-	2	-	-
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, 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 –

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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 28 and best sell is at 39.
5. Collect 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



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- Prepare chart

**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”, 1<sup>st</sup> Edition, CRC Press, 2014
2. Brian W. Kernighan and Dennis Ritchie, “ The C Programming Language” , 2<sup>nd</sup> Edition, Pearson, 2015

**REFERENCES:**

1. Paolo Ferragina and Fabrizio Luccio, “Computational Thinking First Algorithms”, Then Code” ,1<sup>st</sup> Edition, Springer International Publishing, 2018
2. Reema Thareja, “Programming in C”, 2<sup>nd</sup> Edition, Oxford University Press, 2016
3. Paul Deitel and Harvey Deitel, “C How to Program”, 7<sup>th</sup> Edition, Pearson Publication
4. Juneja, B. L and Anita Seth, “Programming in C”, 1<sup>st</sup> Edition, Cengage Learning India Pvt. Ltd., 2011
5. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, 1<sup>st</sup> Edition, Oxford University Press, 2009

**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	
<b>Total: 100</b>					

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



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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:**

COs \ POs	POs													
	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 – Rectang – 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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

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



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U21GEG02	TAMILS AND TECHNOLOGY	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

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

- To learn the extensive literature of classical tamil
- To review the fine arts heritage of tamil culture
- To realise the contribution of tamils in Indian freedom struggle

**COURSE OUTCOMES:**

**CO1:** To understand the extensive literature of tamil and its classical nature (Understand)

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

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

**CO4:** Realisation of thinaï concepts, trade and victory chola dynasty (Understand)

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

**CO-PO MAPPING:**

COs \ POs	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

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**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 beads - 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) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.



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U21GEG02	தமிழரும் தொழில்நுட்பமும்	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

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

- To learn the extensive literature of classical tamil
- To review the fine arts heritage of tamil culture
- To realise the contribution of tamils in Indian freedom struggle

**COURSE OUTCOMES:**

CO1: To understand the extensive literature of tamil and its classical nature (Understand)

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

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

CO4: Realisation of thinaï concepts, trade and victory chola dynasty (Understand)

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

**CO-PO MAPPING:**

COs \ POs	POs												PSOs	
	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:**

**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

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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 தொழிநுட்பம் 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 கணித்தமிழ் 3**

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் 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. பொருளை - 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) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.



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U21MA203	FOURIER ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS (for CS)	Category: BSC				
		L	T	P	J	C
		3	1	0	0	4

**PRE-REQUISITES:**

- U21MA101 : Calculus and Differential Equations

**COURSE OBJECTIVES:**

- To understand the concepts of PDE and its solutions
- To understand the concept of Fourier transform techniques in the field of engineering
- To understand the concepts of mathematical aspects that contribute to the solution of One dimensional wave and heat equation

**COURSE OUTCOMES:**

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

- CO1: Apply a range of techniques to find solutions of standard partial differential equations (Apply)
- CO2: Use the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series (Understand)
- CO3: Analyze the spectral characteristics of signals using Fourier transforms (Apply)
- CO4: Apply Fourier series to solve an initial–boundary value problem for one dimensional wave and heat equation (Apply)
- CO5: Apply Fourier series to solve an initial–boundary value problem for two dimensional heat equation (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I      PARTIAL DIFFERENTIAL EQUATIONS**

9 + 3

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Solution methods for second order homogeneous equations with constant coefficients

**UNIT II      FOURIER SERIES**

9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range series – Parseval's identity – Harmonic analysis

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**UNIT III    FOURIER TRANSFORM**

Fourier transform pair – Fourier sine and cosine transforms – Properties (Without proof) – Transforms of simple functions – Convolution theorem – Parseval's identity

**UNIT IV    ONE DIMENSIONAL BOUNDARY VALUE PROBLEMS** 9 + 3

Fourier series solution – Vibration of strings – One dimensional wave equation – One dimensional heat flow equation (unsteady state)

**UNIT V    TWO DIMENSIONAL BOUNDARY VALUE PROBLEMS** 9 + 3

Fourier series solution – Two dimensional (steady state) heat flow equations(Cartesian form only) – Separation of variables

**Contact Periods:**

Lecture:    45 Periods    Tutorial: 15 Periods    Practical: – Periods    Project: – Periods  
Total: 60 Periods

**TEXT BOOKS:**

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

**REFERENCES:**

1. Bali N P and Dr Manish Goyal, "A text book of Engineering Mathematics", 12<sup>th</sup> Edition, Laxmi Publications, 2016.
2. Wylie C. R. and Barrett L. C, "Advanced Engineering Mathematics", 6<sup>th</sup> edition, Tata McGraw-Hill, New Delhi, 2016.
3. Narayanan S, Manicavachagom Pillay T. K. and Ramanaiah G, "Advanced Mathematics for Engineering Students", Vol. II & III, 2<sup>nd</sup> edition, S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

**EVALUATION PATTERN:**

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

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



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U21MA207	NUMERICAL METHODS (For CS)	Category: BSC				
		L	T	P	J	C
		3	1	0	0	4

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the concepts of direct and iterative method for solving algebraic and transcendental equations using numerical methods of interpolation
- To obtain the solution of differentiation and integration using standard numerical techniques in solving kinematics simulation and composite materials
- To understand the concepts of ordinary and partial differential equations in elastic beams and elastic bars using numerical techniques

**COURSE OUTCOMES:**

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

**CO1:** Identify the basic concepts of solving algebraic and transcendental equations (Understand)

**CO2:** Apply interpolation methods for given discrete data set (Understand)

**CO3:** Apply numerical differentiation and integration methods to find numerical solutions of ordinary and partial differential equations (Understand)

**CO4:** Solve initial value problems of ordinary differential equations using numerical techniques (Understand)

**CO5:** Use finite difference techniques, implicit and explicit methods for solving boundary value problem of partial differential equations (Understand)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I      SYSTEM OF EQUATIONS****9 + 3**

Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Gauss Seidel method

**UNIT II      INTERPOLATION****9 + 3**

Interpolation with equal intervals – Newton's forward and backward difference formulae –  
Interpolation with unequal intervals – Lagrange interpolation

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**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION****9 + 3**

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Evaluation of double integrals by Trapezoidal rule

**UNIT IV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS****9 + 3**

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations

**UNIT V NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS****9 + 3**

Finite difference method – Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method

**Contact Periods:**

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project – Periods  
 Total 60 Periods

**TEXT BOOKS:**

1. Burden R L and Faires J D, "Numerical Analysis", 9<sup>th</sup> Edition, Cengage Learning, 2016.
2. Grewal B S and Grewal J S, "Numerical Methods in Engineering and Science", 10<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2015.

**REFERENCES:**

1. Jain M K, Iyengar S R K., Jain R K, "Numerical Methods for Scientific and Engineering computation", 6<sup>th</sup> Edition, New Age international publishers, 2019.
2. Sastry S S, "Introductory Methods of Numerical Analysis", 5<sup>th</sup> Edition, PHI Learning Pvt. Ltd, 2015.
3. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", 7<sup>th</sup> Edition Tata McGraw-Hill, New Delhi, 2017.

**EVALUATION PATTERN:**

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

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



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U21PH201	<b>MATERIALS SCIENCE</b> (Common to all branches except BME)	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:**

COs \ POs	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

**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

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**UNIT IV DIELECTRIC AND OPTICAL MATERIALS**

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

**UNIT V NEW ENGINEERING MATERIALS AND CHARACTERIZATION TECHNIQUES**

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", 3<sup>rd</sup> Edition, Narosa Publishing House, Chennai, 2018
2. Marikani A, "Materials Science", 1<sup>st</sup> Edition, PHI publishers, Chennai, 2017

**REFERENCES:**

1. Pillai S O "Solid State Physics", 9<sup>th</sup> Edition, New Age International Publishers, New Delhi, 2020
2. Bangwei Zhang, "Physical Fundamentals of Nanomaterials", Chemical Industry Press, China, 2018
3. Joginder Singh Galsin, "Solid State Physics – An Introduction to Theory", 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				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 any one / two components based on the nature of the course.



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U21EN201	<b>PERSONALITY ENHANCEMENT</b> (Common to AD, BM, CH, CE, CS, CS(AIML),EE,EC,ME,MI,IT)	Category: HSMC				
		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:**

Cos \ POs	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****Module:4 Etiquettes**

Activity: Brain storming & performing in actions

9

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**Module:5 Introspection**

Activity: SWOT Analysis, Goal Setting

**Module:6 Co-verbal Gesture**

Activity: Body Language, Non verbal cues

**UNIT III ART OF NETWORKING**

9

**Module:7 Addressing a Multitude**

Activity: Welcome address, Vote of Thanks, Public Speaking

**Module:8 Persuasive 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", 1<sup>st</sup> Edition, Oxford University Press. 2018.
2. Barun. K.Mitra. "Personality Development and Soft Skills", OUP India. 2<sup>nd</sup> Edition, 2016.



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**REFERENCES:**

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

**EVALUATION PATTERN:**

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

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



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U21CSG02	PYTHON PROGRAMMING (Common to All Branches)	Category: PCC				
		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	-	-
CO2	2	1	1	2	-	-	-	1	2	2	-	2	-	-
CO3	3	2	2	2	-	-	-	1	2	2	-	2	2	-
CO4	3	2	2	2	-	-	-	1	2	2	-	2	2	-
CO5	3	2	2	2	1	-	-	1	2	2	-	2	2	2
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

**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.
2. 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.
3. Strings and its operations.
4. 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.
5. List and its operations.
6. Programs for positive and negative indexing.
7. Program to check if the given list is in Ascending order or Not.
8. Tuples and its operations.
9. Python program to convert a tuple to a string.
10. Python program to reverse a tuple.
11. Sets and its operations.
12. Python program to check if a set is a subset of another set.
13. Dictionaries and its operations.
14. Python program to iterate over dictionaries using for loops.
15. Computations using NumPy functions.
16. NumPy program to convert a list of numeric value into a one-dimensional NumPy array.
17. NumPy program to convert a list and tuple into arrays.
18. Data manipulations using Pandas.
19. Program to convert a NumPy array and series to data frames.
20. Program to add, subtract, multiple and divide two Pandas Series.
21. 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", 1<sup>st</sup> Edition, Oxford Press, 2017
2. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2<sup>nd</sup> Edition, Shroff/O'Reilly Publication, 2017

**REFERENCES:**

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2<sup>nd</sup> Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", 2<sup>nd</sup> Edition, McGrawHill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", 1<sup>st</sup> Edition, Pearson India Education Services Pvt. Ltd., 2016
4. <https://python-iitk.vlabs.ac.in/List%20of%20experiments.html>
5. <http://greenteapress.com/wp/think-python/>



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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					

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



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U21ECG01	<b>DIGITAL ELECTRONICS</b> (Common to EC, BM, CS, CSBS , AI & ML , IT and AD : For CS, CSBS , AI & ML , IT and AD, It is offered during II Semester and For EC and BM, It is offered during III Semester)	Category: ESC				
		L	T	P	J	C
		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:**

COs \ POs	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

**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

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**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", 6<sup>th</sup> Edition, Pearson, 2018
2. Charles H. Roth, Jr, Larry L. Kinney "Fundamentals of logic design", 7<sup>th</sup> Edition, Kluwer Academic Publishers, 2014

**REFERENCES:**

1. Thomas L.Floyd, "Digital Fundamentals", 11<sup>th</sup> Edition, Prentice Hall, 2015
2. A.Anand Kumar, "Fundamentals of Digital Circuits", 2<sup>nd</sup> Edition, PHI Learning, 2013
3. Ronald J Tocci, Neal S Widmer, Gregory L Moss, "Digital Systems Principles and Applications", 10<sup>th</sup> Edition, Pearson, 2009
4. D. Donald Givone, "Digital Principles and Design", 4<sup>th</sup> 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	
<b>Total: 100</b>					

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



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U21ECG03	ENGINEERING STUDIO (Common to all Programmes)	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	2
CO3	3	3	3	3	3	2	3	3	3	-	-	3	1	1

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

**Basics of IoT (With Arduino)**

1. Basics of ARDUINO and IoT  
Working with LEDs



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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:**

<b>Continuous Internal Assessments</b>
Evaluation of course workbook, Tasks <b>(Rubrics based)</b>
100



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U21MAG02	DISCRETE MATHEMATICS (Common to AD, CS, CS(AIML), CSBS)	Category: BSC				
		L	T	P	J	C
		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:**

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

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**

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 – sub group – 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", 2<sup>nd</sup> Edition, John Wiley and Sons, 2006
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7<sup>th</sup> 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", 7<sup>th</sup> Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2011

**REFERENCES:**

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

**EVALUATION PATTERN:**

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

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



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U21CS301	COMPUTER ORGANIZATION AND ARCHITECTURE (Common to AM, CB, CS, IT)	Category: PCC				
		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:**

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

**UNIT II DATAPATH AND CONTROL**

9

Fetching and Storing words – Register Transfer – Execution of instruction – Instruction codes – computer registers – computer instructions – timing & control – instruction cycle – memory

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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), 5<sup>th</sup> Edition, Morgan Kaufmann.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5<sup>th</sup> Edition, Tata McGraw Hill.

**REFERENCES:**

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

**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		
<b>40</b>	<b>60</b>	<b>40</b>	<b>60</b>	<b>200</b>	<b>100</b>
<b>Total</b>				<b>40</b>	<b>60</b>
				<b>100</b>	

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

  
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U21CS302	DATABASE MANAGEMENT SYSTEMS (Common to AM,CB,CS)	Category: PCC				
		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	2	2	-	-	-	-	-	-	-	-	2	3	-
CO5	2	1	-	-	1	-	-	-	-	-	-	2	2	-
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", 6<sup>th</sup> Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7<sup>th</sup> Edition, Pearson, 2017.

**REFERENCES:**

1. Pramod J. Sadalage and Marin Fowler, "NoSQL Distilled: A Brief guide to merging world of Polyglot persistence", 2<sup>nd</sup> Edition, Addison Wesley, 2012.
2. Ramakrishnan and Gehrke, "Database Management Systems", 3<sup>rd</sup> 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				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 any one / two components based on the nature of the course.



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U21CS303	DATA VISUALIZATION	Category: PCC				
		L	T	P	J	C
		2	0	0	4	4

**PRE-REQUISITES:**

- U21CSG02 : Python Programming

**COURSE OBJECTIVES:**

- Provide knowledge on visualization design principles and deciding the type of visualization chart to choose for the given sets
- Understand why visualization is an important part of data analysis
- Understand the fundamental design principles and different types of data visualization
- Explore, visualize and analyze various types of data sets such as geospatial and multimodal data
- Makes the students to work on visualization tools and enable the students to understand the visual analytics such as dashboards and storytelling with a hands-on tutorial on tableau and PowerBI

**COURSE OUTCOMES:**

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

- CO1:** Illustrate the importance of visual perception and learn to create basic charts by applying visualization design principles (Understand)
- CO2:** Apply visualization techniques for various data analysis tasks (Apply)
- CO3:** Explore and Analyze Geospatial and multimodal data (Apply)
- CO4:** Experiment to build interactive / animated dashboards construct data stories and communicate important trends / patterns in the datasets (Apply)
- CO5:** Illustrate the advanced data visualization techniques (Understand)

**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	1	2	2	-
CO2	3	2	-	2	2	2	-	1	2	2	2	2	3	-
CO3	3	2	2	2	2	2	-	1	2	2	2	2	3	-
CO4	3	2	2	2	2	2	-	1	2	2	2	2	3	-
CO5	2	1	2	2	2	2	-	1	2	2	1	2	2	-

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

**SYLLABUS:**

**UNIT I      OVERVIEW OF DATA VISUALIZATION      6**

Data Visualization – Introduction to SVG and CSS – Introduction to VizHub – Data Visualization techniques – Various levels of Visualization – Types of Data Visualization

**UNIT II      SHAPES OF DATA AND VISUALIZATION IDIOMS      6**

Input for Visualization – Data and Tasks – Loading and Parsing Data – Data Cleansing and its importance – Reusable Dynamic Components using the General Update Pattern – Reusable Scatter

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Plot – Common Visualization Idioms – Bar Chart – Vertical Pie Chart – Horizontal Pie Chart –  
Coxcomb Plot Line Chart – Area Chart – Criteria to choose charts

**UNIT III GEOSPATIAL DATA VISUALIZATION 6**

Visualization of Geospatial data: spatial join – Overlaying geospatial data to maps and adding special cues – Visualization of multimodal data and analysis – Case study sensor data and healthcare – Genome and biomedical data

**UNIT IV REPORTS FORMATTING AND DATA REDUCTION 6**

Using Color and Size in Visualization – Encoding Data using Color Encoding Data using Size Stacked and Grouped Bar Chart – Stacked Area Chart and Streamgraph Line Chart with Multiple Lines – Histograms Aggregating Data with Group – By Hexbin Mapping Cross filtering – Building a Migrant Deaths Dashboard – Reports Vs Dashboards

**UNIT V REVOLUTION OF VISUALIZATION IN BUSINESS ANALYTICS 6**

Business Analytics and Visualization Tools – Tableau – PowerBI and Other Visualization Tools – Creating Interactive Dashboards and charts to organize data using visualization principles – Data Storytelling – reading data in-depth – Identifying critical messages and communicating these messages in most effective way

**PROBLEM STATEMENTS(INDICATIVE)**

1. Health care – Disease Analysis and Prediction
2. E-Commerce – Payroll Process
3. Food Industry – Food Quality Analysis
4. Entertainment – Movie Analysis and Likes Prediction
5. Banking – Customer Transaction Analysis
6. Finance Industries – Year wise business turnover calculation
7. Real Estate Business – Profit prediction and Analysis
8. Education – Students' progress report, Rating of educational institutes

**Contact Periods:**

Lecture: 30 Periods      Tutorial: – Periods      Practical: 60 Periods      Project: – Periods  
Total 90 Periods

**TEXT BOOKS:**

1. Tamara Munzner, "Visualization Analysis and Design", A K Peters Visualization Series, 2<sup>nd</sup> Edition, CRC Press, 2015
2. Scott Murray, "Interactive Data Visualization for the Web", 1<sup>st</sup> Edition, O'Reilly, 2016
3. VanderPlas J. "Python data science handbook: Essential Tools for Working with Data", 2<sup>nd</sup> Edition, O'Reilly Media. Inc", 2016

**REFERENCES:**

1. Kieran Healy, Data Visualization: A Practical Introduction, 1<sup>st</sup> Edition, 2018
2. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, 1<sup>st</sup> Edition, New Riders, 2016
3. Nathan Yau, Visualize This: The Flowing Data Guide to Design, Visualization and Statistics, 1<sup>st</sup> Edition John Wiley & Sons, 2015.



