M.Sc. (Computer Science)

Curriculum and Syllabus for the

AFFILIATED COLLEGES

of

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI-12

From the Academic Year 2026-2027

VISION AND MISSION OF THE UNIVERSITY

1.Vision

"To provide quality education to reach the un-reached"

2. Mission

- To conduct research, teaching and outreach programs to improve conditions of human living
- To create an academic environment that honors women and men of all races, castes, creeds, and cultures and an atmosphere that values intellectual curiosity, the pursuit of knowledge, academic freedom and integrity
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnerships with industries and government to improve the quality of the workplace and to serve as the catalyst for economic and cultural development
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently-abled

M.Sc. COMPUTER SCIENCE PROGRAMME

3. PREAMBLE

The M.Sc. Computer Science Programme is introduced to develop postgraduates in **Computer Science** with a deep knowledge of theoretical Computer Science who can be employed in research and development units of industries and academic institutions and could pursue higher studies. This programme is designed to provide advanced knowledge and professional skills in the field of computer science and information technology. The course aims to develop competent professionals, researchers, educators, and entrepreneurs capable of addressing modern computing challenges and contributing to technological advancement. The programme emphasizes both theoretical foundations and practical applications in various areas. It also promotes analytical thinking, problem-solving ability,

innovation, ethical practices, and research aptitude among students. The curriculum is structured to prepare students for careers in academia, industry, research organizations, and government sectors. Through laboratory work, projects, internships, seminars, and research activities, students gain hands-on experience and industry-oriented exposure.

4. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 – Professional Competency

To prepare graduates with strong theoretical and practical knowledge in Computer Science so that they can design, develop, and implement innovative computing solutions in industry, academia, and research organizations.

PEO2 – Problem Solving and Research

To enable students to analyse complex computational problems, apply modern tools and technologies, and pursue research-oriented and interdisciplinary solutions in emerging areas of computer science.

PEO3 – Employability and Entrepreneurship

To develop skilled professionals capable of obtaining employment in software industries, IT sectors, educational institutions, and government organizations, and to encourage entrepreneurial abilities in technology-based ventures.

PEO4 – Lifelong Learning

To cultivate continuous learning, adaptability, and professional development so graduates can keep pace with rapidly evolving technologies and global computing trends.

PEO5 – Ethics and Social Responsibility

To instil professional ethics, leadership qualities, communication skills, teamwork, and social responsibility for contributing effectively to society and the nation through technology.

PEO6 – Advanced Technologies

To equipe students with knowledge in emerging domains

5. Programme Outcomes (POs)

After completing M.Sc. Computer Science, students should be able to:

PO1 – Computational Knowledge

Apply advanced knowledge of Computer Science, mathematics, and computing techniques to solve complex problems.

PO2 – Problem Analysis

Identify, analyze, and develop effective solutions for real-world computational and software-related problems using logical and analytical skills.

PO3 – Software Development

Design, develop, test, and maintain software applications using modern programming languages, tools, and technologies.

PO4 – Modern Tool Usage

Use contemporary computing tools, platforms, databases, and emerging technologies for research and industrial applications.

PO5 – Research and Innovation

Conduct research, analyze data, and develop innovative solutions in advanced areas of computer science and information technology.

PO6 – Professional Ethics and Communication

Demonstrate professional ethics, effective communication skills, teamwork, leadership qualities, and social responsibility in professional environments.

PO7 – Lifelong Learning and Employability

Adapt to rapidly changing technologies through continuous learning, higher education, entrepreneurship, certifications, and professional development activities.

6. ProgrammeSpecific Outcomes (PSOs)

PSO1 – Advanced Programming and Problem Solving

Apply advanced programming knowledge and computational techniques to analyze and solve complex problems efficiently using modern programming languages and tools.

PSO2 – Software Development and System Design

Design, develop, test, and maintain reliable, secure, and scalable software applications using appropriate software engineering principles and methodologies.

PSO3 – Database and Data Management

Demonstrate expertise in database design, data modeling, data mining, and big data technologies for effective information management and decision making.

PSO4 – Emerging Technologies

Apply concepts of emerging fields to develop innovative and intelligent computing solutions.

PSO5 – Research and Innovation

Conduct independent research, analyze scientific problems, and develop innovative solutions using modern computational and research methodologies.

PSO6 – Professional Ethics and Teamwork

Exhibit professional ethics, leadership qualities, communication skills, and the ability to work effectively in multidisciplinary teams and professional environments.

PSO7 – Lifelong Learning and Employability

Adapt to rapidly changing technologies through continuous learning, higher education, certifications, entrepreneurship, and professional development for successful careers in industry and academia.

7. Programme Details

- Eligibility Criteria : Students with a three-year Bachelor's degree in Computer Science / Computer Applications / Information Technology/Software Engineering/AI/Computer Science with AI/Data Science/Cyber Security or any other degree accepted by the Syndicate of Manonmaniam Sundaranar University are eligible for this programme (as equivalent in the 10+2+3 pattern)

- Medium of Instruction : English
- Duration of the Programme : Full time 2 years programme spread over four semesters.

8. Examination Scheme

1. 1. Internal Assessment (25 Marks) and External Assessment (75 Marks)

(Total Marks: 100 (Internal: 25 Marks, External: 75 Marks)

<table>
<tr><td colspan="3">Students shall secure passes in both internal and external and also obtain 50 marks together to get a pass</td></tr>
<tr><td colspan="2">CIA- Internal Marks</td><td>End semester Examination - External Marks</td></tr>
<tr><td>i.</td><td>Average of best two tests from three: 15 Marks</td><td rowspan="4">Total: 75 Marks</td></tr>
<tr><td>ii.</td><td>Seminar: 05 Marks</td></tr>
<tr><td>iii.</td><td>Assignment: 05 Marks

Total : 25 Marks</td></tr>
<tr><td colspan="2">Passing a minimum of 40% i.e. 10 marks</td><td>Passing a minimum of 50% i.e. 38 marks</td></tr>
</table>

2. Practical Courses: Assessment Components (External: Internal (CIA) – 50: 50)

Passing Criteria for Practical Examinations:

There is **no Passing Minimum for the Continuous Internal Assessment (CIA)** component. But overall (CIA+ External), a student shall secure a minimum of 50% or more to get a pass.

End Semester Practical Examinations:

Practical examinations will be conducted at the end of each semester. The scheme of valuation is to be decided by the respective board of Question setters before the commencement of Practical exams.

Note: In both Internal and Semester End Examinations

Lower Order Thinking (K1, K2, & K3) – 40 % in each part

Higher Order Thinking (K4, K5, & K6) – 60 % in each part

3. Project Assessment

Mini Project Guidelines

Mode of Mini Project:	Individual Project
Nature of Mini Project:	Every student shall undertake a unique project title (Novel Concept/ idea/system or a small research problem, which shall be designed and implemented using Web Application Development and hosting using open-source software like Python, PHP, HTML, etc., (or) Implementation of Cryptographic Algorithms–RSA–DSA–ECC using C or JAVA Programming approved by her/his guide (or) any recent development
Guide:	Each Student shall be allotted under the Guidance of one Department faculty member by the Programme coordinator/Head
Duration:	One semester - (6 hours per week) Students carry out the Mini Project work in her/his college itself. In the case of a Company project, students are permitted to do the mini-project work in reputed IT companies without affecting the minimum attendance and other classes of the third semester
Continuous Assessment:	Based on periodic reviews (Three reviews during the semester. Tentative review dates are decided by the department and will be communicated to the students at the beginning of the third semester.)

Internal (CIA) (50 Marks) (All the three reviews are mandatory)		**External (50 Marks)**
Review I (Problem identification, Title & Abstract submission, Novelty of the idea, proposed outcomes, issues in existing methods, tools to be used)	15 Marks	Both the internal and external examiners will evaluate the student at the end of the semester based on the following criteria: an internal examiner, determined by the HOD, such as a faculty member from the Guide or any other department, and an external examiner appointed by the COE.