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**EVALUATION PATTERN:**

Continuous Internal Assessments					Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)				
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	Review I	Review II	Project Report and Viva-Voce		
40	60	15	25	60	200	100
<b>Total</b>					40	60
					<b>100</b>	

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



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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-REQUISITE:**

- 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:**

COs \ POs	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)

**SYLLABUS:****UNIT I      LINEAR DATA STRUCTURES – LIST**

6

Abstract Data Types (ADTs) – 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

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 Total 60 Periods



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**TEXT BOOKS:**

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

**REFERENCES:**

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

**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					

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



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

**PRE-REQUISITE:**

- 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 – 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

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**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 STREAMS 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**

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", 11<sup>th</sup> Edition, McGraw Hill Education, 2018
2. Cay.S.Horstmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11<sup>th</sup> Edition, Pearson Education, 2020

**REFERENCES:**

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



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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					

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



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U21CS304	DATABASE MANAGEMENT SYSTEMS LABORATORY (Common to AM,CB,CS)	Category: PCC				
		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
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



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- 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", 6<sup>th</sup> Edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7<sup>th</sup> Edition, Pearson, 2017
3. R. Elmasri S. B. Navathe, "Fundamentals of Database Systems", 2<sup>nd</sup> Edition, Addison Wesley, 2015.
4. Shashank Tiwari, "Professional NOSql", 2<sup>nd</sup> Edition, Wiley, 2011.
5. Pramod J. Sadalage and Marin Fowler, "NoSQL Distilled: A Brief guide to merging world of Polyglot Persistence", 1<sup>st</sup> Edition, Addison 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
<b>Total: 100</b>					

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



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U21CS305	DESIGN STUDIO I	Category: EEC				
		L	T	P	J	C
		0	0	2	0	1

**PRE-REQUISITES:**

- U21ECG03: Engineering Studio

**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.

**CO2:** Apply the design thinking steps "Empathize, Define, ideate and prototype".

**CO3:** Create Experimental proof of concept (TRL 3)

**CO4:** Demonstrate teamwork, project management, technical report writing and presentation skills

**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	-	-	-	-	-
CO2	3	3	3	3	3	3	3	3	3	-	2	1	-	-
CO3	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO4	-	-	-	-	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.
- 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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**Contact Periods:**

Lecture: – Periods

Tutorial: – Periods

Practical: – Periods

Project – Periods

Total 30 Periods

**EVALUATION PATTERN:**

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



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U21MA403	PROBABILITY AND QUEUEING THEORY (Common to CS & IT)	Category: BSC			
		T	P	J	C
		3	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the mathematical concepts of probability, one and two dimensional random variables and distributions
- To understand the concepts of random processes which are widely used in IT fields
- To use the concept of queueing models in the field of engineering

**COURSE OUTCOMES:**

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

- CO1:** Apply probability theory and random variable as a need for the analysis of random experiment (Apply)
- CO2:** Use discrete and continuous probability distributions including requirements, mean and variance for making decisions (Understand)
- CO3:** Distinguish correlation and linear regression in two dimensional random variables (Understand)
- CO4:** Apply various Processes in low pass and band pass noise models (Apply)
- CO5:** Compute the traffic intensity, blocked traffic and the utilization of some queueing systems (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	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	1	-

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

**SYLLABUS:****UNIT I      PROBABILITY**

9

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

**UNIT II      DISTRIBUTION FUNCTIONS**

9

Binomial distribution – Poisson distribution – Exponential distribution – Uniform distribution – Normal distribution – Applications

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**UNIT III TWO – DIMENSIONAL RANDOM VARIABLES**

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

**UNIT IV RANDOM PROCESSES**

9

Classification – Stationary process – Markov chain – Bernoulli and Poisson Process

**UNIT V QUEUEING MODELS**

9

Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formulas with finite waiting rooms

**Contact Periods:**

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

**TEXT BOOKS:**

1. Oliver C. Ibe, "Fundamentals of Applied probability and Random processes", 2<sup>nd</sup> Edition, Elsevier, 2014
2. Gross D and Harris C M, "Fundamentals of Queueing Theory", Wiley Students 4<sup>th</sup> Edition, 2012

**REFERENCES:**

1. Allen A. O. "Probability, Statistics and Queueing Theory with computer applications", 2<sup>nd</sup> Edition, Elsevier, 2005
2. Taha H. A, "Operations Research", 9<sup>th</sup> Edition, Pearson Education, Asia, 2014
3. Trivedi K. S, "Probability and Statistics with Reliability, Queueing and computer science applications", 2<sup>nd</sup> Edition, John Wiley & sons, 2012
4. Narayanan S, Manicavachagom Pillay T. K and Ramanaiah G, "Advanced Mathematics for Engineering Students", Vol. II & III, 2<sup>nd</sup> Edition, S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
Individual Assignment / Seminar / MCQ	Written Test	Individual Assignment / Seminar / 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 any one / two components based on the nature of the course.



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U21CS401	DESIGN AND ANALYSIS OF ALGORITHMS	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21CSG04: Data Structures

**COURSE OBJECTIVES:**

- To understand the fundamental concepts in analysis of algorithms and efficiency
- To learn the various searching and sorting algorithms
- To understand graph algorithms and design techniques

**COURSE OUTCOMES:**

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

- CO1:** Apply the fundamental concepts of algorithmic problem-solving types (Apply)  
**CO2:** Analyze the fundamentals of the algorithm efficiency for real world problems (Analyze)  
**CO3:** Examine the searching and sorting techniques in the analysis of algorithms (Apply)  
**CO4:** Implement the graph algorithms with dynamic programming (Apply)  
**CO5:** Apply the algorithm design techniques for P and NP problems (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I      PROBLEM SOLVING      9**

Introduction – Fundamentals of Algorithmic Problem Solving – Important Problem types – Sorting problem – Searching problems – Combinatorial problems – Geometric Problems – Fundamental Data structures – Trees and Graphs

**UNIT II      FUNDAMENTALS OF ANALYSIS OF ALGORITHM EFFICIENCY      9**

Analysis Framework – Asymptotic notations – Basic Efficiency classes – Mathematical Analysis of Non – recursive Algorithm – Mathematical Analysis of Recursive Algorithm – Fibonacci Numbers – Empirical Analysis of Algorithms

**UNIT III      ANALYSIS OF SORTING AND SEARCHING ALGORITHMS      9**

Brute Force Strategy – Selection Sort and Bubble Sort – Sequential Search and Brute-force string matching – Closest pair and convex hull problem – Divide and conquer – Quick Sort – Binary Search

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**UNIT IV ANALYSIS OF GRAPH ALGORITHMS**

9

Balanced Search trees – AVL Trees – Dynamic Programming – Warshalls and Floyd Algorithm – Greedy Technique – Prims Algorithm – Kruskals Algorithm – Dijkstra Algorithm:

**UNIT V ALGORITHM DESIGN TECHNIQUES TO NP COMPLETE AND NP HARD PROBLEMS**

9

Limitations of algorithm power – P, NP and NP complete problems – Coping with limitation of algorithm power – Backtracking – N-Queens Problem – Hamiltonian Circuit problem – Approximation algorithms for NP hard problems

**Contact Periods:**

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

**TEXT BOOKS:**

1. R Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3<sup>rd</sup> Edition, Pearson Education Asia, 2019
2. A A Putambekar, "Design and Analysis of Algorithms", 1<sup>st</sup> Edition, Technical Publications, 2015

**REFERENCES:**

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", 3<sup>rd</sup> Edition, PHI Pvt. Ltd., 2015
2. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", 1<sup>st</sup> Edition, Pearson Education Asia, 2016
3. A.V.Aho, J.E. Hopcroft and J.D.Ullman, "The Design and Analysis of Computer Algorithms", 1<sup>st</sup> Edition, Pearson Education Asia, 2013

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CS402	THEORY OF COMPUTATION	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21MAG02: Discrete Mathematics

**COURSE OBJECTIVES:**

- To study the concept of finite automata with its types and construction
- To understand the context free grammar for any given language
- To learn Turing machines, decidable and undecidable problems

**COURSE OUTCOMES:**

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

**CO1:** Construct finite automata for a given language with its types (Apply)

**CO2:** Prove the equivalence of languages described by finite automata and regular expressions (Apply)

**CO3:** Construct CFG for a given language, simplify and transform to a normal form (Understand)

**CO4:** Design Push Down Automata, convert into CFG and vice-versa (Apply)

**CO5:** Construct Turing machine and prove the undecidability or complexity of a variety of problems (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I      FUNDAMENTALS OF FINITE AUTOMATA      9**

Introduction – Finite State Systems – Finite Automata – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon Transitions – Equivalence of NFA and DFA – Equivalence of NFAs with and without Epsilon moves

**UNIT II      REGULAR EXPRESSIONS AND LANGUAGES      9**

Regular Expressions – Equivalence of Finite Automata and Regular Expressions – Pumping lemma for regular sets – Closure properties of regular languages – Equivalence and minimization of automata

**UNIT III      GRAMMARS      9**

Introduction to Grammar – Types of grammar – Context Free Grammars (CFGs) and Languages (CFLs) – Derivations and languages – Ambiguity – Relationship between derivation and derivation



trees – Simplification of CFG – Elimination of useless symbols – Unit productions – Null productions – Normal forms – Greibach Normal Form (GNF) – Chomsky Normal Form (CNF)

**UNIT IV    PUSHDOWN AUTOMATA** **9**

Pushdown Automata – Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Equivalence of Pushdown automata and CFL – Pumping lemma for CFL – Closure properties of CFL

**UNIT V    TURING MACHINE AND UNDECIDABILITY** **9**

Turing Machines (TM) – Programming Techniques for TM – Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem – The Class P and NP

**Contact Periods:**

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

**TEXT BOOKS:**

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", 6<sup>th</sup> Edition, Pearson Education, 2016.
2. John C Martin, "Introduction to Languages and the Theory of Computation", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2013.

**REFERENCES:**

1. H.R.Lewis and C.H.Papadimitriou, "Elements of the theory of Computation", 2<sup>nd</sup> Edition, Prentice Hall of India, 2010
2. Peter Linz, "An Introduction to Formal Language and Automata", 3<sup>rd</sup> edition, Narosa Publishers, 2011
3. Micheal Sipser, "Introduction to Theory of Computation", 3<sup>rd</sup> Edition, Cengage Publishers, 2014

**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		
<b>40</b>	<b>60</b>	<b>40</b>	<b>60</b>	<b>200</b>	<b>100</b>
<b>Total</b>				<b>40</b>	<b>60</b>
				<b>100</b>	

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



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U21CS403	OPERATING SYSTEMS	Category: PCC				
		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:**

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	2	1	-	-	-	-	-	-	-	-	-	1	-
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: 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 – Deadlock Avoidance – Banker's algorithm – Deadlock Prevention – Deadlock Recovery

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**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", 10<sup>th</sup> Edition, John Wiley and Sons Inc., 2018.
2. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, 9<sup>th</sup> Edition, 2018.

**REFERENCES:**

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

**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 any one / two components based on the nature of the course.



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U21AMG05	AI FUNDAMENTALS AND MACHINE LEARNING (For CS Department)	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To utilize the fundamentals of Artificial Intelligence for different applications
- To formulate the foundations behind machine learning and preprocessing the datasets
- To apply supervised and unsupervised methods to develop decision systems

**COURSE OUTCOMES:**

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

**CO1:** Summarize the foundations of AI and implement basic heuristic techniques. (Understand)

**CO2:** Develop solutions for local search, constraint satisfaction and planning problems. (Apply)

**CO3:** Formulate the basic concepts of machine learning and preprocess the datasets. (Apply)

**CO4:** Demonstrate supervised learning algorithms for the given problem. (Apply)

**CO5:** Apply the principles of Artificial Neural Network classifier and unsupervised learning algorithms for solving 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	1	-	-	-	-	-	-	-	2	1	-
CO2	3	2	1	2	-	-	-	-	-	-	-	2	1	-
CO3	3	2	1	2	-	-	-	-	-	-	-	2	2	-
CO4	3	2	1	2	-	-	-	-	-	-	-	2	3	-
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	-

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

**SYLLABUS:****UNIT I      FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE      9**

Introduction to AI – History of AI – Intelligent Agents – Agents and Environment: Types, Properties and PEAS – Solving Problems by Searching: Uninformed and Informed Search strategies – Applications of AI – Case studies

**UNIT II      LOCAL SEARCH PROBLEMS AND PLANNING      9**

Local Search Algorithms and Optimization Problems – Constraint Satisfaction Problems: Map coloring problem, N Queens problem – Classical Planning: Air Cargo Transport Problem, Spare tire Problem – Block World Problem – Algorithms for Planning as a State Space Search



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**UNIT III INTRODUCTION TO MACHINE LEARNING**

Components of learning – Types of machine learning - Data Objects and Attribute Types – Basic Statistical Descriptions of Data – Data Preprocessing: Cleaning – Integration – Feature selection – Feature extraction by Principal Component Analysis – Data Transformation by Normalization – Discretization: Binning and Histogram analysis

**UNIT IV SUPERVISED LEARNING: CLASSIFICATION AND REGRESSION**

9

Introduction – Supervised learning – Types of Supervised learning – Decision tree – Bayesian classifier – Support Vector Machine – K-NN classifier– Regression – Types of Regression: Linear Regression – Multivariate Linear regression – Logistic Regression

**UNIT V UNSUPERVISED LEARNING AND NEURAL NETWORKS**

9

Introduction – Unsupervised Learning – Types of unsupervised learning – Distance measures – Types of clustering methods – K-Means clustering – Case Studies – Introduction to Neural Networks – Perceptrons – Feedforward algorithm – Multilayer networks and Back Propagation Algorithm

**Contact Periods:**

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

**TEXT BOOKS:**

1. Stuart Jonathan Russell, Stuart Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach" 1<sup>st</sup> Edition, Pearson, 2020.
2. Jiawei Han, Jian Pei, Hanghang Tong, "Data Mining: Concepts and Techniques", Elsevier Science, 1<sup>st</sup> Edition, 2022.

**REFERENCES:**

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 1<sup>st</sup> Edition, MIT Press, 2012.
2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective", 2<sup>nd</sup> Edition, CRC Press, 2015.

**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
<b>Total</b>				40	60
				100	

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



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U21SSG01	SOFT SKILLS – I	Category: HSMC				
		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:**

<b>UNIT I</b>	<b>VERBAL COMPETENCE</b>	<b>10</b>
Verbal Analogy – Spotting Errors – Ordering of Sentences – Cloze Test – Effective Listening – Reading Comprehension		
<b>UNIT II</b>	<b>EFFECTIVE COMMUNICATION</b>	<b>10</b>
Overcoming Communication Barriers – Body Language and its Etiquettes – Contextual Communication – 7C's of Communication – Listening to Documentaries		
<b>UNIT III</b>	<b>INTERPERSONAL SKILLS</b>	<b>10</b>
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

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**TEXT BOOKS:**

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

**REFERENCES:**

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

**EVALUATION PATTERN:**

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



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U21CS404	OPERATING SYSTEMS LABORATORY	Category: PCC				
		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:** Implement the various Page Replacement Algorithms (Apply)

**CO5:** Implement File Organization and File Allocation Strategies (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	-
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.

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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", 10<sup>th</sup> Edition, John Wiley and Sons Inc., 2018.
2. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, 9<sup>th</sup> Edition, 2018.
3. Maurice J Bach, "The Design of the Unix Operating System", 3<sup>rd</sup> Edition, Pearson Education, 2017.
4. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems: A Spiral Approach", 1<sup>st</sup> Edition, Tata McGraw Hill Edition, 2010.
5. Achyut S.Godbole, Atul Kahate, "Operating Systems", 3<sup>rd</sup> 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		

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



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U21CS407	DESIGN STUDIO II	Category: EEC				
		L	T	P	J	C
		0	0	2	0	1

**PRE-REQUISITES:**

- U21CS305: 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).

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

**CO3:** Demonstrate teamwork, project management, technical report writing and presentation skills.

**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	-	-
CO2	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO3	-	-	-	-	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.
- 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.

**Contact Periods:**

Lecture: – Periods

Tutorial: – Periods

Practical: 30 Periods

Project: – Periods

Total 30 Periods

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EVALUATION PATTERN:

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



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U21AMG06	AI FUNDAMENTALS AND MACHINE LEARNING LABORATORY (For CS Department)	Category: PCC				
		L	T	P	J	C
		0	0	2	2	2

**PRE-REQUISITES:**

- U21CSG02 : Python Programming

**COURSE OBJECTIVES:**

- To develop simple applications using Artificial Intelligence
- To build models using supervise learning algorithms
- Ro design applications using unsupervised learning and reinforcement learning algorithm.

**COURSE OUTCOMES:**

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

**CO1:** Implement heuristic AI techniques for solving real world problems. (Apply)

**CO2:** Create dataset and apply pre-processing techniques. (Apply)

**CO3:** Implement supervised learning algorithms for real life applications. (Apply)

**CO4:** Demonstrate the operations of ANN classifier and regression. (Apply)

**CO5:** Develop applications using unsupervised learning. (Apply)

**CO-PO MAPPING:**

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

**LIST OF EXPERIMENTS**

1. Create a sample dataset and explore statistical operations using Pandas and visualize the results through plots.
2. Implement uninformed search strategies for any real-world problem.
3. Find optimal solution for a given problem using any local search algorithm.
4. Propose an AI solution for a given Constraint Satisfaction problem.
5. Take a sample dataset and apply suitable pre-processing techniques.
6. Perform dimensionality reduction using Principal Component Analysis on a large dataset.
7. Implement and demonstrate the working of Naive Bayesian classifier in a real-life application.
8. Develop a prediction system using linear and logistic regression.

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9. Develop a classifier using Artificial Neural Network for any online expert system.
10. Implement K-Means clustering algorithm for segmenting inputs of a business model.
11. Mini Project.

**Contact Periods:**

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

**REFERENCES:**

1. Oliver Theobald, "Machine Learning for Absolute Beginners", Independently Published, 3<sup>rd</sup> Edition, 2021.
2. Sebastian Raschka, "Python Machine Learning" 2<sup>nd</sup> Edition, Packt Publishing, 2015.

**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			
60					40
<b>Total 100</b>					

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



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U21MA501	LINEAR ALGEBRA AND NUMBER THEORY (for CS)	Category: BSC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the concepts of vector spaces, linear combination and inner product spaces
- To acquire knowledge in the basic concepts of number theory
- To understand the concepts of multiplicative functions

**COURSE OUTCOMES:**

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

- CO1:** Apply the fundamental concepts of advanced algebra and their role in modern mathematics (Apply)
- CO2:** Solve the problems on linear transformation and to construct the inner product space to find the orthogonal and orthonormal basis using orthogonalization method (Understand)
- CO3:** Determine the accurate and efficient use of advanced algebraic techniques (Understand)
- CO4:** Use the Chinese remainder theorem to solve a system two or more simultaneous linear congruences (Understand)
- CO5:** Apply integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject (Understand)

**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	1
CO2	3	2	-	-	2	-	-	-	-	-	-	1	1	3
CO3	3	2	-	-	2	-	-	-	-	-	-	1	1	3
CO4	3	2	-	-	2	-	-	-	-	-	-	1	1	3
CO5	3	2	-	-	2	-	-	-	-	-	-	1	-	3

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

**SYLLABUS:****UNIT I      VECTOR SPACES      9**

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear dependence and independence – Bases and dimensions

**UNIT II      LINEAR TRANSFORMATION AND INNER PRODUCT SPACES      9**

Linear transformation – Null spaces and ranges – Dimension theorem – Matrix representation of a linear transformation – Inner product – Norms – Gram Schimidt orthogonalization process

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**UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS**

9

Division algorithm – Base – b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM

**UNIT IV DIOPHANTINE EQUATIONS AND CONGRUENCES**

9

Linear Diophantine equations – Congruence's – Linear congruence's – Applications: divisibility tests – Modular exponentiation – Chinese remainder theorem – 2 x 2 linear systems

**UNIT V CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS**

9

Wilson's theorem – Fermat's little theorem – Euler's theorem – Euler's Phi functions – Tau and sigma functions

**Contact Periods:**

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

**TEXT BOOKS:**

1. Friedberg A. H, Insel A. J. and Spence L, "Linear Algebra", 4<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2004.
2. Koshy T, "Elementary Number Theory with Applications", Elsevier Publications, 2<sup>nd</sup> Edition, New Delhi, 2002.

**REFERENCES:**

1. Kolman B and Hill D. R, "Introductory Linear Algebra", 1<sup>st</sup> Edition, Pearson Education, New Delhi, 2009.
2. Kumaresan S, "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 1<sup>st</sup> Edition, 2010.
3. Lay D.C, "Linear Algebra and its Applications", 5<sup>th</sup> Edition, Pearson Education, 2015.

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
Individual Assignment / Seminar / MCQ	Written Test	Individual Assignment / Seminar / 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 any one / two components based on the nature of the course.



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U21CS501	WEB TECHNOLOGIES	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To comprehend the basic concepts of web programming
- To describe how the client-server model of Internet programming works
- To create web applications with database access

**COURSE OUTCOMES:**

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

**CO1:** Describe the basic principles of World Wide Web (Understand)

**CO2:** Design user interface for websites using HTML and CSS (Apply)

**CO3:** Develop client side scripting for data validation and manipulation (Apply)

**CO4:** Develop web applications using PHP and MySQL (Apply)

**CO5:** Create web application using Java Servlets and MySQL (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	3	2	2	-	2	-	-	-	-	-	-	2	1	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	1	-
CO4	3	2	2	-	2	-	-	-	-	-	-	2	1	-
CO5	3	2	2	-	2	-	-	-	-	-	-	2	1	-

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

**SYLLABUS:****UNIT I      WEB DEVELOPMENT BASICS      9**

Internet Overview – Fundamental computer network concepts – Web Protocols – URL – Domain Name– Web Browsers and Web Servers– Working principle of a Website –Creating a Website – Client-side and server-side scripting.

**UNIT II      WEB DESIGNING      9**

HTML – Form Elements – Input types and Media elements – CSS3 – Selectors, Box Model, Backgrounds and Borders –Text Effects, Animations –Multiple Column Layout – User Interface.

**UNIT III      CLIENT-SIDE PROCESSING AND SCRIPTING      9**

JavaScript Introduction – Variables and Data Types–Statements – Operators – Literals–Functions– Objects–Arrays–Built-in Objects– Regular Expression, Exceptions, Event handling, Validation – JavaScript Debuggers.



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**UNIT IV SERVER-SIDE PROCESSING AND SCRIPTING - PHP**

9

PHP – Working principle of PHP – PHP Variables – Constants – Operators – Flow Control and Looping – Arrays – Strings – Functions – File Handling – File Uploading – MySQL Databases with PHP – Basic CRUD operations.

**UNIT V SERVLETS AND DATABASE CONNECTIVITY**

9

Servlets: Java Servlet Architecture – Servlet Life cycle– Form GET and POST actions –Sessions – Cookies – JDBC – Creation of simple interactive applications – Simple database applications.

**Contact Periods:**

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

**TEXT BOOKS:**

1. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" 3<sup>rd</sup> Edition, O'REILLY, 2014.
2. Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5<sup>th</sup> Edition, Pearson Education, 2012.

**REFERENCES:**

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.
2. James F. Kurose, "Computer Networking: A Top-Down Approach", 6<sup>th</sup> Edition, Pearson, 2012.
3. Steven Holzener , PHP – The Complete Reference, 1<sup>st</sup> Edition, Mc-Graw Hill, 2017
4. Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3<sup>rd</sup> Edition, Mc-Graw Hill, 2017
5. Bates, "Developing Web Applications", Wiley, 2006

**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 any one / two components based on the nature of the course.



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U21CS502	COMPILER DESIGN	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21CS402: Theory of Computation

**COURSE OBJECTIVES:**

- To acquire knowledge on lexical analyzer and syntax analyzer
- To learn the generation of intermediate code and target code
- To apply optimization techniques in phases of compiler

**COURSE OUTCOMES:**

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

**CO1:** Interpret the structure of a compiler (Understand)

**CO2:** Design a lexical analyser to identify the tokens in a program (Apply)

**CO3:** Construct a parser through the application of grammar (Apply)

**CO4:** Perform type checking to develop Intermediate code for the given source program (Apply)

**CO5:** Translate given intermediate code to target code and apply various code optimization techniques to intermediate code and target code (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	-	3	-	-
CO2	3	2	2	-	2	-	-	-	-	-	-	2	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	2	-	-

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

**SYLLABUS:****UNIT I      PRINCIPLES OF COMPILER      9**

Compilers: Structure of a compiler – Cousins of the Compiler – Grouping of Phases in to passes – Compiler construction tools – Science of Building a Compiler – Applications of Compiler Technology.

**UNIT II      LEXICAL ANALYSIS      9**

Lexical Analysis: Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – A language for Specifying Lexical Analyzer – Scanner Generator (FLEX) – Finite Automata – From a Regular Expression to an NFA and DFA – Minimization of DFA

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**UNIT III SYNTAX ANALYSIS**

Role of the parser – Writing Grammars – Context-Free Grammars – Top-Down Parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Shift Reduce Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser – YACC

**UNIT IV INTERMEDIATE CODE GENERATION**

9

Syntax - Directed definitions – Construction of Syntax Trees – Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back Patching – Type Checking – Type system – Type checker – Type expression – Type conversion

**UNIT V CODE GENERATION AND CODE OPTIMIZATION**

9

Issues in the design of code generator – Runtime Storage management – Basic Blocks and Flow Graphs – A simple Code generator – DAG representation of Basic Blocks – peephole optimization– Principle Sources of Optimization – Optimization of basic Blocks – Loops in flow graph – Overview of LLVM

**Contact Periods:**

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

**TEXT BOOKS:**

1. Alfred Aho, Ravi Sethi, Jeffrey D Ullman, Monica S. Lam, "Compilers Principles, Techniques and Tools", 2<sup>nd</sup> Edition, Pearson Education Asia, 2014
2. Allen I. Holub, "Compiler Design in C", 1<sup>st</sup> Edition, Pearson Education, 2015

**REFERENCES:**

1. Kenneth C. Louden, "Compiler Construction: Principles and Practice", 2<sup>nd</sup> Edition, Thompson Learning, 2006.
2. J.P. Bennet, "Introduction to Compiler Techniques", 2<sup>nd</sup> Edition, Tata McGraw- Hill, 2003.
3. C. N. Fischer and R. J. LeBlanc, "Crafting a compiler with C", 1<sup>st</sup> Edition, Benjamin Cummings, 2010.

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CSG05	COMPUTER NETWORKS	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:** Understand Data-Link Layer Protocols and Media Access Control methods (Apply)

**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 (Understand)

**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
CO2	2	1	2	2	-	-	-	1	2	2	-	-	1	-
CO3	3	3	2	2	-	-	-	1	2	2	-	-	2	-
CO4	2	1	2	2	-	-	-	1	2	2	-	-	1	-
CO5	3	2	2	2	-	-	-	1	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**

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**

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 2<sup>32</sup>. 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. Observe, 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. Observe, 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

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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)

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. Observe 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. Observe 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 observe 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 observe the above by enabling and disabling the local firewall.

**Contact Periods:**

Lecture: 30 Periods

Tutorial: – Periods

Practical: 30 Periods

Project: – Periods

Total 60 Periods



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**TEXT BOOKS:**

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

**REFERENCES:**

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

**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	
<b>Total: 100</b>					

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



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U21CS503	MOBILE APPLICATION DEVELOPMENT	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

**PRE-REQUISITES:**

- U21CSG04: JAVA Programming

**COURSE OBJECTIVES:**

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

**COURSE OUTCOMES:**

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

**CO1:** Describe the features of mobile applications (Understand)

**CO2:** Design user interface for mobile applications (Apply)

**CO3:** Develop android applications with data storage (Apply)

**CO4:** Develop native capabilities of android applications (Apply)

**CO5:** Develop Android apps with GPS (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I INTRODUCTION TO ANDROID APPLICATIONS** **6**

Web Vs mobile App – Cost of Development – Myths - Mobile Applications – Marketing - Mobile User Interface Design - Effective Use of Screen – Mobile Users - Mobile Information Design - Mobile Platforms - Tools of Mobile Interface Design

**UNIT II ANDROID USER INTERFACE DESIGN** **6**

Android Architecture – Android SDK Tools - Application Components - Intents - Content providers - Broadcast receivers – Services - User Interface Design - Views - View Groups – Layouts - Event Handling – Listeners – Adapters – Menus - Action Bars – Notifications - Android Localization



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**UNIT III ANDROID DATA STORAGE 6**

Content Providers – Uri - CRUD access –Browser – CallLog – Contacts – Media Store - Data Access and Storage - Shared Preferences - Storage External - Network Connection - SQLite Databases

**UNIT IV ANDROID SENSOR CAPABILITIES 6**

Camera – Audio - Sensors and Bluetooth - Playing audio/video - Media recording - Sensors - Listening to sensor readings – Bluetooth - Android Communications – GPS - Working with Location Manager, Working with Google Maps extensions - Maps via intent - Map Activity - Location based Services - Location Updates - Location Providers - Selecting a Location Provider - Finding Location

**UNIT V ANDROID NAVIGATION 6**

Android location based services – GPS – Getting current location – Location Object – Location QoS– Introduction to components – Simple application to send the current location to a cloud database

**LIST OF EXPERIMENTS**

1. Install Android studio, configure the settings and virtual device manager. Execute the default 'Hello, World' application in the emulator. Configure the settings in a mobile device and run the application
2. Design an android native application for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers
3. Design and develop an android native application for a calculator with basic arithmetic operation
4. Design and develop an android native application to find and display the current location of the user
5. Design and develop an android native application for user registration and login with local data storage
6. Develop an android mobile application for a BMI calculator
7. Develop a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense
8. Develop a mobile application to convert units from imperial system to metric system ( km to miles, kg to pounds etc.,)
9. Develop a mobile application to store and retrieve student details in a cloud database such as firebase
10. Design and develop an application for day to day task (to-do) management

**Contact Periods:**

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

**TEXT BOOKS:**

1. Jerome DiMarzio, "Beginning Android Programming with Android Studio", 4thEdition, Wrox, 2016.



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U21SSG02	SOFT SKILLS - II	Category: HSMC				
		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 Activity

**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

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**REFERENCES:**

1. Dawn Griffiths, David Griffiths, "Head First Android Development: A Brain-Friendly Guide", 2<sup>nd</sup> Edition, O'Reilly, 2017.
2. Neil Smyth, "Android Studio 3.0 Development Essentials: Android 8", 1<sup>st</sup> Edition, Amazon Digital Services, 2017.
3. Pradeep Kothari, "Android Application Development (With Kitkat Support) Black Book", 1<sup>st</sup> Edition, Dreamtech Press, 2014.

**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	
<b>Total: 100</b>					

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



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U21CS505	PROTO STUDIO I	Category: EEC				
		L	T	P	J	C
		0	0	2	0	1

**PRE-REQUISITES:**

- U21CS407: Design Studio II

**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)

**CO2:** Create Minimum Viable Prototype. (TRL 5)

**CO3:** Analyze product to technology fit

**CO4:** Demonstrate teamwork, project management, technical report writing and presentation skills

**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	-	-
CO2	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO3	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO4	-	-	-	-	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.
- 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.

**Contact Periods:**

Lecture: 45 Periods

Tutorial: – Periods

Practical: – Periods

 Project: – Periods  
 Total 45 Periods



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**TEXT BOOKS:**

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

**REFERENCES:**

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

**EVALUATION PATTERN:**

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



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U21CS504	WEB TECHNOLOGIES LABORATORY	Category: ESC				
		L	T	P	J	C
		0	0	2	2	2

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To design user interface for web sites with HTML and CSS
- To develop web applications with client-side scripting
- To develop server-side programming with database connectivity

**COURSE OUTCOMES:**

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

**CO1:** Design User Interface for web sites using HTML and CSS (Apply)

**CO2:** Develop web sites with client-side scripting for validation and data manipulation (Apply)

**CO3:** Implement web applications using XAMPP server (Apply)

**CO4:** Develop applications using PHP as server-side scripting and MySQL as database (Apply)

**CO5:** Develop applications using Java Servlets and MySQL (Apply)

**CO-PO MAPPING:**

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

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

**LIST OF EXPERIMENTS**

1. Develop a web site with minimum 3 pages for an enterprise using HTML and CSS. Include tables, forms, images and links wherever necessary. The website should provide information about the people, products, services, existing clients and all the relevant information.
2. Develop a simple web page with BMI calculator using JavaScript. Get the required information from the user. Provide necessary analysis and suggestions based on the BMI.
3. Develop a web application using Java script to pull the weather information of a given location using appropriate API calls.

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**EVALUATION PATTERN:**

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



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U21CS601	CRYPTOGRAPHY TECHNIQUES	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21MA207: Numerical Methods
- U21MA501: Applied Linear Algebra

**COURSE OBJECTIVES:**

- To employ classical encryption techniques and symmetric key algorithms
- To apply hash functions and digital signature
- To construct key management and user authentication protocols

**COURSE OUTCOMES:**

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

- CO1:** Employ classical encryption techniques for providing confidentiality service (Apply)
- CO2:** Implement symmetric key algorithms and stream ciphers for encrypting text and multimedia data (Apply)
- CO3:** Apply number theory concepts to design asymmetric key algorithms for providing confidentiality and key exchange services (Apply)
- CO4:** Apply hash function and digital signature for protecting digital documents (Apply)
- CO5:** Construct key management and user authentication protocols for providing key sharing and authentication services (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I      CLASSICAL ENCRYPTION**

8

Basic concepts – Security attacks, services and mechanisms – Characteristics of good ciphers – Security Standards – Classical encryption techniques: Symmetric cipher model, Substitution techniques, and Transposition techniques

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4. Create a user registration form which gets name, phone number, email, pin code, password, confirm password and date of birth. All are mandatory fields. Provide validation for all the above fields.
5. Develop a login and registration modules of an technical event organized by the Department using PHP and MySQL
6. Develop a web application food delivery system that can be used by customers to order items from multiple restaurants using PHP and MySQL
7. Develop a leave management system for telemarketing organization using Java servlets and JDBC where employees can view their available leaves and apply for new leaves.
8. Develop a shopping cart application that can be used an herbal company using Java servlets and JDBC.