Review II System Design / Database Design or Research Methodology / A l g o r i t h m s and Techniques/ detailed Implementation plan	15 Marks	**Internal Examiner** Project Report	20 Marks
Review III		**External Examiner shall evaluate under the following criteria** • Presentation of the Mini Project • Demonstration of the mini-project working • Viva -voce	
System Implementation			
status, Testing, demo of	20 Marks		10 Marks
working system and			
completion of report writing			10 Marks
			10 Marks
Total	**50 Marks**		**50 Marks**

Major Project Guidelines:

Mode of Major Project:	Individual Project
Nature of Major Project:	Every student must choose a unique project title (novel concept, idea, system, or a small research problem) approved by their guide and then design and implement it using available software development tools or programming languages.
Guide:	Each Student shall be allotted under the Guidance of one Department faculty member by the Programme coordinator/Head
Duration :	One semester - (30 hours per week) Major project students may also opt for company projects with prior permission from the Head of the Department/Principal
Continuous Assessment:	Based on periodic reviews (Three reviews during the Semester. Tentative review dates are decided by the department and to be intimated to the students at the beginning of the fourth Semester)

<table>
<tr><td colspan="2">Internal (50 Marks)
(All the three reviews are mandatory)</td><td colspan="2">External (50 Marks)</td></tr>
<tr><td>Review I</td><td></td><td colspan="2" rowspan="6">Both Internal and External Examiner Shall evaluate the student based on the following criteria at the end of the semester:
(Guide or any other department faculty decided by the HOD shall be internal examiner. External Examiner will be appointed by the COE</td></tr>
<tr><td>(Problem identification, Title</td><td></td></tr>
<tr><td>& Abstract submission,</td><td>15 Marks</td></tr>
<tr><td>The novelty of the idea proposed</td><td></td></tr>
<tr><td>outcomes, issues in existing</td><td></td></tr>
<tr><td>methods, tools to be used)</td><td></td></tr>
<tr><td>Review II
System Design / Database Design / Methodology / Algorithms and Techniques/detailed implementation plan</td><td>15 Marks</td><td>Internal Examiner

Project Report</td><td>20 Marks</td></tr>
<tr><td>Review III</td><td></td><td rowspan="5">External Examiner shall evaluate under the following criteria
• Presentation of the Project
• Demonstration of the working project
• Viva -voce</td><td></td></tr>
<tr><td>System Implementation</td><td></td><td></td></tr>
<tr><td>status, Testing, outcomes and</td><td>20 Marks</td><td></td></tr>
<tr><td>report writing</td><td></td><td>10 Marks</td></tr>
<tr><td></td><td></td><td>10 Marks</td></tr>
<tr><td></td><td></td><td></td><td>10 Marks</td></tr>
<tr><td>Total</td><td>50 Marks</td><td></td><td>50 Marks</td></tr>
</table>

Evaluation criteria : *Each student is evaluated by the Internal Examiner (Guide) continuously during the respective semester. External Examination will be conducted at the end of the respective semester.*

Passing Criteria: Student shall secure a minimum of **50 % marks in the external** evaluation and shall secure a **minimum of 50 % marks in combined Internal and External evaluation**. (There is no passing minimum for the internal evaluation)

9. Question Paper Pattern for the Theory Papers

Time: 3 Hours Max. Marks: 75

Part – A

(15*1=15)

Answer all the questions

15 Questions, three objective type questions from each unit.

Part – B

(5*4=20)

Answer all the questions

Five Questions, two short answer type questions from each unit with internal choice

(Either ...Or... type)

Part – C

(5*8=40)

Answer all the questions

Five Questions, two descriptive/Analytical type questions from each unit with internal choice

(Either ...Or... type)

10 Model Theory Question Paper

MODEL THEORY QUESTION PAPER

M.Sc Computer Science

Advanced Computer Network

Time: Three hours **Maximum: 75 marks.**

Part-A (15×1=15 marks) Answer All questions

1 K1 Identify the layer of the OSI model is responsible for establishing, managing, and terminating connections between applications?

A Transport Layer
B Network Layer
C Application Layer
D Data Link Layer

2 K5 Choose one of the following is an example of guided media in data communications?

A Radio Waves
B Fiber optic cable
C Infrared Waves
D Electrical cable

3 K2 The full form of OSI is?

A Open system interface
B Optical System interconnection
C Operating System Internet
D Open system interconnection

4 K4 Select the type of network does each data packet travel independently, possibly taking different paths to reach the destination?

A Circuit-switched network
B Datagram network
C Virtual circuit network
D Token ring network

5 K1 Name which type of multiple access method is typically used in wired LANs such as Ethernet?

A Time Division Multiple Access
B Frequency Division Multiple Access
C Carrier Sense Multiple Access with Collision Detection
D Code Division Multiple Access

6 K1 What does TCP/IP stand for?

A Telephone control protocol/Internet protocol
B Technique control protocol/Internet protocol
C Transmission control protocol /Internet Protocol
D Transmission control protocol /Integrated Protocol

7 K1 Name the Protocol which is used to manage multicast group memberships on an IP network?

A ICMP
B IGMP
C ARP
D DHCP

8 K4 How does IPv6 addressing differ from IPv4 addressing in terms of address space?

A IPv6 provides a smaller address space compared to IPv4
B IPv6 and IPv4 have the same address space
C IPv6 provides a vastly larger address space compared to IPv4
D IPv6 provides the same address space but in a different format

9 K4 What is the length of the IPv6 address?

A 8 bits
B 32 bits
C 16 bits
D 128 bits

10 K5 Choose the protocol is used for applications where low latency is more critical than reliability, such as real-time video streaming?

A UDP
B TCP
C IP
D ICMP

11 K1 Name the transport layer protocol provides reliable, connection-oriented communication with flow control and error recovery?

	A	UDP	C	TCP
	B	IP	D	ICMP

12	ICMP is a			
K3	A	Physical Layer Protocol	C	Network layer protocol
	B	Transport Layer Protocol	D	Presentation layer protocol

13	What is the primary function of the Domain Name System (DNS) on the internet?			
K4	A	To manage email services	C	To transfer files between network devices
	B	To convert domain names into IP addresses	D	To transfer files between network devices

14	What does the term "namespace" refer to in the context of the Domain Name System?			
K4	A	The method of storing user credentials	C	The technology used for email transmission
	B	The hierarchical structure used to organize domain names	D	d) The system used for file storage
15	DNS is an			
K3	A	Physical Layer Protocol	C	Application layer protocol
	B	Transport Layer Protocol	D	Presentation layer protocol

Section B

Answer All questions (5 x 4 = 20)

16	A) k2	De Discuss the OSI model with a neat diagram	
		OR	
	B) k1	Describe the TCP/IP protocol suite and its four layers	
17	A)k1	Describe Circuit Switched Network with a neat diagram	
		OR	
	B)k2	Compare Virtual circuit network and datagram network	
18	A)K 4	What is subnetting? Illustrate the structure of an IPv4 address	
		OR	
	B) K1	Describe the role of ICMP in network communication	
19	A)K 6	Write the differences between UDP and TCP	
		OR	
	B) k2	Explain the common techniques are used to improve QoS?	
20	A) K4	Illustrate the structure and functioning of the Domain Name System	
		OR	
	B)K1	What are the main components of SNMP?	

Section C

Answer All questions (5 x 8 = 40)

21	A) K2	Explain OSI Reference Model and the primary functions of each layer	
		OR	

	B) k2	Explain Guided transmission media	
22	A)k6	Write the concepts of framing, flow control, and error control in data communication. Provide examples of techniques used for each.	
		OR	
	B)k4	Focus cellular telephony, and satellite networks and write the advantages and disadvantages of each	
23	A) k5	Explain the concepts of network layer delivery and forwarding. How do they route packets from the source to the destination?	
		OR	
	B) k5	Compare unicast and multicast routing protocols. Explain their use cases and benefits.	
24	A) k3	Illustrate the congestion control work in TCP to manage network traffic and prevent network congestion? Explain	
		OR	
	B)k3	Describe the techniques used to improve QoS and how they contribute to enhancing network performance.	
25	A)k2	Explain the Simple Network Management Protocol (SNMP) and its components	
		OR	
	B) k4	What are the key features of the Domain Name System (DNS) and how it supports the functioning of various Internet services.	