**Contact Periods:**

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

**REFERENCES:**

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.
2. James F. Kurose, "Computer Networking: A Top-Down Approach", 6<sup>th</sup> Edition, Pearson, 2012.
3. Steven Holzener , PHP – The Complete Reference, 1<sup>st</sup> Edition, Mc-Graw Hill, 2017
4. Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3<sup>rd</sup> Edition, Mc-Graw Hill, 2017
5. Bates, "Developing Web Applications", Wiley, 2006

**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
<b>Total: 100</b>					

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



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U21CS602	OBJECT ORIENTED SOFTWARE ENGINEERING	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To comprehend the basic concepts of Object Oriented Concepts
- To describe the requirements using use case models
- To create the document with testing report

**COURSE OUTCOMES:**

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

**CO1:** Design a model for the software requirements (Apply)

**CO2:** Develop function oriented and object oriented software design using tools (Analyze)

**CO3:** Design object solutions with patterns and architectural layers (Analyze)

**CO4:** Analyze requirements with use cases and Create domain models (Analyze)

**CO5:** Document and present project deliverables (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	3	2	2	2	2	-	-	-	-	-	-	1	1	-
CO3	3	2	2	1	2	-	-	-	-	-	-	1	1	-
CO4	3	2	2	2	2	-	-	-	-	-	-	1	1	-
CO5	3	2	2	2	2	-	-	-	-	-	-	1	1	-

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

**SYLLABUS:****UNIT I      INTRODUCTION**

9

System Concepts – Software Engineering Concepts – Development Activities – Managing Software Development – Unified Modeling Language – Project Organization – Communication – Software related Problems

**UNIT II      ANALYSIS**

9

Requirements Elicitation – Concepts – Activities – Management – Analysis Object Model – Analysis Dynamic Models

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**UNIT II SYMMETRIC AND STREAM CIPHERS**

10

Block cipher principles – Data Encryption Standard (DES) – Fields and finite field arithmetic – Advanced Encryption Standard (AES) – Block cipher modes of operation – Principles of random number generation – Random number generators, Stream ciphers, RC4

**UNIT III ASYMMETRIC CIPHERS**

9

Number theory concepts: Euclidean algorithm – Modular arithmetic – Prime numbers – Fermat's and Euler's theorem, Discrete logarithms, Principles of public – key cryptosystems, RSA algorithm, Diffie – Hellman key exchange, ElGamal cryptographic system

**UNIT IV HASH FUNCTION AND DIGITAL SIGNATURE**

9

Hash function: Applications, Requirements, Secure Hash Algorithm (SHA), Message authentication codes: Requirements, functions, Hash based Message Authentication Codes (HMAC) – Digital signature: Properties, ElGamal digital signature scheme, Digital Signature Standard (DSS)

**UNIT V KEY MANAGEMENT AND USER AUTHENTICATION**

9

Key management and distribution – X.509 certificate – Public key infrastructure – User authentication – Kerberos protocol

**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 Practices", Pearson Education, 6<sup>th</sup> Edition, 2014.
2. Douglas R Stinson, "Cryptography - Theory and Practice", Chapman and Hall / CRC Press, New York, 2013.

**REFERENCES:**

1. Behrouz A Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata McGraw Hill, New Delhi, 2011.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill, New Delhi, 2013.
3. <https://www.khanacademy.org/computing/computer-science/cryptography>

**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 any one / two components based on the nature of the course.



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U21ECG04	INTERNET OF THINGS AND ITS APPLICATIONS (Common to CS and AD)	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

**PRE-REQUISITES:**

- U21CSG05: Computer Networks

**COURSE OBJECTIVES:**

- To provide basic knowledge about embedded processor, its hardware and software
- To be acquainted with interfacing of sensors and actuators with microprocessor
- To apply Internet of Things techniques in the real time applications

**COURSE OUTCOMES:**

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

**CO1:** Outline the basics of embedded system and its components (Understand)

**CO2:** Explain the fundamentals of Arduino programming (Understand)

**CO3:** Implement the interfacing of different sensors and actuators to the development boards (Apply)

**CO4:** Apply the knowledge of IoT and Cloud interface for application development (Apply)

**CO5:** Develop simple projects using IoT platform (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
CO2	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	2	2	2	2	3	2	1	2	2	2	1	-	3
CO4	3	2	2	2	2	3	2	1	2	2	2	1	-	3
CO5	3	2	2	2	2	3	3	1	2	2	2	1	-	2
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)			3: Substantial (High)						

**SYLLABUS:****UNIT I OVERVIEW OF EMBEDDED SYSTEMS 6**

Embedded systems – Features, characteristics, model – Simple embedded system – Microprocessor Vs Microcontroller – Microcontroller unit – 8 bit MCU – Functional blocks of a mobile phone

**UNIT II ARDUINO BOARDS AND PROGRAMMING CONCEPTS 6**

Arduino families – Uno, Nano, Leonardo, Ethernet, Mega2560 – IDE tool – Variables and data types – Control structures – I/O functions

**UNIT III INTERFACING SENSORS AND ACTUATORS 6**

Programming and Interfacing with sensors – Temperature, humidity, water, MQ2, PIR and ultrasonic – Magnetic relay switches – Actuators – Servo motor – Stepper motor

**UNIT IV COMMUNICATION AND NETWORKING 6**

ESP8266 characteristics – SPI protocol – I2C protocol – Wi-Fi communication – Blynk protocol – MQTT protocol – ThinkSpeak IoT platform

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**UNIT III SYSTEM DESIGN**

9

Decomposing the system – Overview of System Design – System Design Concepts – System Design Activities – Addressing Design Goals – Managing System Design

**UNIT IV OBJECT DESIGN AND IMPLEMENTATION ISSUES**

9

Reusing Pattern Solutions : An overview of object design Reuse Concepts, Solution objects, inheritance and design patterns – Specifying Interfaces – Mapping Models to Code – Testing

**UNIT V MANAGING CHANGE**

9

Rationale Management – Configuration Management – Project Management Concepts – Software Life Cycle – Testing concepts, activities and managing testing – Project Management activities

**Contact Periods:**

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

**TEXT BOOKS:**

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2<sup>nd</sup> Edition, Pearson Education, 2017.
2. "An introduction to Object Oriented Analysis System and Design with UML and the Unified Process", Stephen Schach, Software Engineering 7<sup>th</sup> Edition, Tata McGraw-Hill, 2015

**REFERENCES:**

1. Craig Larman, Applying UML and Patterns, 3<sup>rd</sup> Edition, Pearson Education, 2005.
2. Object-Oriented Software Engineering: Practical software development using UML and Java, Timothy C Lethbridge and Robert Laganriere, 2<sup>nd</sup> Edition, McGraw-Hill Higher Education

**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 any one / two components based on the nature of the course.



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U21SSG03	SOFT SKILLS – III	Category: HSMC				
		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:**

Cos \ POs	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", 1<sup>st</sup> Edition, Bloomsbury, 2009.
2. Alan Barker, "Improve Your Communication Skills: Present with Confidence; Write with Style; Learn Skills of Persuasion", 1<sup>st</sup> Edition, Kogan Page, 2010.

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**UNIT V    IoT APPLICATIONS**

IoT enabling technologies – Automatic water level controller – Smart irrigation system – Weather monitoring system – Home automation – Smart parking system

**LIST OF EXPERIMENTS**

1. Temperature monitoring system
2. Obstacle detection using ultrasonic sensor
3. Stepper motor control
4. IoT based Gas leakage monitoring system
5. IoT based Smart Lighting system using Blynk App.
6. IoT based weather monitoring using ThingSpeak

**Contact Periods:**

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

**TEXT BOOKS:**

1. James A. Langbridge, "Arduino Sketches: Tools and Techniques for Programming Wizardry", 1<sup>st</sup> Edition, John Wiley & Sons, 2015
2. Lyla B. Das, " Embedded Systems: An Integrated Approach", 1<sup>st</sup> Edition, Pearson Education, 2013

**REFERENCES:**

1. Raj Kamal, "Embedded Systems Architecture, Programming and Design", 3<sup>rd</sup> Edition, McGraw-Hill Higher Education, 2017
2. Simon Monk, "Programming Arduino: Getting Started with Sketches", 2<sup>nd</sup> Edition, Tata Mc Graw Hill, 2016
3. Massimo Banzi, Michael Shiloh, Make, "Getting Started with Arduino: The open source electronics prototyping platform", 3<sup>rd</sup> Edition, LLC, 2015
4. Brock Craft, "Arduino Projects for Dummies", 2<sup>nd</sup> Edition, John Wiley & Sons, 2013

**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	
<b>Total: 100</b>					

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



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U21CS605	PROTO STUDIO II	Category: EEC				
		L	T	P	J	C
		0	0	2	0	1

**PRE-REQUISITES:**

- U21CS505: 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)

**CO2:** Create Minimum Viable Prototype. (TRL 6)

**CO3:** Analyze product to technology fit

**CO4:** Develop a business model

**CO5:** Demonstrate teamwork, project management, technical report writing and presentation skills

**CO-PO MAPPING:**

Cos \ POs	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	-
CO2	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO3	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO4	3	3	3	3	3	3	3	3	3	-	3	2	-	-
CO5	-	-	-	-	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.
- 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.

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**REFERENCES:**

1. Jeremy Stranks, "Stress at Work: Management and Prevention", 1<sup>st</sup> Edition, Butterworth-Heinemann, 2005.
2. Edward J Watson, "Emotional Intelligence: A Practical Guide on How to Control Your Emotions and Achieve Lifelong Social Success", 1<sup>st</sup> Edition, Amazon Digital Services LLC, 2016.

**EVALUATION PATTERN:**

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



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U21CS604	OBJECT ORIENTED SOFTWARE ENGINEERING LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	2	2	2

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To comprehend the basic concepts of Object-Oriented Concepts
- To describe the requirements using use case models
- To create the sequence and class diagrams of the statement

**COURSE OUTCOMES:**

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

**CO1:** Design a Use case Diagram for the problem statement (Apply)

**CO2:** Identify the Actors for the problem statement (Apply)

**CO3:** Design a Sequence Diagram for the problem statement (Apply)

**CO4:** Design a Collaboration Diagram for the problem statement (Apply)

**CO5:** Design a Class Diagram for the problem statement (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	-	-	1	2	2	-	2	1	-
CO2	3	2	2	2	2	-	-	1	2	2	-	2	1	-
CO3	3	2	2	2	2	-	-	1	2	2	-	2	1	-
CO4	3	2	2	2	2	-	-	1	2	2	-	2	1	-
CO5	3	2	2	2	2	-	-	1	2	2	-	2	1	-

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

**LIST OF EXPERIMENTS**

1. Identify and create Use cases for the problem statement
2. Identify and create the Actors for the problem statement
3. Define classes in the logical view associated with each Use case and define their structure
4. Draw Sequence Diagram for each use case identified in the problem statement
5. Draw the collaboration diagram for the problem statement
6. Draw the class diagram for the problem statement.

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- The student will learn teamwork, project management, technical report writing and presentation skills through this course.

**Contact Periods:**

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

**EVALUATION PATTERN:**

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



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**Contact Periods:**

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

**REFERENCES:**

1. Craig Larman, Applying UML and Patterns, 3<sup>rd</sup> Edition, Pearson Education, 2005.
2. Object-Oriented Software Engineering: Practical software development using UML and Java, Timothy C Lethbridge and Robert Laganiere, 2<sup>nd</sup> Edition, McGraw-Hill Higher Education

**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
Total: 100					

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



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U21CBG701	HUMAN VALUES AND ETHICS	Category: HSMC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To realize the significance of value education and explore the happiness and prosperity
- To practice the harmony in the human being, family, society and nature
- To learn harmony in existence in their profession and lead an ethical life

**COURSE OUTCOMES:**

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

**CO1:** Identify the implication of value education and apply in the life and profession (Understand)

**CO2:** Distinguish between the self and the body, understand the meaning of harmony in the self and the co-existence of self and body (Understand)

**CO3:** Realize the value of harmonious relationship based on trust and respect in their life and Profession (Understand)

**CO4:** Explore the role of a human being in ensuring harmony in society and nature (Understand)

**CO5:** Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work (Understand)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I      Introduction to Value Education**

9

Understanding Value Education, Self-exploration as a means of Value Education, Continuous Happiness and Prosperity, Basic Human Aspirations, Right Understanding, Relationship and physical Facilities, Method to Fulfil the Basic Human Aspirations.

**UNIT II      Harmony in the Human Being**

9

Understanding Human being as the Co-existence of self ('I') and the Body, Discriminating between the Needs of the Self ('I') and the Body, Sukh and Savidha, The Body as an Instrument of 'I', Understanding Myself as Co-existence of the Self and the Body,

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Understanding Needs of the Self and the Needs of the Body, Understanding the harmony of 'I' with the Body: Sanyam and Swasthya.

**UNIT III Harmony in the Family and Society 9**

Harmony in the Family, Basic Unit of Human Interaction, Understanding values in Human to Human Relationships, Trust and Respect as the Foundational Values in Relationships, Understanding Harmony in the Society, Universal Human Order: from family to world family.

**UNIT IV Harmony in the Nature and Existence 9**

Understanding Harmony in the Nature, Interconnectedness, Self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels and the Holistic Perception of Harmony in Existence.

**UNIT V Professional Ethics 9**

Natural Acceptance of Human Values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Case studies: Holistic Technologies, Production Systems and Management Models, Strategies for Transition towards Value based Life and Profession.

**Contact Periods:**

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

**TEXT BOOKS:**

1. Smriti Srivastava, "Professional Ethics and Human Values", 1<sup>st</sup> Edition, Scitech Publications, 2018.
2. B S Raghavan, "Human Values and Professional Ethics", 3<sup>rd</sup> Edition, S. Chand Limited, 2009.

**REFERENCES:**

1. R.R.Gaur, R.Sangal, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excel Books, 2010.
2. Banerjee B P, "Foundations of Ethics and Management", 1st Edition, Excel Books, 2005.

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CS704	INTERNET SECURITY PRACTICES	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

**PRE–REQUISITES:**

- U21CS601: Cryptography Techniques

**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:** Make use of IP security and web security protocols for providing data security services (Apply)

**CO3:** Identify suitable security protocols for securing e-mail services (Apply)

**CO4:** Apply wireless security protocols for protecting data in a wireless environment (Apply)

**CO5:** Identify security services needed in cloud environment for secure data sharing (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I INTRODUCTION 6**

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 6**

IP security: IP security policy – Encapsulating Security Payload – Web security: Secure Socket Layer, Transport Layer Security – HTTPS – Secure Shell (SSH)

**UNIT III ELECTRONIC MAIL SECURITY 6**

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).

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**UNIT IV WIRELESS NETWORK SECURITY**

6

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**

6

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.

**LIST OF EXPERIMENTS**

1. Study and installation of Kali Linux operating system
2. Simulation of password management system in Windows and Linux operating systems
3. Implementation of intrusion detection system using Snort
4. Implementation of packet capturing using Wireshark
5. Implementation of packet capturing using Tcpdump
6. Simulation of virtual private network using OpenVPN tool
7. Implement IP and port scanning using nmap tool
8. Simulation of Secure Shell (SSH) protocol
9. Simulation of Pretty Good Privacy protocol
10. Audit the WPA encrypted network using Wifite tool

**Contact Periods:**

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

**TEXT BOOKS:**

1. William Stallings, "Cryptography and Network Security – Principles and Practice", Pearson Education, 6<sup>th</sup> Edition, New Delhi, 2014
2. Ronald L Krutz and Russell Dean Vines, "Cloud Security- A Comprehensive Guide to Secure Cloud Computing", 2<sup>nd</sup> Edition, Wiley India, New Delhi, 2016

**REFERENCES:**

1. J Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 3<sup>rd</sup> Edition, New Delhi, 2014
2. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security: Private Communication in a Public World", 3<sup>rd</sup> Edition, Pearson Education, New Delhi, 2007
3. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms and Source Code in C", 3<sup>rd</sup> Edition, John Wiley and Sons, New York, 2013
4. <https://training.apnic.net/wp-content/uploads/sites/2/2016/12/TSEC01.pdf>



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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	
<b>Total: 100</b>					

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



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U21CS703	PROJECT WORK PHASE - I	Category: EEC				
		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 Computer Engineering
- 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 (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 (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.



B.E. – CS – R2021– CBCS



**Contact Periods:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments (100 Marks)			
Review I	Review II	Review III	Total Assessment
30	30	40	100

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U21CS801	PROJECT WORK PHASE - II	Category: PCC				
		L	T	P	J	C
		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 Computer Engineering
- 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.

**Contact Periods:**

Lecture: - Periods    Tutorial: – Periods    Practical: – Periods

Project: 280 Periods

Total: 280 Periods

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**EVALUATION PATTERN:**

Continuous Internal Assessments (40 Marks)			End Semester Examinations (60 Marks)	
Review I	Review II	Review III	Project Report	Viva-Voice
10	15	15	10	50
<b>Total: 100 Marks</b>				



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U21ADP01	MATHEMATICAL FOUNDATION FOR DATA SCIENCE	Category: PEC				
		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:**

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

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.

**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

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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, Wellesley-Cambridge Press, 5<sup>th</sup> Edition, USA, 2016
2. Bendat, J. S. and A. G. Piersol. Random Data: Analysis and Measurement Procedures. 4<sup>th</sup> Edition. John Wiley & Sons, Inc., NY, USA, 2010

**REFERENCES:**

1. Montgomery, D. C. and G. C. Runger. Applied Statistics and Probability for Engineers. 5<sup>th</sup> Edition. John Wiley & Sons, Inc., NY, USA, 2011
2. David G. Luenberger. Optimization by Vector Space Methods, John Wiley & Sons (NY), 1969
3. Cathy O'Neil and Rachel Schutt, Doing Data Science, O'Reilly Media, 2013

**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 Designer can choose any one / two components based on the nature of the course.



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U21ADP02	PATTERN RECOGNITION	Category: PEC				
		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:**

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	3	2	2	2	-	-	-	-	-	-	-	1	2
CO2	3	3	3	2	-	-	-	-	-	-	-	1	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	1	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	1	2	-
CO5	3	3	3	2	-	-	-	-	-	-	-	1	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", 2<sup>nd</sup> Edition, John Wiley, 2006

**REFERENCES:**

1. Andrew Webb, "Statistical Pattern Recognition", 2<sup>nd</sup> Edition, Arnold publishers, London, 1999
2. Bishop, Christopher M., "Pattern Recognition and Machine Learning", 1<sup>st</sup> Edition, Springer, 2009
3. S. Theodoridis, K. Koutroubas, "Pattern Recognition", 4<sup>th</sup> Edition, Academic Press, 2009

**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
<b>Total</b>				40	60
				<b>100</b>	

\*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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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:**

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

**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



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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", 2<sup>nd</sup> Edition, Pearson Prentice Hall, 2008.
2. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.