11. Entire Programme Structure

Template for Curriculum Design and Credit Distribution for the PG Programme

Semester–I	Credit	Semester-II	Credit	Semester-III	Credit	Semester–IV	Credit
1.1. Core-I	4	2.1. Core-IV	4	3.1. Core-VI	4	4.1 Project with Viva-Voce	18
1.2 Core-II	4	2.2 Core-V	4	3.2 Core-VII	4	4.2 Extension Activity	1
1.3 Core – III	4	2.3 Elective (Generic / Discipline Centric) – III	4	3.3 Core – VIII	4		
1.4 Elective (Generic / Discipline Centric)- I	4	2.4 Elective (Generic / Discipline Centric)- IV	4	3.4 Elective (Generic / Discipline Centric) – V	4		
1.5 Elective (Generic / Discipline Centric)-II	4	2.5 Core Practical 3	2	3.5 Core Practical 5	2		
1.6 Core Practical 1	2	2.6 Core Practical 4	2	3.6 Mini Project	3		
1.7 Core Practical2	2	2.7 Skill Enhancement Course SEC 1	2	3.7 Skill Enhancement Course –SEC 2	2		
				3.8 Internship/ Industrial Activity	2		
	24		**22**		**25**		**19**
						Total Credit Points	**90**

Component-wise Credit Distribution

Credits	Sem I	Sem-II	Sem III	Sem IV	Total
Core/Core LAB/Mini Project/ Major Project	18	14	12+6	18	68
Electives (i)Discipline– Centric	6	6	3		15
(ii Skill Enhancement		2	2		6
(iii)Summer Internship / Industrial Training/ Project			2		
Ability Enhancement / Extension				1	1
Total Credits	24	22	25	19	90

Bloom's Taxonomy Levels with Course Outcomes (CO)

In Outcome-Based Education (OBE), Course Outcomes (COs) are usually written based on Bloom's Taxonomy Cognitive Levels. These levels indicate the depth of learning and the type of questions asked in examinations.

Bloom's Taxonomy Levels

Level	Taxonomy Name	Action Verbs	Type of Questions
K1	Remember	Define, List, Recall, Identify	Objective / Recall Questions
K2	Understand	Explain, Describe, Discuss, Summarize	Short Answer Questions
K3	Apply	Solve, Use, Implement, Demonstrate	Problem Solving / Practical Questions
K4	Analyze	Compare, Differentiate, Analyze, Examine	Analytical Questions
K5	Evaluate	Justify, Criticize, Evaluate, Validate	Critical Thinking Questions
K6	Create	Design, Develop, Construct, Formulate	Project / Design Questions

Mapping Between CO and Bloom's Taxonomy

CO	**Description**	**Bloom's Level**
CO1	Basic Understanding	K1, K2
CO2	Application Skills	K3
CO3	Analytical Ability	K4
CO4	Evaluation Skills	K5
CO5	Design & Innovation	K6

Level of Correlation between COs and POs

0 – No Correlation 1 – Low 2 – Medium 3 – High

Mapping of Courses with Programme Specific Outcomes (PSOs)

Sl. No	Title of the Paper	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PS07	Total Score
1	Analysis & Design of Algorithms	3	2.75	2.25	2.5	1.5	1.5	1.5	3
2	Object Oriented Analysis and Design & C++	3	2.75	2.5	2.25	2.25	2	1.75	3
3	Python Programming	3	2.75	2.75	2.25	2.25	2	1.75	3
4	Advanced Software Engineering	3	2.75	2.25	2.25	2.25	2	1.5	3
5	Web services	3	2.75	2	2.5	1.75	1.5	1.25	3
6	Multimedia and its Applications	3	2.75	2.25	2	1.25	0.75	0.25	3
7	Advanced Operating System	2.5	2.75	2.25	1.75	1.75	0.5	0.5	2.5
8	Advanced Computer Network	3	2.75	1.75	2.25	2	0.25	1	3
9	Mobile Computing	2.75	2	2.25	2.25	1.75	2	1.25	2.75
10	Algorithm Lab	3	2.75	2.75	2.25	2.25	2	1.75	3
11	Python Programming Lab	3	2.75	2.75	2.25	2.25	2	1.75	3
12	Data Mining and Warehousing	3	2.75	2.75	2.25	2.25	2	1.75	3
13	Advanced Java Programming	3	2.75	2.75	2.25	2.25	2	1.75	3
14	Artificial Intelligence &Machine Learning	2.5	2.75	2.25	1.75	1.5	1	0.5	2.5
15	Robotics Process Automation for Business	3	2.75	2.5	2.25	2.25	1.75	1.5	3
16	Cloud Computing	2.25	2.75	2.25	1.75	1.75	1.25	0.75	2.25
17	IoT	3	2.75	2.25	2.5	2	1.5	0.75	3
18	Embedded System	3	2.75	2.25	2.5	2	1.5	0.75	3
19	Block Chain Technology	2.75	2.5	2.5	2.25	1.75	1.75	1.25	2.75
20	Data Mining Lab using R	3	2.75	2.75	2.25	2.25	2	1.75	3
21	Advanced Java Lab	3	2.75	2.25	2	1.25	0.75	0.25	3
22	Statistical Tools	3	2.75	2.75	2.25	1.75	1.5	0.75	3
23	Digital Image Processing	3	2.75	2.25	2.5	2	1.5	0.75	3
24	Network Security and Cryptography	3	2.75	2.25	2.25	2.5	2	1.5	3
25	Data Science & Analytics	3	2.75	2.25	2.5	2	1.5	0.75	3
26	Big Data Analytics	3	2.75	2.25	2.5	2	1.5	0.75	3
27	Deep Learning	3	2.75	2.25	2.25	2	1.5	1.5	3
28	Critical thinking, Design Thinking & Problem Solving	2.75	2.5	2.25	2	2.75	2.25	2	2.75
29	Digital Image Processing Using MatLab	3	2.75	2.25	2.5	2	1.5	0.75	3
30	Mini Project	3	2.75	2.25	2	2	1.5	1.25	3

31	Cloud Computing Tools	3	2.75	2.25	2.5	2	1.5	0.75	3
32	Internship	2.75	2.75	2.25	2	2	2.25	2.25	2.75
33	Major Project	3	2.75	2.5	2	2	1.5	1.25	3
34	Extension Activity	1.75	2	2	1.5	1.25	2.25	2.25	1.75
	Total Score	98	91.5	80	75	66.75	54.25	41.75	98

M.Sc., Computer Science

First Semester

Course Code	**Title of the Course**	**Credits**	**Hours**		**Maximum Marks**		
			Theory	**Practical**	**CIA**	**ESE**	**Total**
Core – I	Analysis & Design of Algorithms	4	5		25	75	100
Core – II	Object Oriented Analysis and Design & C++	4	5		25	75	100
Core – III	Python Programming	4	4		25	75	100
Elective – I	Advanced Software Engineering / Web Services /Multimedia and its Applications	4	4		25	75	100
Elective – II	Advanced Operating System/Advanced Computer Network/ Mobile Computing	4	4				
Lab I	Algorithm Lab	2		4	50	50	100
Lab II	Python Programming Lab	2		4	50	50	100
	Total	24	22	8			

SECOND SEMESTER							
Course Code	**Title of the Course**	**Credits**	Hours		**Maximum Marks**		
			Theory	Practical	**CIA**	**ESE**	**Total**
Core - IV	Data Mining and Warehousing	4	5		25	75	100
Core – V	Advanced Java Programming	4	5		25	75	100
Elective – III	Artificial Intelligence &Machine Learning/ Robotics Process Automation for Business/Cloud Computing	4	4		25	75	100
Elective – IV	IoT/Embedded System/Block Chain Technology	4	4		25	75	100
Core Practical 3	Data Mining Lab using R	2		4	50	50	100
Core Practical 4	Advanced Java Lab	2		4	50	50	100
SEC 1	Statistical Tools	2	4		25	75	100
	Total	22	22	8			