**REFERENCES:**

1. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education.
3. Claudio Bechetti 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				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
<b>Total</b>				40	60
				<b>100</b>	

\*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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U21ADP04	WEB MINING	Category: PEC				
		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	-	-	-	-	-	-	-	1	-
CO2	1	1	1	-	1	-	-	-	-	-	-	-	2	-
CO3	1	1	1	-	1	1	-	-	-	-	-	-	2	-
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

**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



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Bayesian Classification, Naïve Bayesian Text Classification – Probabilistic Framework, Naïve Bayesian Model – 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. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications)

**REFERENCES:**

1. Data Mining: Concepts and Techniques, Second Edition Jiawei Han, Micheline Kamber (Elsevier Publications)
2. Web Mining : Applications and Techniques by Anthony Scime
3. Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
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40	60	40	60	200	100
<b>Total</b>				40	60
				<b>100</b>	

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U21ADP05	EXPLORATORY DATA ANALYSIS AND VISUALIZATION	Category: PEC				
		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:**

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	3	2	2	-	3	2	-	-	-	-	-	2	2
CO2	3	3	3	-	3	2	-	-	-	-	-	2	2	-
CO3	3	3	3	-	3	2	-	-	-	-	-	2	2	-
CO4	3	3	3	2	3	2	-	-	-	-	-	2	2	-
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 VISUALIZATION**

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. Think Stats, "Exploratory Data Analysis", 2<sup>nd</sup> Edition: Allen B. Downey, Pages:226, ISBN 13:978-1-49190-733-7, 2014
2. Eric Pimpler, Data Visualization and Exploration with R, Geo Spatial Training service, 2017

**REFERENCES:**

1. Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, Glenn J. Myatt, and Wayne P. Johnson. Print ISBN:9780470222805 |Online ISBN:9780470417409 |DOI:10.1002/9780470417409.
2. Claus.O.Wlrike, Fundamentals of Data Visualization, A primer on making informative and compelling Figures, O'Reilly Publications, 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 / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
<b>Total</b>				40	60
				<b>100</b>	

\*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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U21ADP06	PREDICTIVE ANALYTICS	Category: PCC				
		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:**

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

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

**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– 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", Wiley, 2014
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", 3<sup>rd</sup> Edition, Elsevier, 2012.

**REFERENCES:**

1. Conrad Carlberg, "Predictive Analytics: Microsoft Excel", 1<sup>st</sup> Edition, Que Publishing, 2012.
2. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014
3. Anasse Bari, Mohamed Chaouchi, Tommy Jung, Predictive Analytics for Dummies, 2<sup>nd</sup> Edition, Wiley, 2017.

**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
<b>Total</b>				40	60
				<b>100</b>	

\*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.



**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, 4<sup>th</sup> 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", ed.: New York: Springer, cop. 2008.

**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	



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U21ADP08	HEALTH CARE ANALYTICS	Category: PCC				
		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	-	-	-	-	-	-	-	2	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	3	-	-	-	-	-	-	-	3	-
CO5	2	2	2	-	3	-	-	-	-	-	-	-	2	-

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.

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**UNIT II ANALYTICS ON MACHINE LEARNING**

Machine Learning Pipeline – Pre-processing – Visualization – Feature Selection – Training model parameter – Evaluation model: Sensitivity, Specificity, PPV, NPV, FPR, Accuracy, ROC, Precision Recall Curves, Valued target variables  
 Python: Variables and types, Data Structures and containers, Pandas Data Frame: Operations – Scikit – Learn: Pre-processing, Feature Selection.

9

**UNIT III HEALTH CARE MANAGEMENT**

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.

9

**UNIT IV HEALTHCARE AND DEEP LEARNING**

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.

9

**UNIT V CASE STUDIES**

Predicting Mortality for cardiology Practice – Smart Ambulance System using IOT – Hospital Acquired Conditions (HAC) program – Healthcare and Emerging Technologies – ECG Data Analysis.

9

**Contact Periods:**

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

**TEXT BOOKS:**

1. Vikas Kumar, "Health Care Analytics Made Simple", Packt Publishing, 2018.
2. Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatt, "Health Care Data Analysis and Management", 1<sup>st</sup> Edition, Academic Press, 2018.

**REFERENCES:**

1. Hui Jang, Eva K.Lee, "HealthCare Analysis: From Data to Knowledge to Healthcare Improvement", 1<sup>st</sup> Edition, Wiley, 2016.
2. Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, "Big Data Analytics in HealthCare", Springer, 2020.

**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 Designer can choose any one / two components based on the nature of the course



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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
- To discuss methodologies and modeling for Agent Design and Development
- To design and develop ontologies
- To apply reasoning with ontologies and rules
- To understand learning and rule learning

**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:**

COs \ POs	POs												PSOs	
	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	3	2	1	-	-	-	1	1	-	1	2	-
CO3	3	2	3	2	2	-	-	-	1	1	-	1	2	-
CO4	3	2	3	1	1	-	-	-	1	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 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 –

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Inquiry-driven analysis and synthesis – Evidence-based assessment – Believability assessment – Drill-down analysis, Assumption-based reasoning, and What-if scenarios

**UNIT III ONTOLOGIES – DESIGN AND DEVELOPMENT 9**

Concepts and instances – Generalization hierarchies – Object features – Defining features – Representation – Transitivity – Inheritance – Concepts as feature values – Ontology matching – Design and development methodologies – Steps in ontology development – Domain understanding and concept elicitation – Modelling-based ontology specification

**UNIT IV 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", 1<sup>st</sup> Edition, Cambridge University Press, 2016
2. Ela Kumar, " Knowledge Engineering", 1<sup>st</sup> Edition, I K International Publisher House, 2018

**REFERENCES:**

1. Ronald J. Brachman, Hector J. Levesque, "Knowledge Representation and Reasoning", 1<sup>st</sup> Edition, Morgan Kaufmann, 2004
2. John F. Sowa, "Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole", 1<sup>st</sup> Edition, Thomson Learning, 2000
3. King, "Knowledge Management and Organizational Learning", 1<sup>st</sup> Edition Springer, 2009
4. Jay Liebowitz, " Knowledge Management Learning from Knowledge Engineering," 1<sup>st</sup> Edition, 2001

**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
<b>Total</b>				40	60
				<b>100</b>	

\*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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U21AMP02	SOFT COMPUTING	Category: PEC				
		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:**

COs \ POs	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	-	2
CO3	3	2	1	1	-	-	-	-	1	-	-	1	-	2
CO4	3	2	2	2	1	-	-	-	1	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 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 ", 1<sup>st</sup> edition, PHI Learning Pvt. Ltd., 2017
2. Sivanandam S.N., Deepa S.N., "Principles of Soft Computing", 1<sup>st</sup> edition (Reprint), 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", 1<sup>st</sup> edition, PHI Learning Private Limited, New Delhi, 2014
2. K. Sundareswaran, "A Learner's Guide to Fuzzy Logic Systems", 1<sup>st</sup> edition, Jaico Publishing House, 2006
3. Padhy N.P., "Artificial Intelligence and Intelligent System, 1<sup>st</sup> edition, Oxford University Press, 2005

**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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U21AMP03	DEEP NEURAL NETWORKS	Category: PEC				
		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:**

COs \ POs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	2	-
CO2	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO3	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO4	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO5	3	2	2	2	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", 1<sup>st</sup> Edition, Springer International Publishing, 2018.
2. Hasmik Osipyan, Bosede Iyiade Edwards, Adrian David Cheok, "Deep Neural Network Applications", 1<sup>st</sup> Edition, CRC Press, 2022.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", 1<sup>st</sup> Edition, MIT Press, 2016

**REFERENCES:**

1. Katy Warr, "Strengthening Deep Neural Networks Making AI Less Susceptible to Adversarial Trickery", 1<sup>st</sup> Edition, O'Reilly Media, 2019.
2. Information Resources Management Association, "Deep Learning and Neural Networks: Concepts, Methodologies, Tools, and Applications", 1<sup>st</sup> Edition, IGI Global, 2020.
3. Aston Zhang, Zack C. Lipton, Mu Li, and Alex J. Smola, "Dive into Deep Learning", 1<sup>st</sup> 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	
<b>Total</b>					40	60
					<b>100</b>	

\*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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U21AMP04	REINFORCEMENT LEARNING	Category: PEC				
		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:**

COs \ POs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	2	-
CO2	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO3	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO4	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO5	3	2	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", 2<sup>nd</sup> Edition, The MIT Press, 2020
2. CsabaSzepesvári, "Algorithms for Reinforcement Learning", 1<sup>st</sup> Edition, Morgan & Claypool, 2013

**REFERENCES:**

1. Kevin Murphy, "Machine Learning - A Probabilistic Perspective", 1<sup>st</sup> Edition, MIT press, 2012
2. Christopher Bishop, "Pattern Recognition and Machine Learning", 1<sup>st</sup> Edition, Springer, 2006

**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
<b>Total</b>				40	60
				<b>100</b>	

\*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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U21AMP05	COMPUTER VISION	Category: PEC				
		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:**

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

**UNIT III      IMAGE SEGMENTATION AND OBJECT DETECTION      9**

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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", Springer- Texts in Computer Science, 2<sup>nd</sup> edition, 2022
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, 2<sup>nd</sup> edition, Pearson Education, 2015
3. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3<sup>rd</sup> edition, Pearson- 2017

**REFERENCES:**

1. E.R.Davies, "Computer and Machine Vision", 4<sup>th</sup> edition, Academic Press, 2012
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1<sup>st</sup> edition, Springer, 2006
3. Richard Hartley, Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2<sup>nd</sup> edition, Cambridge University Press, 2004
4. Adrian Kaehler, Gary Bradski, "Learning OpenCV 4: Computer Vision with Python", 3<sup>rd</sup> edition, O'Reilly Media, 2019
5. Adrian Rosebrock, "Deep Learning for Computer Vision with Python", 1<sup>st</sup> edition, PyImageSearch, 2020

**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
<b>Total</b>				40	60
				<b>100</b>	

\*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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U21AMP06	FEATURE ENGINEERING	Category: PEC				
		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:**

COs \ POs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	-	2	-
CO2	3	2	2	2	1	-	-	-	1	1	-	1	2	-
CO3	3	2	1	1	-	-	-	-	1	-	-	-	2	-
CO4	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO5	3	2	2	2	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", 1<sup>st</sup> edition Manning Publications, 2022
2. Alice Zheng and Amanda Casari, "Feature Engineering for Machine Learning: Principles and Techniques", 1<sup>st</sup> edition, O'Reilly Media, 2018

**REFERENCES:**

1. Alice Zheng and Amanda Casari, "Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists", 1<sup>st</sup> 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", 1<sup>st</sup> edition, Packt Publishing, 2018
3. Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, "Introduction to Statistical Learning: With Applications in R", 1<sup>st</sup> edition, Springer, 2013

**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	
<b>Total</b>					40	60
					<b>100</b>	

\*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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U21AMP07	OBJECT DETECTION & FACE RECOGNITION	Category: ESC				
		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	-	-	-	2	-
CO2	3	2	1	1	-	-	-	-	1	-	-	-	2	-
CO3	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO4	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO5	3	2	2	2	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 Verdhani, "Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras", 1<sup>st</sup> edition, Apress, 2021
2. Joseph Howse, Prateek Joshi, "Object Detection and Recognition Using Deep Learning in OpenCV", 1<sup>st</sup> edition, Packt Publishing, 2020
3. Rafael C. Gonzalez, David A. Forsyth, and Christopher R. Dance, "Deep Learning for Object Detection and Recognition", 1<sup>st</sup> 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", 1<sup>st</sup> edition Packt Publishing, 2021
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4<sup>th</sup> edition, Thomson Learning, 2014
3. E. R. Davies, "Computer & Machine Vision", 4<sup>th</sup> edition, Academic Press, 2012
4. Kelleher, John D., Tierney, Brian and Pacheco, Aoife, "Applied Machine Learning: From Classification to Object Detection Using Python", 1<sup>st</sup> edition, Springer, 2021

**EVALUATION PATTERN:**

Continuous Internal Assessments					Total Internal Assessments	End Semester Examinations	
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		
<b>Total</b>					40	60	
					<b>100</b>		

\*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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U21AMP08	TEXT AND VISUAL ANALYTICS	Category: PEC				
		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:**

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	3	2	1	1	-	-	-	-	1	-	-	-	2
CO2	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO3	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO4	3	2	2	2	1	-	-	-	1	1	-	1	3	-
CO5	3	2	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", 3<sup>rd</sup> Edition, Pearson Prentice Hall, 2022
2. Nan Cao, Weiwei Cui, "Introduction to Text Visualization", 1<sup>st</sup> Edition, Atlantis Press, 2016


**REFERENCES:**

1. Steven Struhl, "Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence", 1<sup>st</sup> Edition, Kogan Page Limited, 2016
2. Bing Liu, "Sentiment Analysis: Mining Opinions, Sentiments, and Emotions", 1<sup>st</sup> Edition, Cambridge University Press, 2020
3. Tamara Munzner, "Visualization Analysis and Design", 1<sup>st</sup> Edition, CRC press, 2015.
4. Dan Jurafsky and James H. Martin, "Speech and Language Processing", 1<sup>st</sup> Edition, Prentice Hall, 2009
5. Li Bai, Alfred Kobsa, and Jinah Park, "Visual Analytics and Interactive Technologies: Data, Text and Web Mining Applications", 1<sup>st</sup> Edition, IGI Global, 2011

**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
<b>Total</b>				40	60
				<b>100</b>	

\*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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U21CSP01	FOUNDATIONS OF CLOUD COMPUTING	Category: PEC				
		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:**

COs \ POs	POs												PSOs	
	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, CDML, 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

**TEXT BOOKS:**

1. Dac–Nhuong Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, "Cloud Computing and Virtualization", Second Edition, Wiley Publishers, 2018
2. Nick, Gillam, Lee, "Cloud Computing – Principles, Systems and Applications", Second Edition, Springer, 2017

**REFERENCES:**

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering the Cloud Computing", Morgan Kaufmann, 2013
2. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation Management, and Security", CRC Press, 2016.
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
4. Barrie Sosinsky, "Cloud Computing Bible", First Edition, Wiley Publishing, 2015

**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 any one / two components based on the nature of the course.

  
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U21CSP02	DATA STORAGE AND MANAGEMENT IN CLOUD	Category: PEC				
		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:**

Cos	POs													
	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      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 Storage 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

**TEXT BOOKS:**

1. Greg Schulz, "Cloud and Virtual Data Storage Networking", First Edition, CRC Press, 2011
2. Kayla Kipps, Allison Kaiser Jones, "Collection Management in the Cloud, A Guide for Using Cloud Computing Technologies in Libraries", First Edition, 2022

**REFERENCES:**

1. Somasundaram Gnanasundaram, Alok Shrivastava, "Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments", Second Edition, EMC Educations Services, Wiley, 2012
2. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller–Friedt, Rainer Wolafka, Nils Hausteil, "Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE", 2<sup>nd</sup> Edition, Wiley, 2011

**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 any one / two components based on the nature of the course.

  
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U21CSP03	VIRTUALIZATION TECHNIQUES	Category: PEC				
		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:**

Cos \ POs	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	-	-	-	-	-	-	-	2	-	2
CO3	3	2	2	1	2	-	-	-	-	-	-	3	-	3
CO4	3	2	2	1	2	-	-	-	-	-	-	3	-	3
CO5	3	2	2	1	3	-	-	-	-	-	-	3	-	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 Hypervisor – 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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<b>UNIT III NETWORK VIRTUALIZATION</b>	<b>9</b>
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 – VFI's Virtual Firewall Contexts	
<b>UNIT IV STORAGE VIRTUALIZATION</b>	<b>9</b>
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	
<b>UNIT V APPLYING VIRTUALIZATION</b>	<b>9</b>
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

**TEXT BOOKS:**

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Second Edition, Elsevier/Morgan Kaufmann Publishers, 2015.
2. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", Second Edition, Berkeley, Apress, 2016.
3. Gerardus Blokdyk, "Virtualization Technology A Complete Guide", Emer2020.

**REFERENCES:**

1. William von Hagen, "Professional Xen Virtualization", First Edition, Wrox Publications, 2014
2. Matthew Portnoy, "Virtualization Essentials", Second Edition, Wiley, 2015.
3. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Sixth Edition, Addison–Wesley, Publications, 2012

**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
<b>Total</b>				40	60
				100	

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



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U21CSP04	SECURITY AND PRIVACY IN CLOUD	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To acquire knowledge on cloud security and privacy foundations
- To learn threat model and security techniques of cloud computing
- To understand vulnerability, network Security, Strategies and Management of cloud

**COURSE OUTCOMES:**

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

**CO1:** Outline the cloud security and privacy foundations. (Understand)

**CO2:** Identify threat model and security techniques. (Apply)

**CO3:** Apply the cloud infrastructure management and security. (Apply)

**CO4:** Identify the need for vulnerability management and network security. (Apply)

**CO5:** Analyze the strategies and practices related to cloud security. (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
CO2	3	2	1	1	-	-	-	-	-	-	-	2	-	3
CO3	3	2	1	1	-	-	-	-	-	-	-	2	-	3
CO4	3	2	1	1	-	-	-	-	-	-	-	2	-	3
CO5	3	3	1	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

**TEXT BOOKS:**

1. Preeti Mishra, Emmanuel S Pilli, RC Joshi, "Cloud Security–Attacks, Techniques, Tools, and Challenges", 1<sup>st</sup> Edition, CRC Press,2022
2. Chris Dotson, "Practical Cloud Security – A Guide for Secure Design and Deployment", 1<sup>st</sup> Edition, O'Reilly, 2019

**REFERENCES:**

1. Vic (J.R.) Winkler, "Securing the Cloud: Cloud Computer Security Techniques and Tactics", 1<sup>st</sup> Edition, Elsevier 2011
2. Riyan Ko, Kim–Kwang Raymond Choo , "The Cloud Security Ecosystem, Technical, Legal, Business and Management Issues", 1<sup>st</sup> Edition, Elsevier,2015
3. Tim Mather, Subra Kumaraswamy, and Shahed Latif , " Cloud Security and Privcy", 1<sup>st</sup> Edition, O'Reilly, 2009

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CSP05	DATA ANALYSIS IN CLOUD COMPUTING	Category: PEC				
		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:**

Cos \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	2	1	1	1	1	-	-	-	-	-	-	2	-
CO2	3	2	1	1	3	-	-	-	-	-	-	2	-	3
CO3	3	2	1	1	3	-	-	-	-	-	-	2	-	3
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 Work Flows – Work Flow Programming – Work Flow Management System – Work Flow Management System for Cloud – NoSQL Models for Data Analysis



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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 – Work Flow 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

**TEXT BOOKS:**

1. Domenico Talia, Paolo Trunfio, Fabrizio Marozzo, "Data Analysis in the cloud, Models, Techniques and Applications", Elsevier 2016.
2. Sachi Nandhan Mohanty, Jyotir Moy Chatterjee, Monika mangla, Suneetha Sathpathy, Sirisha Potluri, 'Machine Learning Approach for Cloud Data Analytics in IoT', Wiley , 2021

**REFERENCES:**

1. Nick, Gillam, Lee, "Cloud Computing – Principles, Systems and Applications", Second Edition, Springer, 2017
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering the Cloud Computing", Morgan Kaufmann, 2013
3. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation "Management, and Security", CRC Press, 2016.