THIRD SEMESTER							
Core - VI	Digital Image Processing	4	5		25	75	100
Core – VII	Network Security and Cryptography	4	4		25	75	100
Core – VIII	Data Science & Analytics	4	4		25	75	100
Elective - V	Big Data Analytics/ Deep Learning /Critical thinking, Design Thinking & Problem Solving	4	4		25	75	100
Core Practical 5	Digital Image Processing Using MatLab	2		4	50	50	100
Mini Project	Web Application Development& Hosting	3		6	50	50	100
SEC 2	Cloud Computing Tools	2	3		25	75	100
Internship/ Industrial Activity/ Research Updation Activity		2	-				
	Total	25	20	10			
FOURTH SEMESTER							
Core Project	Project work and Viva-voce	18		30	50	50	100
	Extension Activity	1	-				
	Total	19		30			

I – SEMESTER

Course code		ANALYSIS & DESIGN OF ALGORITHMS	L	T	P	C
Core/Elective/ Supportive		Core -I	4	1		4
Pre-requisite		Basic Data Structures & Algorithms				

Course Outcomes:

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

CO1	Understand the fundamentals of algorithm design, asymptotic notations, time and space complexity, and basic data structures.	K1, K2
CO2	Apply traversal, searching, divide-and-conquer techniques, and sorting algorithms to solve computational problems.	K3
CO3	Apply greedy method to solve optimization problems such as MST and shortest path.	K4
CO4	Analyze and implement dynamic programming techniques for solving complex optimization problems and Design solutions using backtracking and branch-and-bound techniques for combinatorial problems	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	15hours

Introduction: - Algorithm Definition and Specification – Space Complexity- Time Complexity- Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heapsort- Graph.

Unit:2	TRAVERSALANDSEARCHTECHNIQUES	15hours

Basic Traversal and Search Techniques: Techniques for Binary Trees-Techniques for Graphs - Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.

Unit:3	GREEDY METHOD	15hours

The Greedy Method: -General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path.

Unit:4	DYNAMIC PROGRAMMING	15hours

Dynamic Programming-General Method–Multistage Graphs–All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.

Unit:5	BACKTRACKING	13hours

Backtracking: -General Method–8-QueensProblem–Sum Of Subsets–Graph Coloring– Hamiltonian Cycles – Branch and Bound: - The Method – Traveling Salesperson.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars– webinars		
	Total Lecture hours	**75hours**

Text Books	
1	Ellis Horowitz, “Computer Algorithms”, Galgotia Publications.
2	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms".
Reference Books	
1	Goodrich, “Data Structures& Algorithms in Java”, Wiley3rd edition.
2	Skiena,” The Algorithm Design Manual”, second edition, Springer,2008
3	Anany Levith,” Introduction to the Design and Analysis of Algorithm”, Pearson Education Asia, 2003.
4	Robert Sedgewick, Phillipe Flajolet,” An Introduction to the Analysis of Algorithms”, Addison-Wesley Publishing Company,1996.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
3	https://www.javatpoint.com/daa-tutorial

ANALYSIS & DESIGN OF ALGORITHMS

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	3	2	3	1	1	2
CO3	3	3	3	3	1	1	2
CO4	3	3	3	3	2	1	3
Total Score	12	11	9	11	5	4	9

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	1	1	1	1
CO2	3	3	2	3	1	1	1
CO3	3	3	3	3	2	2	1
CO4	3	3	3	3	2	2	3
Total Score	12	11	9	10	6	6	6

I – SEMESTER

Course code		**OBJECT-ORIENTED ANALYSIS AND DESIGN & C++**	**L**	**T**	**P**	**C**
Core/Elective/ Supportive		**Core -II**	4	1		4
Pre-requisite		Basics of C++ and Object-Oriented Concepts				

Course Outcomes:

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

CO1	Understand the principles of object-oriented analysis and design, object model, classes, objects, and relationships among objects	K1, K2
CO2	Identify and apply object-oriented concepts such as abstraction, encapsulation, inheritance, polymorphism, and classification in software design.	K3
CO3	Apply the fundamentals of C++ programming including input/output operations, control structures, functions, and arrays for developing applications.	K4
CO4	Design and implement object-oriented programs using classes, constructors, destructors, inheritance, operator overloading, and type conversion techniques and Develop efficient applications using advanced C++ features such as polymorphism, virtual functions, exception handling, templates, file handling, and memory management	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	**OBJECT MODEL**	**15hours**

The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects**.**

Unit:2	**CLASSES AND OBJECTS**	**15hours**

Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects – Key Abstractions and Mechanism.

Unit:3	**C++ INTRODUCTION**	**15hours**

Introduction to C++-Input and output statements in C++-Declarations-control structures– Functions in C++.

Unit:4	**INHERITANCE AND OVERLOADING**	**13hours**

Classes and Objects–Constructors and Destructors–operators overloading–Type Conversion-Inheritance – Pointers and Arrays.

Unit:5	**POLYMORPHISM AND FILES**	**15hours**

Memory Management Operators-Polymorphism–Virtual Functions–Files–Exception Handling – String Handling -Templates.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**75hours**

Text Books	
1	"Object Oriented Analysis and Design with Applications", Grady Booch, Second Edition, Pearson Education.
2	"Object-Oriented Programming with ANSI & Turbo C++", Ashok N.Kamthane, First Indian Print -2003, Pearson Education.
Reference Books	
1	Balagurusamy "Object Oriented Programming with C++", TMH, SecondEdition,2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

OBJECT-ORIENTED ANALYSIS AND DESIGN & C++

CO-PO MAPPING

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	3	1	1
CO3 (K4)	3	3	3	3	3	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
Total Score	12	11	9	9	10	7	5

CO-PSO MAPPING

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	3	2	2	2	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	10	9	9	8	7

I – SEMESTER

Course code		**PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
Core/Elective/ Supportive		**Core – III**	3	1		4
Pre-requisite		Basics of any OO Programming Language				

Course Outcomes:

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

CO1	Understand Python fundamentals including data types, variables, operators, strings, lists, tuples, dictionaries, and sets.	K1, K2
CO2	Apply control structures, functions, comprehensions, generators, decorators, and exception handling techniques in Python programming.	K3
CO3	Develop object-oriented Python applications using modules, packages, classes, inheritance, polymorphism, and special methods.	K4
CO4	Implement file handling, database operations, web services, and data processing techniques using Python and Design networked and concurrent applications using processes, threads, sockets, APIs, cloud computing, and distributed computing concepts in Python.	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	**INTRODUCTION**	**15hours**

Python: Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets–Comparison.

Unit:2	**CODE STRUCTURES**	**15hours**

Code Structures: if, else if, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions.

Unit:3	**MODULES, PACKAGES AND CLASSES**	**15hours**

Modules, Packages, and Programs: Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. **Objects and Classes:** Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent with super–Inself Defense –Get and Set Attribute Values with Properties –Name Mangling for Privacy – Method Types – Duck Typing – Special Methods –Composition.

Unit:4	**DATA TYPES AND WEB**	**13hours**

Datatypes: Text Strings–Binary Data, **Storing and Retrieving Data:** File Input/Output–Structured Text Files – Structured Binary Files - Relational Databases – NoSQL Data Stores.

Web: Web Clients –Web Servers–Web Services and Automation

Unit:5	**SYSTEMS AND NETWORKS**	**15hours**

Systems: Files–Directories–Programs and Processes–Calendars and Clocks.

Concurrency: Queues– Processes–Threads–Green Threads and event–twisted–Redis.