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CSP06	EDGE COMPUTING	Category: PEC				
		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 fogs. (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:**

Cos \ POs	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	-	-	-	-	-	-	-	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.



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**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

**TEXT BOOKS:**

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, Rheinweg publishing, 2019

**REFERENCES:**

1. Bahga, Arshdeep, and Vijay Madiseti. 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, 1 st edition, River Publishers, 2014
3. Michael Missbach, Thorsten Staerk, Cameron Gardiner, Joshua McCloud, Robert Madl, Mark Tempes, George Anderson, SAP on Cloud, 1 st edition, Springer, 2016

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
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<b>Total</b>				40	60
				<b>100</b>	

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


  
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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", Second 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", First Edition, O'Reilly, 2010

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
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40	60	40	60	200	100
<b>Total</b>				40	60
				<b>100</b>	

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U21CSP08	BIG DATA INTEGRATION AND PROCESSING	Category: PEC				
		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:**

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

**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



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**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", 1<sup>st</sup> 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" , 1<sup>st</sup> Edition, John Wiley & Sons ,2013
2. Pelin Yildirim Taser, "Emerging Trends in IoT and Integration with Data Science, Cloud Computing, and Big Data Analytics", IGI Global, 2021

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
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				<b>100</b>	

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**VERTICAL IV**  
**NETWORKING AND CYBER SECURITY**

<b>U21ITP01</b>	<b>PARALLEL AND DISTRIBUTED COMPUTING</b>	<b>Category: PEC</b>				
		<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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
CO1	2	1	1	1	-	-	-	-	-	-	-	2	-	2
CO2	3	2	3	2	1	-	-	-	-	-	-	2	-	3
CO3	2	1	2	2	1	-	-	-	-	-	-	2	-	2
CO4	2	1	2	1	-	-	-	-	-	-	-	2	-	2
CO5	2	1	1	1	-	-	-	-	-	-	-	2	-	2

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

**SYLLABUS:****UNIT I      MESSAGE PASSING INTERFACE**

8

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**

10

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**

8

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 – Case study : CORBA, Google spanner

**Contact Periods:**

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

**TEXT BOOKS:**

1. Vick Eijkhout, "Parallel Programming in MPI and OpenMP", 2<sup>nd</sup> Edition, McGraw-Hill Education, 2022
2. Ian Foster, "Designing and Building Parallel Programs – Concepts and tools for Parallel Software Engineering", 1<sup>st</sup> Edition, Pearson, 2019
3. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "Distributed Systems: Concepts and Design", 5<sup>th</sup> Edition, Pearson Education, 2017

**REFERENCES:**

1. FokkinkW, "Distributed Algorithms: an Intuitive Approach", 2<sup>nd</sup> Edition, MIT Press, 2018
2. Peter Pacheco, "An Introduction to Parallel Programming", Illustrated Edition, Morgan Kaufmann, 2011.

**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	


  
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U21ITP02	MOBILE COMPUTING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- 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	-	2
CO3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	-	-	-	-	-	-	-	-	-	2	-	2
CO5	2	3	-	-	-	-	-	-	-	-	-	2	-	3

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 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

**TEXT BOOK:**

1. Prasant Kumar Pattnaik, RajibMall, "Fundamentals of Mobile Computing", PHI Learning, 1<sup>st</sup> Edition, 2019

**REFERENCES:**

1. Schiller J, "Mobile Communication", 2<sup>nd</sup> Edition, Pearson Education, 2023
2. Raj Kamal, "Mobile Computing", 3<sup>rd</sup> Edition, Oxford University press Inc, 2019
3. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing Technology, Applications and Service Creation", 2<sup>nd</sup> Edition , McGraw Hill, 2018
4. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", 1<sup>st</sup> Edition, Wiley, 2014

**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
<b>Total</b>				40	60
				<b>100</b>	

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

  
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U21ITP03	WIRELESS SENSOR NETWORKS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- Nil

**COURSE OBJECTIVES:**

- Understand the basic concepts and functionalities of MAC and routing algorithms in sensor network
- Choose appropriate solutions for network management and Middleware services.
- 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	-	2
CO3	2	1	2	-	2	-	-	-	-	-	-	2	-	2
CO4	3	2	2	2	2	-	-	-	-	-	-	2	-	3
CO5	3	2	2	2	3	-	-	-	-	-	-	2	-	3
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", 2<sup>nd</sup>Edition, Wiley, 2016
2. Abbas Jamalipour, JunZheng, "Wireless Sensor Networks: A Networking Perspective", 1<sup>st</sup>Edition, Wiley, 2014
3. Hossam Mahmoud Ahmad Fahmy, "Wireless Sensor Networks: Concepts, Applications, Experimentation and Analysis", 1<sup>st</sup>Edition, Springer, 2018


**REFERENCES:**

1. Zhao, Feng,Guibas, Leonidas, "Wireless Sensor networks : An information processing approach", 2<sup>nd</sup> Edition, Elsevier, 2016
2. Mohammad Ilyas, "The Handbook of Ad Hoc Wireless Networks", 1<sup>st</sup> Edition, CRC Press, 2017
3. ImadMahgoub, MohammadIlyas, "Sensor Network Protocols", 1<sup>st</sup>Edition, CRC Press, 2018

**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
<b>Total</b>				<b>40</b>	<b>60</b>
				<b>100</b>	

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

  
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U21ITP04	SOFTWARE DEFINED NETWORKS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- Nil

**COURSE OBJECTIVES:**

- Utilize the concepts of open flow and SDN controllers to provide services
- Identify and build SDN framework to model and deploy services for data centres
- 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	-	2
CO2	2	1	1	1	1	-	-	-	-	-	-	1	-	2
CO3	3	2	2	2	1	-	-	-	-	-	-	2	-	3
CO4	3	2	2	2	1	-	-	-	-	-	-	2	-	3
CO5	3	2	2	1	2	-	-	-	-	-	-	1	-	3

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

**SYLLABUS:****UNIT I      INTRODUCTION      10**

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**

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**

SDN Frameworks – Open daylight controller – Floodlight controller – Bandwidth calendaring – Data center orchestration.

**UNIT V SDN APPLICATIONS AND OPEN SOURCE**

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", 1<sup>st</sup> Edition, O'Reilly Media, 2013
2. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", 2<sup>nd</sup> Edition, Morgan Kaufmann, 2016

**REFERENCES:**

1. Siamak Azodolmolky, "Software Defined Networking with Open Flow", 2<sup>nd</sup> Edition, Packet Publishing, 2017
2. Vivek Tiwari, "SDN and Open Flow for Beginner", 1<sup>st</sup> Edition, M.M. D.D. Multimedia LLC, 2013
3. Fei Hu, "Network Innovation through Open Flow and SDN: Principles and Design", 1<sup>st</sup> Edition, CRC Press, 2014

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21ITP05	CYBER SECURITY	Category: PEC				
		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 defencing 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	-	3
CO2	2	1	-	1	-	2	-	2	-	-	-	2	-	3
CO3	2	1	-	1	-	2	-	2	-	-	-	2	-	3
CO4	2	1	-	2	3	2	-	3	-	-	-	2	-	3
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, E-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 - Defense 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", 1<sup>st</sup>Edition, John Wiley & Sons, 2012
2. James Graham, Rick Howard, Ryan Olson, "Cyber Security Essentials", 1<sup>st</sup> Edition, CRC Press, 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", 2<sup>nd</sup> Edition, Tata McGraw -Hill, 2006
4. <https://www.sans.org/white-papers>

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21ITP06	INTERNET SECURITY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- 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:**

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

**SYLLABUS:****UNIT I INTRODUCTION**

8

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**

10

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**

9

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, 7<sup>th</sup> Edition, 2017
2. Ronald L Krutz and Russell Dean Vines, "Cloud Security- A Comprehensive Guide to Secure Cloud Computing", 1<sup>st</sup> Edition, Wiley, 2016

**REFERENCES:**

1. J Bernard Menezes, "Network Security and Cryptography", 2<sup>nd</sup> Edition, Cengage Learning, 2014
2. Chalie Kaufman, Radia Perlman, Mike Speciner, "Network Security: Private Communication in a Public World", 2<sup>nd</sup> Edition, Pearson Education, 2022
3. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms and Source Code in C", 20<sup>th</sup> Anniversary 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				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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21ITP07	ETHICAL HACKING	Category: PEC				
		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 (Understand)
- CO2: Demonstrate port scanning tools 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	-	3
CO2	2	1	1	1	2	2	-	2	-	-	-	2	-	3
CO3	3	2	1	1	1	2	-	2	-	-	-	2	-	3
CO4	2	1	1	2	3	2	-	2	-	-	-	2	-	3
CO5	3	2	2	2	3	2	-	2	-	-	-	3	-	3

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 Medusa – Attacking SQL servers – Metasploit: commands – reconnaissance – port scanning – Metasploit databases – Useful scans with Metasploit

**UNIT V WIRELESS HACKING 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 BOOK:**

- Baloch, R, "Ethical Hacking and Penetration Testing Guide", 1<sup>st</sup> Edition, CRC Press, 2015

**REFERENCES:**

- Sagar Rahalkar, "Quick Start Guide to Penetration Testing with NMAP, OpenVAS and Metasploit", Apress, 1<sup>st</sup> Edition, 2019
- Alan T Norman, "Kali Linux and Wireless Hacking Ultimate Guide with Security and Penetration Testing Tools, Practical Step by Step Computer Hacking Book", 1<sup>st</sup> Edition, CB-India, 2018

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21ITP08	DIGITAL FORENSICS	Category: PEC				
		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:** Describe the process of acquiring and documenting computer forensic evidence for investigation (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	-	-	-	-	-	3
CO2	2	1	1	1	-	2	-	1	-	-	-	-	-	3
CO3	2	1	1	1	-	2	-	1	-	-	-	-	-	3
CO4	3	2	2	2	3	2	-	2	-	-	-	-	-	3
CO5	3	2	2	2	3	2	-	2	-	-	-	-	-	3
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**

8

Working undercover – Website evidence – Background searches on a suspect – Online crime – Capturing online communications

**UNIT IV NETWORK AND MOBILE FORENSICS**

10

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 BOOK:**

1. Darren R. Hayes, "A Practical Guide to Digital Forensics Investigations", 2<sup>nd</sup> Edition, Pearson, 2020

**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. Bill Nelson, Amelia Phillips, Christopher Stuart, "Guide to Computer Forensics and Investigations", 6<sup>th</sup> Edition, Cengage learning, 2020.
4. Kevin Mandia, Chris Prosis, Matt Pepe, "Incident Response and Computer Forensics", 2<sup>nd</sup> Edition, BCS, The Chartered Institute for IT, 2018.
5. <https://www.sans.org/white-papers>

**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
<b>Total</b>				40	60
				<b>100</b>	

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<b>U21CSP09</b>	<b>UI/UX DESIGN</b>	<b>Category: PEC</b>				
		<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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. (Understand)

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	-	-
CO2	2	1	1	-	-	-	-	-	-	2	-	1	-	-
CO3	2	1	1	-	-	-	-	-	-	2	-	1	-	-
CO4	2	1	1	-	-	-	-	-	-	2	-	1	-	-
CO5	3	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.



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**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.

**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, First 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				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
<b>Total</b>				40	60
				<b>100</b>	

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U21CSP10	PYTHON WEB DEVELOPMENT	Category: PEC				
		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	1	-
CO3	3	2	3	1	3	-	-	-	-	-	-	3	2	-
CO4	3	2	3	1	3	-	-	-	-	-	-	3	2	-
CO5	3	2	3	1	3	-	-	-	-	-	-	3	2	3

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



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**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", Fifth Edition, O' Reilly 2013.
2. Miguel Grinberg, "Flask Web Development Developing Web Applications with Python", O'Reilly, 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, Second Edition, Apress, 2016.

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
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<b>Total</b>				40	60
				<b>100</b>	

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



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U21CSP11	APP DEVELOPMENT	Category: PEC				
		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      9**

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

**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



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**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, "Head First Android Development", O'Reilly, 1<sup>st</sup> edition
2. Anthony Accomazzo, HousseinDjirdeh, Sophia Shoemaker, Devin Abbott, "Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native", FullStack publishing

**REFERENCES:**

1. Android Programming for Beginners, John Horton, Packt Publishing, 2<sup>nd</sup> Edition
2. Apache Cordova 4 Programming, John M Wargo, 2015
3. React Native Cookbook, Daniel Ward, Packt Publishing, 2<sup>nd</sup> Edition
4. Apache Cordova in Action, Raymond K. Camden, Manning. 2015

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CSP12	JAVASCRIPT FRAMEWORKS	PEC				
		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:**

Cos \ POs	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	1	-
CO3	3	2	2	1	3	-	-	-	-	-	-	3	2	-
CO4	3	2	2	1	3	-	-	-	-	-	-	3	1	-
CO5	3	2	2	1	3	-	-	-	-	-	-	3	1	-

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, Second Edition, 2018, Pearson Education, Inc.
2. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasana Subramanian, 2017, Apress.

**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 ed. edition (19 November 2018).
2. Kirupa Chinnathambi, "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux", Addison-Wesley Professional, 2nd edition (26 April 2018).
3. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage", 3rd Edition, O'Reilly publication, December 31, 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 any one / two components based on the nature of the course.

U21CSP13	WEB SERVICES AND API DESIGN	Category: PEC				
		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:**

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



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**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 DEPLOYMENT**

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", 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. Harihara Subramanian, Pethuru Raj, "Hands-On RESTful API Design Patterns and Best Practices: Design, develop, and deploy highly adaptable, scalable, and secure

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CSP14	SOA & MICROSERVICES	Category: PEC				
		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:**

Cos \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	2	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

**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 WORKING WITH APIS** 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", Third Edition, Wiley, 2018.
2. Tarek Ziadé, "Python Microservices Development", O'REILLY publication, 2017.

**REFERENCES:**

1. Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective", Pearson Education, 2016
2. Nathaniel Felsen, "Effective DevOps with AWS", Packt Publishing, [ISBN:9781786466815], 2017
3. Jim Webber, SavasParastatidis, Ian Robinson, "REST in Practice" O'Reilly Media; 1 edition, [ISBN: 978-0596805821] 2010.

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CSP15	CLOUD NATIVE APPLICATIONS DEVELOPMENT	Category: PEC				
		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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<b>UNIT III DOCKER</b>	<b>9</b>
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	
<b>UNIT IV CONTAINER ORCHESTRATION</b>	<b>9</b>
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	
<b>UNIT V CONTINUOUS INTEGRATION AND DEVELOPMENT</b>	<b>9</b>
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", Wiley publication
2. Tom Laszewski, Kamal Arora, Eric Farr, Piyum Zanoos, "Cloud Native Architectures: Design high–availability and cost–effective applications for the cloud", Packt publishing

**REFERENCE BOOKS**

1. Bill Wilder, Cloud Architecture Patterns: Using Microsoft Azure, O'Reilly Media
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.

**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
<b>Total</b>				<b>40</b>	<b>60</b>
				<b>100</b>	

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

  
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**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: 30 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, Second 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: Cidc 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”, First Edition, 2015.
3. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOpsll”, Second Edition, 2016.

**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
<b>Total</b>				40	60
				<b>100</b>	

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



U21CSP17	COMPREHENSION – I	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21MA101 – Calculus and Differential Equations, U21MAG02 – Discrete Mathematics, U21ECG01 – Digital Electronics, U21CS301 – Computer Organization and Architecture, U21CSG03 – Data Structures, U21CS401 – Design and Analysis of Algorithms

**COURSE OBJECTIVES:**

- To acquire the knowledge of engineering mathematics
- To learn deep knowledge about modern computing technology through hardware and software interface by exploring how machines are designed, built, and operate
- To understand the importance of data structures and algorithms

**COURSE OUTCOMES:**

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

**CO1:** Apply mathematical foundations to real world problems (Apply)

**CO2:** Design and analyze combinational and sequential logic circuits (Analyze)

**CO3:** Make use of computer organization principles, covering machine instructions, addressing modes, and memory hierarchy (Apply)

**CO4:** Utilize the application of linear and non-linear data structures for various problems (Apply)

**CO5:** Examine algorithm design techniques for a given application (Analyze)

**CO-PO MAPPING**

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

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

**SYLLABUS:****UNIT I ENGINEERING MATHEMATICS**

9

Discrete Mathematics – Propositional and first order logic – Sets – relations – functions – partial orders and lattices – Monoids – Groups – Graphs: connectivity – matching – coloring – Combinatorics: counting – recurrence relations – generating functions

Linear Algebra: Matrices – determinants – system of linear equations – eigenvalues and eigenvectors – LU decomposition

Calculus: Limits – continuity and differentiability – Maxima and minima – Mean value theorem – Integration – Probability and Statistics: Random variables – Uniform – Normal – Exponential – Poisson

and binomial distributions – Mean – median – mode and standard deviation – Conditional probability and Bayes theorem

**UNIT II DIGITAL LOGIC** 9

Boolean algebra – Combinational and sequential circuits – Minimization – Number representations and computer arithmetic (fixed and floating point)

**UNIT III COMPUTER ORGANIZATION AND ARCHITECTURE** 9

Machine instructions and addressing modes – ALU – Data path and control unit – Instruction pipelining – pipeline hazards – Memory hierarchy: cache – main memory and secondary storage – I/O interface interrupt and DMA mode

**UNIT IV PROGRAMMING AND DATA STRUCTURES** 9

Programming in C: Recursion – Arrays – stacks – queues – linked lists – trees – binary search trees – binary heaps – graphs

**UNIT V ALGORITHMS** 9

Searching – sorting – hashing – Asymptotic worst-case time and space complexity – Algorithm design techniques: greedy – dynamic programming and divide-and-conquer – Graph traversals – minimum spanning trees – shortest paths

**Contact Periods:**

Lecture: 45 Periods      Tutorial: – Periods      Practical: – Periods      Total: 45 Periods

**REFERENCES:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth Edition, Wiley India Pvt Ltd, 2018
2. Oliver C. Ibe, Fundamentals of Applied probability and Random processes, Second Edition, Elsevier, 2014
3. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2017
4. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Fifth Edition, Morgan Kaufmann / Elsevier, 2014
5. M.A.Weiss, "Data Structures and Algorithm Analysis in C++", Fourth Edition, Pearson Education, 2013
6. Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, Prentice Hall, 2010

**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
<b>Total</b>				40	60
				<b>100</b>	

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



U21CSP18	COMPREHENSION – II	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21CS302 – Database Management Systems, U21CS402 – Theory of Computation, U21CS403 – Operating Systems, U21CSG05 – Computer Networks, and U21CS502 – Compiler Design

**COURSE OBJECTIVES:**

- To understand the concepts of theory of computations, compilers principles and techniques
- To learn operating systems concepts and database systems concepts
- To understand knowledge on data communications and networking

**COURSE OUTCOMES:**

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

**CO1:** Apply regular expressions and finite automata for recognizing and manipulating regular languages (Apply)

**CO2:** Implement compiler design principles, optimizing code and performing data flow analyses for efficiency (Apply)

**CO3:** Examine the features of various operating systems (Analyze)

**CO4:** Demonstrate the proficiency of databases, utilizing ER-model, relational algebra, SQL, and normalization techniques (Apply)

**CO5:** Examine the functions of different network layers (Apply)

**CO-PO MAPPING**

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

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

**SYLLABUS:**

**UNIT I THEORY OF COMPUTATION 9**

Regular expressions and finite automata – Context-free grammars and push-down automata – Regular and context-free languages – pumping lemma – Turing machines and decidability

**UNIT II COMPILER DESIGN 9**

Lexical analysis – parsing – syntax-directed translation – Runtime environments – Intermediate code generation – Local optimization – Data flow analyses: constant propagation – liveness analysis – common sub-expression elimination

*Handwritten notes:*  
TCS 106 - academics

*Handwritten signature:* yee  
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**UNIT III OPERATING SYSTEMS 9**

System calls – processes – threads – inter-process communication – concurrency and synchronization – Deadlock – CPU and I/O scheduling – Memory management and virtual memory – File systems

**UNIT IV DATABASES 9**

ER-model – Relational model: relational algebra – tuple calculus – SQL – Integrity constraints – normal forms – File organization – indexing (example B and B+ trees) – Transactions and concurrency

**UNIT V COMPUTER NETWORKS 9**

Concept of layering: OSI and TCP/IP Protocol Stacks – Basics of packet – circuit and virtual circuit – switching – Data link layer – framing – error detection – Medium Access Control – Ethernet bridging – Routing protocols – shortest path – flooding – distance vector and link state routing – Fragmentation and IP addressing – IPv4 – CIDR notation – Basics of IP support protocols ARP – DHCP – ICMP – Network Address Translation – Transport layer – flow control and congestion control – UDP – TCP – sockets – Application layer protocols: DNS – SMTP – HTTP – FTP – Email

**Contact Periods:**

Lecture: 45 Periods      Tutorial: – Periods      Practical: – Periods      Total: 45 Periods

**REFERENCES:**

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2014
2. Alfred Aho, Ravi Sethi, Jeffrey D Ullman, Monica S. Lam, "Compilers Principles, Techniques and Tools", Second Edition, Pearson Education, 2014
3. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Ninth Edition, John Wiley & Sons (Asia) Pvt. Ltd, 2016
4. Abraham Silberschatz, Henry Korth, and S. Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill, 2011
5. Behrouz A Forouzan, "Data Communications and Networking", Fifth edition, Tata McGraw-Hill, New Delhi, 2013

**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
<b>Total</b>				40	60
				100	

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

**VERTICAL VI**  
**IT AND IT ENABLED SERVICES (ITES)**

<b>U21ITP09</b>	<b>NEXT GENERATION NETWORKS</b>	<b>Category: PEC</b>				
		<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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 applications 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	-	2
CO2	2	1	1	1	-	-	-	-	-	-	-	2	-	2
CO3	2	1	2	2	2	-	-	-	-	-	-	2	-	2
CO4	3	2	3	3	3	-	-	-	-	-	-	2	-	3
CO5	3	3	-	3	-	-	-	-	-	-	-	2	-	3

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

  
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**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 BOOK:**

- Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", 1<sup>st</sup> Edition, Wiley, 2015

**REFERENCES:**

- Yin Zhang, Min Chen, "Cloud Based 5G Wireless Networks – Springer Briefs in Computer Science", 1<sup>st</sup> Edition Springer, 2016
- Athanasios G. Kanatas, Konstantina S. Nikita, Panagiotis (Takis) Mathiopoulos, "New Directions in Wireless Communications Systems: From Mobile to 5G", 1<sup>st</sup> Edition, CRC Press, 2017

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21ITP10	GAME DEVELOPMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- Introduce the notion of a game, its solutions concepts, and other basic notions and tools of game theory
- Formalize the notion of strategic thinking and rational choice by using the tools of game theory
- 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	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	2	3	-	-	-	-	-	-	3	-	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	-	-
CO5	3	2	2	2	3	-	-	-	-	-	-	2	-	-

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

**SYLLABUS:****UNIT I      INTRODUCTION**

10

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

**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)



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**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** 8

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 BOOK:**

1. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani , “Algorithmic Game Theory” 1<sup>st</sup> Edition(Revised), Cambridge University Press, 2011

**REFERENCES:**

1. M. Machler, E. Solan, S. Zamir, “Game Theory”, 1<sup>st</sup> Edition, ,Cambridge University Press, 2020
2. A.Dixit and S. Skeath, “Games of Strategy”, 2<sup>nd</sup> Edition, W W Norton & Co Inc, 2015
3. YoavShoham, Kevin Leyton-Brown, “Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations”, 4<sup>th</sup> Edition, Cambridge University Press, 2008
4. Zhu Han, DusitNiyato, WalidSaad, Tamer Basar and Hjorungnes, “Game Theory in Wireless and Communication Networks”, 1<sup>st</sup> Edition, Cambridge University Press, 2012

**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 any one / two components based on the nature of the course.

U21ITP11	BLOCKCHAIN TECHNOLOGIES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- 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:**

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

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

**SYLLABUS:**

- UNIT I      FUNDAMENTALS OF BLOCKCHAIN      8**  
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.

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**UNIT III ETHEREUM 10**

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", 1<sup>st</sup> Edition, Apress, 2019
2. Chandramouli Subramanian, Asha A George, Abhilash K A "Blockchain Technology", 1<sup>st</sup> Edition, Universities Press, 2020

**REFERENCES:**

1. Joseph Bonneau , "SoK: Research Perspectives and Challenges for Bitcoin and Cryptocurrency", IEEE Symposium on Security and Privacy, 2015
2. Imran Bashir, "Mastering Blockchain", 2<sup>nd</sup> Edition, Packt, 2018

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21ITP12	AUGMENTED REALITY / VIRTUAL REALITY	Category: PEC				
		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	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	1	-	-	-	-	-	-	-	2	-	-
CO3	3	2	3	3	2	-	-	-	-	-	-	3	-	-
CO4	2	1	2	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	2	-	-	-	-	-	-	2	-	-

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

**SYLLABUS:****UNIT I      XR OVERVIEW****10**

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**

8

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", 1<sup>st</sup> Edition, Wiley, 2021
2. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", 2<sup>nd</sup> Edition, John Wiley & Son, 2014
3. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", 1<sup>st</sup> Edition, Addison-Wesley, 2017

**REFERENCES:**

1. Steve Aukstaklnis, "Practical Augmented Reality: A Guide to the Technology Applications, and Human Factors for AR and VR", 1<sup>st</sup> Edition, Addison-Wesley, 2016
2. Robert Scoble, Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial intelligence Will Change Everything", 1<sup>st</sup> Edition, Patrick Brewster Press, 2016
3. Jesse Glover, Jonathan Linowes, "Complete Virtual Reality and Augmented Reality Development with Unity", 1<sup>st</sup> 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
<b>Total</b>				40	60
				<b>100</b>	

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



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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:**

COs \ POs	POs												PSOs	
	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	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.



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**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-qubit 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", 1<sup>st</sup> Edition, Springer, 2021
2. Eleanor Rieffel, Wolfgang Polak, "Quantum Computing: A Gentle Introduction", 1<sup>st</sup> Edition, MIT Press, 2011
3. Bernhardt, Chris, "Quantum Computing for Everyone" 1<sup>st</sup> Edition, MIT Press, 2019

**REFERENCES:**

1. David J Griffiths, "Introduction to Quantum Mechanics", 1<sup>st</sup> Edition, Cambridge, 2016
2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 1<sup>st</sup> Edition, 2013
3. Michael A. Nielsen, Isaac L. Chuang, "Quantum Computation and Quantum Information", 10<sup>th</sup> Anniversary Edition, Cambridge University Press, 2011

**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
<b>Total</b>				<b>40</b>	<b>60</b>
				<b>100</b>	

  
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U21ITP14	GRAPHICS PROCESSING UNIT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- 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	-	2
CO3	3	2	2	2	2	-	-	-	-	-	-	2	-	3
CO4	3	2	2	1	1	-	-	-	-	-	-	2	-	2
CO5	3	2	2	1	1	-	-	-	-	-	-	2	-	2

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

**SYLLABUS:****UNIT I INTRODUCTION**

8

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

**UNIT II MEMORY**

10

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



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**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", 2<sup>nd</sup> Edition, Morgan Kaufman, 2013
2. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", 1<sup>st</sup> Edition, Elsevier, 2013

**REFERENCES:**

1. Avimanyu Bandyopadhyay, "Hands on GPU Computing with Python", 1<sup>st</sup> Edition, Packt, 2019
2. Brian Tuomanen, "Hands-On GPU Programming with Python and CUDA", 1<sup>st</sup> Edition, Packt, 2018

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21ITP15	AGILE METHODOLOGIES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- 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:**

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



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**UNIT III AGILITY AND KNOWLEDGE MANAGEMENT**

9

Agile information systems – Agile decision making - Early 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", 2<sup>nd</sup> Edition, Cengage Learning, 2016
2. Orit Hazzan, Yael Dubinsky, "Agile Software Engineering", 2<sup>nd</sup> Edition, Springer, 2014

**REFERENCES:**

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), "Agile Software Development, Current Research and Future Directions", 1<sup>st</sup> Edition, Springer, 2010
2. Karl Weigers, John Beatty, "Software Requirement", 3<sup>rd</sup> Edition, Microsoft Press US, 2013

**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 any one / two components based on the nature of the course.

  
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U21ITP16	SOFTWARE TESTING TOOLS AND TECHNIQUES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITE:**

- 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 testing 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
CO1	2	1	-	1	-	-	-	2	-	-	-	2	-	-
CO2	2	1	-	1	-	-	-	2	-	-	-	2	-	-
CO3	2	1	-	1	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	2	3	-	-	-	-	-	-	2	-	-
CO5	3	2	-	2	3	-	-	-	-	-	-	3	-	-
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.

  
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**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", 5<sup>th</sup> Edition, CRC Press, 2021
2. Navneesh Garg, "Test Automation using Selenium WebDriver with Java: Step by Step Guide" 1<sup>st</sup> Edition, AdactIn Group, 2014

**REFERENCES:**

1. Ralf Bierig, Stephen brown, Edgar Galvan, Joe Timoney, "Essentials of Software Testing", 1<sup>st</sup> Edition, Cambridge University Press, 2022
2. Gerard O'Regan, "Concise Guide to Software testing", 1<sup>st</sup> Edition, Springer Nature, 2019
3. William E.Lewis, David D.Dobbs, Gunasekaran Veerapillai, "Software Testing and Continuous Quality Improvement", 3<sup>rd</sup> Edition, CRC press, 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
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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 any one / two components based on the nature of the course.



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U21CBP01	INTRODUCTION TO INNOVATION, IP MANAGEMENT AND ENTREPRENEURSHIP	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To develop and strengthen innovation, IP management and entrepreneurial quality
- To motivate in and to impart basic skills
- To understanding to run a business efficiently and effectively

**COURSE OUTCOMES:**

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

**CO1:** Outline the current and emerging trends in innovation. (Understand)

**CO2:** Exemplify the importance of IPR in patents, copyrights, and geographical indications (Understand)

**CO3:** Apply legal and regulatory requirements for the registration of IPRs (Apply)

**CO4:** Analyze various types of entrepreneurs and analyze their motivations (Apply)

**CO5:** Develop a comprehensive small business plan integrating feasibility and financial strategies (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I INTRODUCTION TO INNOVATION**

9

Adoption of Innovations, Exploring Innovations, Idea generation, Developing innovative culture, Executing innovations, Innovation attributes and their adoption rate, Measuring and evaluation of innovation, Exploiting and renewing innovations, Managing innovations in organizations, Innovation and intellectual property rights, Innovation portfolio

**UNIT II INTRODUCTION TO IPR**

9

Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR



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**UNIT III REGISTRATION OF IPRs** 9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad, Agreements and Legislations

**UNIT IV ENTREPRENEURSHIP** 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur, Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management

**UNIT V BUSINESS AND FINANCING** 9

Small Enterprises – Characteristics, Ownership Structures – Steps involved in setting up a Business – Identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project 100 Appraisal – Sources of Finance, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax

**Contact Periods:**

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

**TEXT BOOKS:**

1. V. Scope Vinod, "Managing Intellectual Property: The Strategic Imperative", 5<sup>th</sup> Edition, Prentice Hall of India pvt Ltd, 2012
2. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9<sup>th</sup> Edition, Cengage Learning, 2014.

**REFERENCES:**

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, 3<sup>rd</sup> Edition, 2012.
2. Oliver Gassmann, Martin A. Bader, Mark James Thompson, "Patent Management Protecting Intellectual Property and Innovation", 1<sup>st</sup> Edition, Springer, 2020.
3. Hisrich R D, Peters M P, "Entrepreneurship" 8<sup>th</sup> Edition, Tata McGraw-Hill, 2013.

**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 any one / two components based on the nature of the course.



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U21CBP02	IT PROJECT MANAGEMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To learn the concepts of managing IT projects
- To understand about planning, budgeting, resource allocation and scheduling
- To learn software quality management

**COURSE OUTCOMES:**

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

- CO1:** Describe the project management principles to manage business situations effectively (Understand)
- CO2:** Illustrate the planning, budgeting, and scheduling skills to create effective project plans (Understand)
- CO3:** Optimize resource utilization and time management to ensure project success (Apply)
- CO4:** Analyze and control resource allocation for successful project completion (Analyze)
- CO5:** Implement software quality management techniques to ensure high-quality project deliverables (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO PROJECT MANAGEMENT**

9

Project Management – Definition – Goal - Lifecycles. Project Selection Methods. Project Portfolio Process – Project Formulation. Project Manager – Roles - Responsibilities and Selection – Project Teams, Project support activities, Types of project organizations

**UNIT II PLANNING AND BUDGETING**

9

The Planning Process – Work Break down Structure – Role of Multidisciplinary teams, Critical path analysis. Budget the Project – Methods. Cost Estimating and Improvement. Budget uncertainty and risk management



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**UNIT III SCHEDULING & RESOURCE ALLOCATION**

9

PERT & CPM Networks - Crashing – Project Uncertainty and Risk Management – Simulation – Gantt Charts – Expediting a project – Resource loading and leveling. Allocating scarce resources – Goldratt's Critical Chain

**UNIT IV CONTROL AND COMPLETION**

9

The Plan-Monitor-Control cycle – Data Collecting and reporting – Project Control – Designing the control system. Project Evaluation, Earned Value Analysis, Auditing and Termination, Risk Management – Conflict – Origin & Consequences. Managing conflict – Team methods for resolving conflict

**UNIT V SOFTWARE QUALITY MANAGEMENT**

9

Product quality and software quality – Quality management systems, principles and features – System quality specification and measurement – Process and product quality approaches – Quality assurance and quality control, project audit and quality audit, Methods of enhancing quality: the different types of testing, inspections, reviews, standards – Management and control of testing

**Contact Periods:**

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

**TEXT BOOKS:**

1. Hughes B, "IT-related Projects" , 2nd Edition, BCS Publications, 2012
2. Greg Horine, "Project Management Absolute Beginner's Guide", 4th Edition, Pearson Education, 2017.
3. John M. Nicholas, "Business and Technology - Principles and Practice ", 2nd Edition, Pearson Education, 2006.

**REFERENCES:**

1. Gido and Clements, Successful Project Management, 2<sup>nd</sup> Edition, Thomson Learning, 2003.
2. Harvey Maylor, Project Management, 3<sup>rd</sup> Edition, Pearson Education, 2006.

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
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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 any one / two components based on the nature of the course.