Networks: Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – Zero MQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and MapReduce – Working in the Clouds.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars		
	Total Lecture hours	**75hours**
Text Books		
1	BillLubanovic, “Introducing Python”, O’Reilly, FirstEdition-SecondRelease,2014.	
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.	
Reference Books		
1	David M. Beazley, “Python Essential Reference”, Developer’s Library, Fourth Edition,2009.	
2	Sheetal Taneja, Naveen Kumar, “Python Programming-A Modul ar Approach”, Pearson Publications.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.programiz.com/python-programming/	
2	https://www.tutorialspoint.com/python/index.htm	
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview	

Python Programming

CO-PO MAPPING

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	3	2	3	1	1
CO3 (K4)	3	3	3	3	3	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
TOTAL SCORE	12	11	10	9	11	7	5

CO-PSO MAPPING

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	2	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
TOTAL SCORE	12	11	11	9	9	8	7

I – SEMESTER

Course code		**CORE LAB I: ALGORITHM LAB**	**L**	**T**	**P**	**C**
Core/Elective/ Supportive		**Lab – I**			4	2
Pre-requisite		Basic Programming of C++ language				
Course Outcomes:						
On the successful completion of the course, students will be able to:						
CO1	Implement basic data structures and recursive algorithms such as stack, queue, BST traversal, and Tower of Hanoi.				K1,K2	
CO2	Apply sorting and searching techniques such as quick sort, heap sort, and divide-and-conquer strategies in programming.				K3	
CO3	Solve optimization problems using greedy method and backtracking techniques like knapsack and 8-queens problem.				K4	
CO4	Develop C++ programs using object-oriented concepts such as constructors, function overloading, inheritance, and friend functions and Design and implement advanced C++ applications using virtual functions, file handling, and memory management techniques.				K5, K6	
K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create						
LIST OF PROGRAMS					**75hours**	

1) Write a program to solve the tower of Hanoi using recursion.
2) Write a program to traverse through binary search tree using traversals.
3) Write a program to perform various operations on stack using linked list.
4) Write a program to perform various operation in circular queue.
5) Write a program to sort an array of an elements using quick sort.
6) Write a program to solve number of elements in ascending order using heap sort.
7) Write a program to solve the knap sack problem using greedy method
8) Write a program to search for an element in a tree using divide& conquer strategy.
9) Write a program to place the 8 queens on an 8X8 matrix so that no two queens Attack.
10) Write a C++ program to perform Virtual Function
11) Write a C++ program to perform Parameterized constructor
12) Write a C++ program to perform Friend Function
13) Write a C++ program to perform Function Overloading

14) Write a C++ program to perform Single Inheritance 15) Write a C++ program to perform Employee Details using files.	
Expert lectures, online seminars –webinars	
Total Lecture hours	**75hours**
Text Books	
1	Goodrich, "Data Structures& Algorithms in Java", Wiley 3rd edition.
2	Skiena," The Algorithm Design Manual", Second Edition, Springer,2008
Reference Books	
1	Anany Levith," Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2	Robert Sedgewick, Phillipe Flajolet," An Introduction to the Analysis of Algorithms", Addison-Wesley Publishing Company,1996.
Related Online Contents [MOOC, SWAYAM, NPTEL, Web sites etc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Algorithm and OOPs Lab

CO-PO MAPPING

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	3	2	3	1	1
CO3 (K4)	3	3	3	3	3	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
Total Score	12	11	10	9	11	7	5

CO-PSO MAPPING

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	2	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	11	9	9	8	7

I – SEMESTER

Course code		CORE LAB II: PYTHON PROGRAMMING LAB	L	T	P	C
Core/Elective/ Supportive		Lab – II			4	2
Pre-requisite		Basics of any OO Programming Language				

Course Outcomes:

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

CO1	Implement Python programs using basic data structures such as lists, tuples, and dictionaries.	K1,K2
CO2	Develop Python programs using control structures like conditional statements and loops.	K3
CO3	Apply functions, modules, exception handling, and file operations in Python programs.	K4
CO4	Design object-oriented Python programs using inheritance and polymorphism concepts and Develop dynamic and interactive web-based applications using Python and integrate programming concepts for real-world solutions	K5, K6

K1-Remember; **K2**- Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS	**75hours**

Implement the following in Python:

1. Programs using elementary data items, lists, dictionaries and tuples
2. Programs using conditional branches,
3. Programs using loops.
4. Programs using functions
5. Programs using exception handling
6. Programs using inheritance
7. Programs using polymorphism
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive Web Pages using forms.

Total Lecture hours	**75hours**

Text Books

1	Bill Lubanovic, “Introducing Python”, O’Reilly, FirstEdition-SecondRelease,2014.
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.

Reference Books

1	DavidM. Beazley, “Python Essential Reference”, Developer’s Library Fourth Edition,2009.
2	Sheetal Taneja, Naveen Kumar, ”Python Programming-A Modular Approach”, Pearson Publications.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

Python Programming Lab

CO-PO MAPPING

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	3	2	3	1	1
CO3 (K4)	3	3	3	3	3	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
Total Score	12	11	10	9	11	7	5

CO-PSO MAPPING

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	2	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	11	9	9	8	7

SECOND SEMESTER							
Course Code	**Title of the Course**	**Credits**	Hours		**Maximum Marks**		
			Theory	Practical	**CIA**	**ESE**	**Total**
Core - IV	Data Mining and Warehousing	4	5		25	75	100
Core – V	Advanced Java Programming	4	5		25	75	100
Elective – III	Artificial Intelligence &Machine Learning/ Robotics Process Automation for Business/Cloud Computing	4	4		25	75	100
Elective – IV	IoT/Embedded System/Block Chain Technology	4	4		25	75	100
Core Practical 3	Data Mining Lab using R	2		4	50	50	100
Core Practical 4	Advanced Java Lab	2		4	50	50	100
SEC 1	Statistical Tools	2	4		25	75	100
	Total	22	22	8			

II – SEMESTER

Course code		DATA MINING AND WAREHOUSING	L	T	P	C
Core/Elective/Supportive		Core – IV	4	1		4
Pre-requisite		Basics of RDBMS & Algorithms				

Course Outcomes:

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

CO1	Understand the basic concepts, tasks, techniques, and issues related to data mining and knowledge discovery in databases.	K1, K2
CO2	Apply classification algorithms, statistical methods, and decision tree techniques for data analysis and prediction.	K3
CO3	Analyze clustering methods and association rule mining techniques for discovering patterns in large datasets.	K4
CO4	Apply data warehousing concepts, OLTP, OLAP systems, and multidimensional data models for business analysis and Design and evaluate data warehouse architectures and implement data mining applications for real-world and government domains	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	BASICS AND TECHNIQUES	12hours

Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.

Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.

Unit:2	ALGORITHMS	12hours

Classification: Introduction –Statistical–based algorithms -distance–based algorithms-decision tree-based algorithms-neural network-based algorithms–rule-based algorithms–combining techniques.

Unit:3	CLUSTERING AND ASSOCIATION	12hours

Clustering: Introduction–SimilarityandDistanceMeasures–Outliers–HierarchicalAlgorithms -Partitional Algorithms.

Association rules: Introduction - large item sets - basic algorithms – parallel &distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.

Unit:4	DATA WAREHOUSING AND MODELING	11hours

Data warehousing: introduction-characteristics of a data warehouse–data marts–other aspects Of data mart. Online analytical processing: introduction -OLTP & OLAP systems. Data modelling – star schema for the multidimensional view –data modelling – multi-fact star schema or snowflake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.

Unit:5	APPLICATIONS OF DATA WAREHOUSE	11 hours

Developing a data WAREHOUSE: why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse.

Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60hours**

Text Books	
1	Margaret.Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education,2003.
2	C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications", PHI, Second Edition.
Reference Books	
1	Arun K. Pujari, "Data Mining Techniques", Universities Press (India) Pvt. Ltd.,2003.
2	Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", TMCH, 2001.
3	Jiawei Han & Micheline Kamber, "Data Mining Concepts & Techniques", 2001, Academic Press.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

Data Mining and Warehousing

CO-PO MAPPING

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	2	2	3	1	1
CO3 (K4)	3	3	3	3	3	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
Total Score	12	11	9	9	11	7	5

CO-PSO MAPPING

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	2	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	11	9	9	8	7

II – SEMESTER

Course code		**ADVANCED JAVA PROGRAMMING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core – V**	4	1		4
Pre-requisite		Basics of Java & its Usage				

Course Outcomes:

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

CO1	Understand advanced Java concepts including event handling, threading, networking, and multimedia techniques.	K1, K2
CO2	Apply Remote Method Invocation (RMI), distributed application architecture, object serialization, and Java Spaces concepts in distributed systems.	K3
CO3	Develop database applications using JDBC principles, database access techniques, and multimedia database concepts.	K4
CO4	Design dynamic web applications using Java Servlets, JSP, cookies, and HTTP request-response mechanisms and Implement advanced Java techniques such as Swing programming, internationalization, JAR file creation, and enterprise application development	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	**BASICS OF JAVA**	**12hours**

Java Basics Review: Components and event handling–Threading concepts–Networking features – Media techniques

Unit:2	**REMOTE METHOD INVOCATION**	**12hours**

Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons-Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces

Unit:3	**DATABASE**	**10hours**

Java in Databases-JDBC principles–database access-Interacting-database search–Creating multimedia databases – Database support in web applications

Unit:4	**SERVLETS**	**12hours**

Java Servlets: Java Servlet and CGI programming- A simple Java Servlet-Anatomy of a Java Servlet-Reading data from a client-Reading HTTP request header-sending data to a client and writing the HTTP response header-working with cookies

Java Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page-Expressions-Scriptlets-Directives-Declarations-A complete example

Unit:5	**ADVANCED TECHNIQUES**	**12hours**

JAR file format creation–Internationalization–Swing Programming–Advanced java techniques

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars

	Total Lecture hours	**60 hours**

Text Books

1	Jamie Jaworski, “Java Unleashed”, SAMS Tech media Publications,1999.
2	Campione, Walrath and Huml, “The Java Tutorial”, Addison Wesley,1999.
Reference Books	
1	JimKeogh,” TheCompleteReferenceJ2EE”, TataMcGrawHillPublishingCompanyLtd,2010.
2	DavidSawyerMcFarland,“JavaScriptAndJQuery-TheMissingManual”, Oreilly Publications, 3rd Edition,2011.
3	Deitel and Deitel, “Java How to Program”, Third Edition, PHI/Pearson Education Asia.
4	"Java: The Complete Reference" by Herbert Schildt
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

ADVANCED JAVA PROGRAMMING

CO-PO MAPPING

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	3	2	3	1	1
CO3 (K4)	3	3	3	3	3	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
Total Score	12	11	10	9	11	7	5

CO-PSO MAPPING

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	2	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	11	9	9	8	7

Course code		PRACTICAL III: DATA MINING USING R	L	T	P	C
Core/Elective/Supportive		Lab - III			4	2
Pre-requisite		Basics of DM Algorithms & R Programming				

Course Outcomes:

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

CO1	Understand R programming environment to perform basic data preprocessing and implement data mining tasks.	K1,K2
CO2	Implement association rule mining using the Apriori algorithm for discovering frequent itemsets.	K3
CO3	Apply clustering techniques such as K-Means and hierarchical clustering for data grouping and analysis.	K4
CO4	Develop classification models and decision tree algorithms for predictive data analysis using R and Perform regression analysis and data visualization to interpret and present data mining results effectively	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS	75hours

- Create visualizations using histograms, bar charts, box plots, and scatter plots.
- Implement the Apriori algorithm to extract the association rule of data mining.
- Implement k-means clustering technique.
- Implement any Hierarchal Clustering.
- Implement Classification algorithm.
- Implement Decision Tree.
- Implement Random Forest Classification.
- Linear Regression.
- Data Visualization.
- Perform Principal Component Analysis (PCA) for dimensionality reduction.

Total Lecture hours	75hours

Text Books

1	Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson education,2003.
2	C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications", PHI, Second Edition

Reference Books

1	Arun K. Pujari, "Data Mining Techniques", Universities Press (India) Pvt. Ltd.,2003.
2	Alex Berson ,Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", TMCH, 2001.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/

3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

PRACTICAL III: DATA MINING USING R

PO-CO MAPPING

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	3	2	3	1	1
CO3 (K4)	3	3	3	3	3	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
Total Score	12	11	10	9	11	7	5

CO-PSO MAPPING

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	2	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	11	9	9	8	7

Course code		PRACTICAL IV: ADVANCED JAVA LAB	L	T	P	C
Core/Elective/Supportive		Lab - IV			4	2
Pre-requisite		Basics in Java Programming				

Course Outcomes:

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

CO1	Develop and implement Java Servlet programs to handle HTTP requests, responses, and web-based interactions.	K1,K2
CO2	Design dynamic web applications using JSP, HTML forms, sessions, and server-side scripting techniques.	K3
CO3	Apply JDBC concepts to perform database operations such as insert, update, delete, and retrieve records.	K4
CO4	Develop distributed applications using RMI and socket programming techniques and Design and implement real-time and enterprise applications using advanced Java technologies such as servlets, JSP, JDBC, and networking.	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS	75hours
1. Display a welcome message using Servlet. 2. Design a Purchase Order form using HTML form and Servlet. 3. Develop a program for calculating the percentage of marks of a student using JSP. 4. Design a Purchase Order form using HTML form and JSP. 5. Prepare an Employee pay slip using JSP. 6. Write a program using JDBC for creating a table, Inserting, deleting records and listing out the records. 7. Write a program using Java servlet to handle form data. 8. Write a simple Servlet program to create a table of all the headers it receives along with their associated values. 9. Write a program in JSP by using a session object. 10. Write a program to build a simple Client Server application using RMI. 11. Create an apple for a calculator application. 12. Program to send a text message to another system and receive the text message from the system (use socket programming).	
Expert lectures, online seminars –webinars	
Total Lecture hours	**75hours**

Text Books

1	JamieJaworski,"JavaUnleashed",SAMSTechmediaPublications,1999.
2	Campione, Walrath and Huml,"TheJavaTutorial",AddisonWesley,1999.

Reference Books

1	JimKeogh,"TheCompleteReferenceJ2EE",Tata Mc Graw Hill Publishing Company Ltd,2010.

2	DavidSawyerMcFarland,"JavaScriptAndJQuery-TheMissingManual",Oreilly Publications, 3rd Edition,2011.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

ADVANCED JAVA LAB

CO-PO MAPPING

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	1	2	0	0
CO2 (K3)	3	3	3	2	3	1	0
CO3 (K4)	3	3	2	3	3	1	1
CO4 (K5&K6)	3	3	3	3	3	2	1
Total Score	12	11	9	9	11	4	2

CO-PSO MAPPING

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	1	1	0	0	0
CO2 (K3)	3	3	2	2	1	0	0
CO3 (K4)	3	3	3	2	2	1	0
CO4 (K5&K6)	3	3	3	3	2	2	1
Total Score	12	11	9	8	5	3	1

Course code		STATISTICAL TOOLS	L	T	P	C
Core/Elective/Supportive		Skill Enhancement Course 1	4			2
Pre-requisite		Fundamentals of Statistics				

Course Outcomes:

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

CO1	Explain the fundamentals of statistics, data collection methods, sampling techniques, and types of data.	K1,K2
CO2	Apply graphical methods and measures of central tendency for organizing and summarizing data.	K3
CO3	Analyze statistical test procedures such as Z-test, T-test, F-test, and goodness-of-fit test for hypothesis testing.	K4
CO4	Evaluate correlation, regression, and analysis of variance techniques for prediction and decision-making.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

STATISTICAL TOOLS

UNIT 1	12 hrs

Introduction- Descriptive and Inferential Statistics-Variables and types of data- Data Collection and sampling technique- Uses and Misuses of Statistics-Introduction to Data Science and Data Analytics

UNIT 2	10 hrs

Organizing data-Histogram, Frequency Polygon and Ogives-other types of Graph- Measures of Central Tendency

UNIT 3	12 hrs

Classical Test statistics: Z-test, T-test, F-tests and Goodness of fit test

UNIT 4	14 hrs

Correlation and Regression- Scatter Plots-Analysis of Variance: one-way analysis of variance-Two-way analysis of variance-Multiple Linear Regression -Regression and Predictive Analytics

UNIT 5	12 hrs

Statistics Packages: SPSS, MS-EXCEL, SAS, R-Programming, Minitab. Big Data Analytics using Statistical Techniques. Python for Statistical Analysis (NumPy, Pandas, SciPy).