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U21CBP03	E – BUSINESS MANAGEMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the practices and technology to start an online business
- To learn e-business payment and security
- To understand legal and privacy issues

**COURSE OUTCOMES:**

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

**CO1:** Infer the need for e-business (Understand)

**CO2:** Identify the technology infrastructure required for e-business (Understand)

**CO3:** Apply the knowledge of consumer-oriented e-business models (Apply)

**CO4:** Employ the e-business payment and security protocols (Apply)

**CO5:** Apply the ethical, legal, privacy issues and encryption policies for e-business (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO e-BUSINESS 9**

e-business, e-business vs e-commerce, Economic forces – advantages – myths – e-business models, design, develop and manage e-business, Web 2.0 and Social Networking, Mobile Commerce's-commerce

**UNIT II TECHNOLOGY INFRASTRUCTURE 9**

Internet and World Wide Web, internet protocols – FTP, intranet and extranet, information publishing technology – Basics of web server hardware and software

**UNIT III BUSINESS APPLICATIONS 9**

Consumer oriented e-business – e-tailing and models - Marketing on web – advertising, e-mail marketing, affiliated programs – e-CRM; online services, Business oriented e-business, e-governance, EDI on the internet, Delivery management system, Web Auctions, Virtual communities and Web portals – social media marketing



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**UNIT IV E-BUSINESS PAYMENTS AND SECURITY 9**

E-payments – Characteristics of payment of systems, protocols, e-cash, e-cheque and Micro payment systems- internet security – Cryptography – Security protocols – Network security

**UNIT V LEGAL AND PRIVACY ISSUES 9**

Legal, Ethics and privacy issues – Protection needs and methodology – consumer protection, cyber laws, contracts and warranties, Taxation and encryption policies

**Contact Periods:**

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

**TEXT BOOKS:**

1. Lee, I. "Electronic Commerce Management for Business Activities and Global Enterprises: Competitive Advantages", 2<sup>nd</sup> Edition, Business Science Reference, 2012.
2. Lee, I., "Encyclopedia of E-Commerce Development, Implementation, and Management", IGI Global, 2016.
3. Martínez-López, F. J., Jelassi, T., "Strategies for E-Business: Concepts and Cases on Value Creation and Digital Business Transformation", 4<sup>th</sup>, Springer International Publishing, 2020.

**REFERENCES:**

1. Harvey M.Deitel, Paul J.Deitel, Kate Steinbuhler, "e-business and e-commerce for managers", 1<sup>st</sup> edition, Pearson, 2011.
2. Efraim Turban, Jae K. Lee, David King, Ting Peng Liang, Deborrah Turban, "Electronic Commerce –A managerial perspective", 8<sup>th</sup> Edition, Pearson Education Asia, 2015.

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CBP04	RECOMMENDER SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the foundations and significance of machine learning and data mining algorithms for Recommender systems
- To gain the design and implementation of a recommender system using collaborative filtering
- To acquire a comprehensive understanding of collaborative filtering techniques

**COURSE OUTCOMES:**

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

- CO1:** Elucidate different recommender systems and their effective construction using data mining methods (Understand)
- CO2:** Illustrate the content-based recommendation systems through user and item profile learning (Understand)
- CO3:** Evaluate user and item-based collaborative filtering techniques for building recommendation systems (Apply)
- CO4:** Apply strategies to detect and protect recommender systems from attacks (Apply)
- CO5:** Employ appropriate evaluation paradigms and metrics to assess the recommender systems (Apply)

**CO-PO MAPPING:**

COs \ POs	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	1	2	-	-	-	-	-	-	2	2	-
CO4	3	2	2	2	2	-	-	-	-	-	-	2	3	-
CO5	3	2	2	1	2	-	-	-	-	-	-	2	3	-

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

**SYLLABUS:****UNIT I INTRODUCTION**

9

Introduction and basic taxonomy of recommender systems – Traditional and non-personalized Recommender Systems – Overview of data mining methods for recommender systems - similarity measures – Dimensionality reduction – Singular Value Decomposition (SVD), Applications of recommendation systems, Issues with recommender system



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**UNIT II CONTENT-BASED RECOMMENDATION SYSTEMS** 9

High-level architecture of content-based systems – Advantages and drawbacks of content based filtering, Item profiles – Representing item profiles – Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

**UNIT III COLLABORATIVE FILTERING** 9

A systematic approach – Nearest-neighbour collaborative filtering (CF) – User-based and item-based CF – Components of neighbourhood methods (rating normalization, similarity weight computation, and neighbourhood selection)

**UNIT IV ATTACK-RESISTANT RECOMMENDER SYSTEMS** 9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms

**UNIT V EVALUATING RECOMMENDER SYSTEMS** 9

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Error metrics, Decision-Support metrics, User-Centred metrics, and Design Issues – Accuracy metrics – Limitations of Evaluation measures

**Contact Periods:**

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

**TEXT BOOKS:**

1. Charu C. Aggarwal, "Recommender Systems: The Textbook, Springer ", 2<sup>nd</sup> Edition, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , "Recommender Systems: An Introduction, Cambridge University Press", 1<sup>st</sup> Edition, 2011.
3. Francesco Ricci ,LiorRokach , Bracha Shapira , "Recommender Sytems Handbook", 1<sup>st</sup> Edition, Springer 2011,
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of massive datasets", 3<sup>rd</sup> edition, Cambridge University Press, 2020.

**REFERENCES:**

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender "Systems Handbook, Springer", 1<sup>st</sup> Edition, 2011.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer", 1<sup>st</sup> Edition, 2013.

**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
<b>Total</b>				40	60
				<b>100</b>	



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U21CBP05	INDUSTRIAL PSYCHOLOGY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To introduce students to industrial psychology and its applications in organizational settings
- To understand key topics such as employment law, job analysis, recruitment, selection, training, performance appraisal, motivation, and workplace safety
- To emphasize an applied approach to prepare students for their roles as employees and managers

**COURSE OUTCOMES:**

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

- CO1:** Elucidate the I/O psychology research methods for job analysis, evaluation, compensation, and recruitment (Understand)
- CO2:** Illustrate the employee performance measurement and evaluation methods (Understand)
- CO3:** Analyze theories of employee motivation, satisfaction, commitment, diversity, and leadership for organizational development (Apply)
- CO4:** Apply the knowledge of organizational culture, cultural fit, cross-cultural issues, and work behavior (Apply)
- CO5:** Employ stress management strategies to mitigate stress-inducing factors (Apply)

**CO-PO MAPPING:**

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

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

**SYLLABUS:****UNIT I INTRODUCTION**

9

I/O Psychology-definition. Research Methods, Statistics, and Evidence-based Practice – Introduction & Legal Context of Industrial Psychology – Job Analysis & Competency Modelling – Job Evaluation & Compensation – Job Design & Employee Well-Being – Recruitment

**UNIT II EMPLOYEES PERFORMANCE AND EVALUATION**

9

Identifying Criteria & Validating Tests and Measures, Screening Methods, Intensive Methods, Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance



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**UNIT III LEADERSHIP AND ORGANISATIONAL DEVELOPMENT** 9

Employee Motivation – Satisfaction and Commitment – Fairness and Diversity, Leadership, Leadership vs Management – Leadership Theories – Organizational Climate, Culture, and Development – Emerging issues in Leadership

**UNIT IV ORGANIZATIONAL CULTURE** 9

Organizational Climate and Culture – Functions of organizational culture – Organizational Socialization, Assessing Cultural Values and Fit – Cross Cultural issues Teams in Organizations – The Organization of Work Behaviour

**UNIT V STRESS MANAGEMENT** 9

Source of Stress – Consequences of stress – Managing Stress, Stress Reduction Interventions Related to Life/Work Issues – Measuring Stress – Demands of Life and Work

**Contact Periods:**

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

**TEXT BOOKS:**

1. Jeffrey M. Conte, Frank J. Landy."Work in the 21st Century: An Introduction to Industrial and Organizational Psychology", 6<sup>th</sup> Edition, Wiley, 2019.
2. Aamodt, M. G. "Industrial/Organizational Psychology: An Applied Approach" , 1<sup>st</sup> Edition, Cengage Learning, 2022

**REFERENCES:**

1. Ashwathappa, K. "Human Resource Management: Text & Cases, McGraw Hill Education ", 8<sup>th</sup> Edition, 2017.
2. Donald M. Truxillo, Talya N. Bauer, Berrin Erdogan," Psychology and Work An Introduction to Industrial and Organizational Psychology",2<sup>nd</sup> Edition, Taylor & Francis, 2021.

**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 any one / two components based on the nature of the course.



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U21CBP06	MARKETING RESEARCH AND MARKETING MANAGEMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the changing business environment and the fundamental premise underlying market driven strategies
- To analyse the nature of consumer buying behaviour
- To understanding the marketing research and new trends in the arena of marketing

**COURSE OUTCOMES:**

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

- CO1:** Explain contemporary marketing theories to practical business and management situations (Understand)
- CO2:** Illustrate the marketing strategies for consumer and industrial markets (Understand)
- CO3:** Select and manage appropriate marketing mix elements and integrated marketing channels for a given product or service. (Apply)
- CO4:** Evaluate the factors influencing consumer buying behavior (Apply)
- CO5:** Analyze emerging marketing trends and recommend strategies for adaptation. (Analyze)

**CO-PO MAPPING:**

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

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

**SYLLABUS:**

**UNIT I      INTRODUCTION TO MARKETING RESEARCH AND MARKETING MANAGEMENT      9**

Defining Marketing – Core concepts in Marketing – Evolution of Marketing – Marketing Planning Process – Scanning Business environment: Internal and External – Value chain – Core Competencies – PESTEL – SWOT Analysis – Marketing interface with other functional areas – Production – Finance Human Relations Management – Information System – Marketing in global environment – International Marketing – Rural Marketing – Prospects and Challenges.

**UNIT II      MARKETING STRATEGY      9**

Marketing strategy formulations – Key Drivers of Marketing Strategies – Strategies for Industrial Marketing – Consumer Marketing – Services marketing – Competition Analysis – Analysis of



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consumer and industrial markets – Influence of Economic and Behavioral Factors – Strategic Marketing Mix components.

**UNIT III MARKETING MIX DECISIONS 9**

Product planning and development – Product life cycle – New product Development and Management – Defining Market Segmentation – Targeting and Positioning – Brand Positioning and Differentiation – Channel Management – Managing Integrated Marketing Channels – Managing Retailing, Wholesaling and Logistics – Advertising and Sales Promotions – Pricing Objectives, Policies and Methods

**UNIT IV BUYER BEHAVIOUR 9**

Understanding Industrial and Consumer Buyer Behaviour – Influencing factors – Buyer Behaviour Models – Online buyer behaviour – Building and measuring customer satisfaction – Customer relationships management – Customer acquisition, Retaining, Defection – Creating Long Term Loyalty Relationships.

**UNIT V MARKETING RESEARCH & TRENDS IN MARKETING 9**

Marketing Information System – Marketing Research Process – Concepts and applications: Product – Advertising – Promotion – Consumer Behaviour – Retail research – Customer driven organizations - Cause related marketing – Ethics in marketing – Online marketing trends - social media and digital marketing.

**Contact Periods:**

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

**TEXT BOOKS:**

1. Philip T. Kotler and Kevin Lane Keller, Marketing Management, 15th Edition, Prentice Hall India, 2017.
2. KS Chandrasekar, "Marketing management-Text and Cases", 1st Edition ,Tata McGraw Hill Education, 2012

**REFERENCES:**

1. Paul Baines, Chris Fill, Kelly Page, Marketing, Asian edition, 5th Edition, Oxford University Press, 2019.
2. Philip Kotler, Gay Armstrong, Prafulla Agnihotri, "Principles of marketing", 7th Edition, 2018.

**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
<b>Total</b>				40	60
				<b>100</b>	

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



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U21CBP07	HUMAN RESOURCE MANAGEMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the fundamental concepts and theories of HRM
- To practice the ethical values in achieving stakeholders welfare
- To involve stakeholders and team members in executing decisions

**COURSE OUTCOMES:**

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

**CO1:** Explain the concepts of human resource management (Understand)

**CO2:** Illustrate the recruitment and selection strategies for an organization (Understand)

**CO3:** Utilize training programs to enhance employee performance and appraisal (Apply)

**CO4:** Manage wage and salary programs aligned with the industry standards (Apply)

**CO5:** Apply legal and ethical principles to manage employee relations and promote workplace safety. (Apply)

**CO-PO MAPPING:**

COs \ POs	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	2	-	2	-	-	-	1	-	-	3	2	-	-
CO4	3	2	-	2	-	2	-	2	-	-	3	2	-	-
CO5	3	2	-	2	-	2	-	3	-	-	3	2	-	-

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

**SYLLABUS:****UNIT I INTRODUCTION TO HRM****9**

Meaning and Definition – Characteristics of HRM – Evolution of HRM – Organization and Policies of Personnel Department – Scope of HRM – Functions of HRM– Objectives of HRM– Qualities of HR Manager– Important Trends in HR Management

**UNIT II HR PLANNING, RECRUITMENT AND SELECTION****9**

Importance of HR Planning – Job Analysis-Job description and job specification – Recruitment Sources of Recruitment – Selection- Importance of careful selection – Process of selection – Types of Tests for selection – Interview- Methods of Selection Interview – Induction Process



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**UNIT III TRAINING AND DEVELOPMENT & PERFORMANCE APPRAISAL 9**

Training and Development: Objectives of training – Identification of Training needs – Concepts of Training – Training methods – Orientation and Placement – Management development – Purposes and Principles of promotion – Bases and types for promotion – Transfer – Separation Performance Appraisal: Introduction – Identification of issues in performance appraisal – Uses of Performance Appraisal – limitations of Performance Appraisal – Performance Management – Career Management Basics – Talent Management – Methods of appraisal

**UNIT IV WAGE AND SALARY ADMINISTRATION 9**

Meaning and Definition – Job Evaluation – Basic Factors in Determining Pay Rates – Establishing Pay Rates – Competency-Based Pay – Money and Motivation: An Introduction – Insurance Benefits – Retirement Benefits – Personal Services and Family-Friendly Benefits – Flexible Benefits Programs

**UNIT V INDUSTRIAL RELATION, HEALTH AND SAFETY 9**

Industrial Relation– Health and safety measures Industrial Relations – Meaning & Characteristics, Industrial Relations – Parties to Industrial relations – Nature of Trade Unions – Problems of Trade-Union – Measures to Strengthen Trade Union Movement in India – Causes for Industrial Disputes-Settlement of Industrial Disputes – Occupational Security and Safety : Accidents – Workplace Health Hazards: Problems and Remedies

**Contact Periods:**

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

**TEXT BOOKS:**

1. Gary Dessler, BijuVarkkey, "Human Resource Management", 15<sup>th</sup> Edition, Pearson Education, 2018.
2. Denisi, Griffin, Sarkar, "Human Resource Management", 2<sup>nd</sup> Edition Cengage Learning, 2016.
3. George W.Bchlander, Scott A.Snell, "Principles of Human Resource Management", 16<sup>th</sup> Edition, Cengage Learning, 2014.

**REFERENCES:**

1. Denisi, Griffin, Sarkar, "Human Resource Management", 2<sup>nd</sup> Edition Cengage Learning, 2016.
2. Aswathappa K, "Human Resource Management: Text and Cases ", 17<sup>th</sup> Edition, Tata McGraw-Hill, 2013.
3. Armstrong Michael, "A Handbook of Human Resource Management", 13<sup>th</sup> Edition, Kogan Page, 2014.
4. Peter J. Dowling, Marion Festing, Allen D Engle, Sr, "International Human Resource Management", 6<sup>th</sup> Edition, Cengage Learning, 2013.



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**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
<b>Total</b>				40	60
				<b>100</b>	

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U21CBP08	FINANCIAL MANAGEMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- Understand the operational nuances of a Finance Manager
- Comprehend the technique of making decisions related to finance functions

**COURSE OUTCOMES:**

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

**CO1:** Elucidate the concepts of financial decision of an organisation (Understand)

**CO2:** Illustrate the capital budgeting principles and techniques (Understand)

**CO3:** Apply EBIT-EPS analysis, capital structure theories, and dividend decisions to understand the impact on business (Apply)

**CO4:** Apply the principles of working capital management (Apply)

**CO5:** Assess the short-term and long-term sources of finance (Apply)

**CO-PO MAPPING:**

COs \ POs	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	2	-	2	2	-	-	-	-	-	3	2	-	-
CO4	3	2	-	2	2	-	-	-	-	-	3	2	-	-
CO5	3	2	-	2	2	-	-	-	-	-	3	2	-	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)					

**SYLLABUS:****UNIT I INTRODUCTION TO FINANCE**

9

Introduction to finance – Financial Management – Nature, scope and functions of Finance, organization of financial functions, objectives of Financial management, Major financial decisions – Time value of money – features and valuation of shares and bonds – Concept of risk and return – single asset and of a portfolio

**UNIT II INVESTMENT DECISIONS**

9

Capital Budgeting: Principles and techniques – Nature of capital budgeting- Identifying relevant cash flows – Evaluation Techniques: Payback, Accounting rate of return, Net Present Value, Internal Rate of Return, Profitability Index – Comparison of DCF techniques – Concept and measurement of cost of capital – Specific cost and overall cost of capital



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**UNIT III FINANCING AND DIVIDEND DECISION**

9

Leverages – Operating and Financial leverage – Measurement of leverages – Degree of Operating & Financial leverage – Combined leverage, EBIT – EPS Analysis- Indifference point. Capital structure – Theories – Net Income Approach, Net Operating Income Approach, MM Approach – Determinants of Capital structure. Dividend decision- Issues in dividend decisions, Importance, Relevance & Irrelevance theories Walter's – Model, Gordon's model and MM model. – Factors determining dividend policy – Types of dividend policies – Forms of dividend

**UNIT IV WORKING CAPITAL MANAGEMENT**

9

Principles of working capital: Concepts, Needs, Determinants, issues and estimation of working capital- Receivables Management – Inventory management – Cash management – Working capital finance: Commercial paper, Company deposit, Trade credit, Bank finance

**UNIT V LONG TERM SOURCES OF FINANCE**

9

Indian capital market – New issues market – Secondary market – Long term finance: Shares, debentures and term loans, lease, hire purchase, venture capital financing, Private Equity

**Contact Periods:**

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

**TEXT BOOKS:**

1. I.M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11<sup>th</sup> edition, 2018
2. James C. Van Horne, Sanjay Dhamija, Financial Management and Policy, 12<sup>th</sup> Edition, Pearson Education, 2012.
3. Eugene F Brigham, Michael C. Ehrhardt, Financial Management Theory and Practice, 14<sup>th</sup> Edition, Cengage Learning, 2014.

**REFERENCES:**

1. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 8<sup>th</sup> edition, 2017.
2. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning, 13<sup>th</sup> Edition, 2014.
3. Prasanna Chandra, "Financial Management", 9<sup>th</sup> Edition, Tata McGraw Hill, 2017.

**EVALUATION PATTERN:**

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
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				<b>100</b>	

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