Text Book(s):

1. Allan G. Bluman, Elementary Statistics, 1992.
2. Dr. M.J de Smith, Statistical Analysis Handbook, 2014.
3. ARice, John. Mathematical Statistics and Data Analysis. Duxbury Press, 2006.
4. 4Statistics in a NutShell-Sarab Boslaugh & Paul Andrew Watters

STATISTICAL TOOLS

CO-PO MAPPING

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	0	2	0	0
CO2 (K3)	3	3	2	2	3	1	0
CO3 (K4)	3	3	3	3	2	2	1
CO4 (K5&K6)	3	3	3	3	3	2	2
Total Score	12	11	9	8	10	5	3

CO-PSO MAPPING

COs - PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	2	1	0	0	0
CO2 (K3)	3	3	3	2	2	1	0
CO3 (K4)	3	3	3	3	2	2	1
CO4 (K5&K6)	3	3	3	3	3	3	2
Total Score	12	11	11	9	7	6	3

LIST OF ELECTIVES

Course code		ADVANCED SOFTWARE ENGINEERING	L	T	P	C
Core/Elective/Supportive		Elective 1-1	3	1		4
Pre-requisite		Basics of Software Engineering & SPM				

Course Outcomes:

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

CO1	Understand the fundamental concepts of software engineering, software processes, and development life cycle models.	K1, K2
CO2	Apply requirement engineering techniques, SRS preparation, and software quality management concepts to software projects.	K3
CO3	Analyze software project management activities such as estimation, scheduling, risk management, and staffing.	K4
CO4	Apply software design principles including cohesion, coupling, and design methodologies for system development and Evaluate software testing strategies, maintenance processes, and configuration management techniques for improving software quality.	K5, K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	15hours

Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.

Unit:2	SOFTWARE REQUIREMENTS	15hours

Software Requirements Analysis and Specification: Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Result management system. Software Quality Management –Software Quality, Software Quality Management System, ISO 9000, SEI CMM.

Unit:3	PROJECT MANAGEMENT	15hours

Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead's software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.

Unit:4	SOFTWARE DESIGN	15hours

Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.

Unit:5	SOFTWARE TESTING	13hours

Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging– Testingtools-Metrics-ReliabilityEstimation.SoftwareMaintenance -Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars –webinars		
	Total Lecture hours	**75 hours**
Text Books		
1	An Integrated Approach to Software Engineering – Pankaj Jalote, Narosa Publishing House, Delhi, 3rd Edition.	
2	Fundamentals of Software Engineering –Rajib Mall, PHI Publication,3rdEdition.	
Reference Books		
1	Software Engineering– K.K. Aggarwal and Yogesh Singh, New Age International Publishers, 3 rd edition.	
2	A Practitioners Approach-Software Engineering,- R.S. Pressman, McGraw Hill.	
3	Fundamentals of Software Engineering - Carlo Ghezzi, M Jarayeri, D. Manodrioli, PHI Publication.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.javatpoint.com/software-engineering-tutorial	
2	https://onlinecourses.swayam2.ac.in/cec20_cs07/preview	
3	https://onlinecourses.nptel.ac.in/noc19_cs69/preview	

Advanced Software Engineering

CO-PO MAPPING

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	1	1	1	0
CO2 (K3)	3	3	2	2	3	2	1
CO3 (K4)	3	3	3	3	2	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	9	9	9	8	6

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	1	1	1	1	0
CO2 (K3)	3	3	2	2	3	2	1
CO3 (K4)	3	3	3	3	2	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	9	9	9	8	6

Course code		WEB SERVICES	L	T	P	C
Core/Elective/Supportive		Elective 1-2	3	1		4
Pre-requisite		Basics of Distributed Computing				

Course Outcomes:

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

CO1	Explain the fundamentals of distributed computing, web services architecture, standards, and platforms.	K1,K2
CO2	Apply XML technologies including XML documents, namespaces, schemas, and XML processing techniques.	K3
CO3	Analyze SOAP, WSDL, and UDDI models for designing and implementing web service communication systems.	K4
CO4	Evaluate advanced web service technologies, workflow management systems, and security issues in web services and Design QoS-enabled web service applications using modern standards, management techniques, and future web service trends.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms.

Unit:2	XMLFUNDAMENTALS	12hours

XMLFundamentals–XMLdocuments-XMLNamespaces-XMLSchema–ProcessingXML.

Unit:3	SOAP MODEL	12hours

SOAP: The SOAP model- SOAP messages-SOAP encoding- WSDL: WSDL structure- interface definitions-bindings-services-Using SOAP and WSDL-UDDI: About UDDI- UDDI registry Specification- Core data structures-Accessing UDDI

Unit:4	TECHNOLOGIESANDSTANDARDS	12hours

Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. Workflow: business process management-workflows and workflow management systems Security: Basics-data handling and forwarding-data storage-errors-Web services security issues.

Unit:5	QUALITYOFSERVICE	10 hours

Quality of Service: Importance of QoS for web services-QoS metrics-holes-design patterns-QoS enabled web services-QoS enabled applications. Web services management-web services standards and future trends.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**
Text Books		
1	Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services: An Architects Guide", Prentice Hall, Nov 2003.	
2	Keith Ballinger, "NET Web services: Architecture and Implementation with .Net", Pearson Education, First Edition, Feb 2003.	
Reference Books		
1	RameshNagappan,"DevelopingJavaWebServices:Architectinganddevelopingsecure Web Services Using Java", John Wiley and Sons, first Edition Feb 2003.	
2	Eric A Marks and Mark J Werrell ," Executive Guide to Webservices" ,John Wiley and sons, March 2003.	
3	Anne Thomas Manes, "Web Services :A managers Guide", AddisonWesley,June2003.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/webservices/index.htm	
2	https://www.javatpoint.com/web-services-tutorial	
3	https://www.btechguru.com/training--programming--xml--web-services--web-services-part-1-video-lecture--11801--24--147.html	

Web Services

CO-PO Mapping

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1(K1,K2)	3	2	1	2	1	1	2
CO2(K3)	3	3	2	3	1	1	2
CO3(K4)	3	3	3	3	1	1	2
CO4(K5,K6)	3	3	2	3	2	2	3
Total Score	12	11	8	11	5	5	9

CO-PSO Mapping

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1(K1,K2)	3	2	1	1	1	1	1
CO2(K3)	3	3	2	3	1	1	1
CO3(K4)	3	3	3	3	2	2	1
CO4(K5,K6)	3	3	2	3	3	2	2
Total Score	12	11	8	10	7	6	5

Course code		MULTIMEDIA AND ITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		Elective 1-3	3	1		4
Pre-requisite		Basics of Multimedia				

Course Outcomes:

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

CO1	Explain the fundamentals of multimedia systems, production platforms, and multimedia software tools.	K1,K2
CO2	Apply multimedia authoring tools and multimedia building blocks such as text and sound in multimedia content creation.	K3
CO3	Analyze image processing, animation, and video technologies for multimedia applications.	K4
CO4	Design multimedia applications for the Internet and World Wide Web using multimedia tools and web technologies and Evaluate advanced multimedia systems including HDTV, desktop multimedia computing, and knowledge-based multimedia systems	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

What is Multimedia?–Introduction to making Multimedia–Macintosh and Windows Production platforms – Basic Software tools.

Unit:2	MULTIMEDIATOOLS	12hours

Making Instant Multimedia–Multimedia authoring tools–Multimedia building blocks–Text– Sound.

Unit:3	ANIMATION	10hours

Images–Animation–Video.

Unit:4	INTERNET	12hours

Multimedia and the Internet–The Internet and how it works–Tools for World Wide Web–Designing for the World Wide Web.

Unit:5	MULTIMEDIASYSTEMS	12hours

High Definition Television and Desktop Computing –Knowledge based Multimedia systems.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	60hours

Text Books	
1	Tay Vaughan, “Multimedia making it work”, Fifth Edition, Tata McGraw Hill.
2	John F. Koegel Bufford, “Multimedia Systems”, Pearson Education.
Reference Books	
1	Judith Jef floate, “Multimedia in Practice (Technology and Applications)”, PHI,2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/multimedia/index.htm
2	https://www.tutorialspoint.com/basics_of_computer_science/basics_of_computer_science_multimedia.htm
3	https://nptel.ac.in/courses/117/105/117105083/

MULTIMEDIA AND ITS APPLICATIONS

CO-PO MAPPING

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	0	2	0	0
CO2 (K3)	3	3	2	2	3	1	0
CO3 (K4)	3	3	3	3	2	1	1
CO4(K5&K6)	3	3	3	3	3	2	1
Total Score	12	11	9	8	10	4	2

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	1	1	0	0	0
CO2 (K3)	3	3	2	2	1	0	0
CO3 (K4)	3	3	3	2	2	1	0
CO4 (K5&K6)	3	3	3	3	2	2	1
Total Score	**12**	11	9	8	5	3	1

Course code		ADVANCED OPERATING SYSTEMS	L	T	P	C
Core/Elective/Supportive		Elective 2-1	3	1		4
Pre-requisite		Basics of OS& its functioning				

Course Outcomes:

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

CO1	Understand the concepts and functionalities of advanced operating systems including process scheduling, inter-process communication, and deadlock handling.	K1, K2
CO2	Analyze distributed operating system concepts, communication primitives, logical clocks, and distributed file systems.	K3
CO3	Apply real-time operating system concepts, scheduling techniques, safety, and reliability mechanisms in practical applications.	K4
CO4	Understand the architecture, features, and security mechanisms of handheld operating systems such as Android, Palm OS, and Symbian OS and Evaluate modern operating systems such as Linux and iOS with respect to memory management, scheduling policies, file systems, and system architecture.	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	BASICS OF OPERATING SYSTEMS	12hours

Basics of Operating Systems: What is an Operating System? – Mainframe Systems –Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems –Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter-Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery.

Unit:2	DISTRIBUTED OPERATING SYSTEMS	12hours

Distributed Operating Systems: Issues – Communication Primitives – Lamports Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda.

Unit:3	REALTIMEOPERATINGSYSTEM	10hours

Realtime Operating Systems: Introduction – Applications of Real-Time Systems – Basic Model of Real-Time System – Characteristics – Safety and Reliability - Real-Time Task Scheduling

Unit:4	HANDHELD SYSTEM	12hours

Operating Systems for Handheld Systems: Requirements–Technology Overview–Handheld Operating Systems–Palm OS-Symbian Operating System-Android–Architecture of android–

Securing handheld systems

Unit:5	CASE STUDIES	12hours

Case Studies: Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars–webinars

	Total Lecture hours	60hours

Text Books

1	Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
2	Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
Reference Books	
1	Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India,2006.
2	Pramod Chandra P. Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.
3	Daniel.P. Bovet&MarcoCesati, "UnderstandingtheLinuxkernel",3rdedition,O"Reilly,2005
4	Neil Smyth, "iPhone iOS 4Development Essentials–Xcode", Fourth Edition, Payload media, 2011.
Related Online Contents [MOOC, SWAYAM,NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2	https://www.udacity.com/course/advanced-operating-systems--ud189
3	https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf

Advanced Operating Systems

CO-PO MAPPING

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1(K1,K2)	3	2	1	0	1	0	1
CO2(K3)	3	3	2	2	2	0	0
CO3(K4)	2	3	3	2	2	1	0
CO4(K5,K6)	2	3	3	3	3	2	1
TOTAL SCORE	10	11	9	7	8	3	2

CO-PSO MAPPING

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1(K1,K2)	3	2	1	0	1	0	1
CO2(K3)	3	3	2	2	1	0	0
CO3(K4)	2	3	3	2	2	0	0
CO4(K5,K6)	2	3	3	3	3	2	1
Total Score	10	11	9	7	7	2	2

Course code		ADVANCED COMPUTER NETWORKS	L	T	P	C
Core/Elective/Supportive		Elective 2-2	3	1		4
Pre-requisite		Basic Knowledge of mathematics and networking				

Course Outcomes:

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

CO1	Understand the fundamentals of data communication, network models, OSI layers, and TCP/IP protocol suite.	K1, K2
CO2	Analyze data link layer mechanisms such as framing, error control, switching techniques, and LAN/WAN technologies.	K3
CO3	Apply network layer concepts including IPv4/IPv6 addressing, routing protocols, and forwarding mechanisms.	K4
CO4	Analyze transport layer protocols including TCP, UDP, congestion control, and Quality of Service (QoS) and Evaluate application layer protocols such as DNS, email, file transfer, and network management using SNMP.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction- data communications – networks – The internet – Protocols and standards – OSI model – layers in OSI model – TCP/IP protocol suite – addressing – guided media – Unguided media

Unit:2	DATA LINK LAYER	12hours

Switching – Circuit switched networks – datagram networks – virtual circuit networks – Framing – Flow and error control Multiple access – random access – wired Lan – wireless Lan – Cellular telephony – satellite networks

Unit:3	NETWORK LAYER	12hours

Network layer – IP V4 addressing – IPV6 addressing – ICMP – IGMP –Network layer delivery – forwarding – unicast and multicast routing protocols

Unit:4	TRANSPORT LAYER	12hours

Transport layer – Process to process delivery – UDP -TCP -Congestion – congestion control – QOS – Techniques to improve QOS

Unit:5	APPLICATION LAYER	12hours

Domain name system – name space – domain name space – distribution of name space – DNS in the internet – remote logging - email – file transfer -Network management system – SNMP Protocol

Unit:6	Contemporary Issues	2 hours

Expert lectures,online seminars– webinars

	Total Lecture hours	60hours

Text Books	
1	Data communications and networking – Behrouz A Forouzan McGraw Hill 4th Edition 2015 Reprint
Reference Books	
1	Computer Networks – Tenenbaum -Pearson -2022
2	Computer networking –Kurose James F, Ross Keith W -Pearson – 2017
3	Data and computer communications – William Stallings – Pearson 2017
4	Computer networks and Internet – Douglas E Comer – Pearson - 2018
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106105080
2	https://www.tutorialspoint.com/computer-networks/index.asp
3	https://www.javatpoint.com/computer-network-tutorial

ADVANCED COMPUTER NETWORKS

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1(K1,K2)	3	2	2	2	1	0	1
CO2(K3)	3	3	3	3	2	0	1
CO3(K4)	3	3	3	3	2	0	1
CO4(K5,K6)	3	3	3	3	3	1	1
Total Score	12	11	11	11	8	1	4

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1(K1,K2)	3	2	1	1	1	0	1
CO2(K3)	3	3	2	2	2	0	1
CO3(K4)	3	3	2	3	2	0	1
CO4(K5,K6)	3	3	2	3	3	1	1
Total Score	12	11	7	9	8	1	4

Course code		MOBILE COMPUTING	L	T	P	C
Core/Elective/Supportive		Elective 2-3	3	1		4
Pre-requisite		Basics of Mobile Communication				

Course Outcomes:

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

CO1	Explain the fundamentals, evolution, and architecture of mobile communication systems and mobile computing.	K1,K2
CO2	Apply mobile communication standards, mobility management, and frequency management techniques in wireless networks.	K3
CO3	Analyze mobile data networks, satellite communication systems, and interference issues in cellular communication.	K4
CO4	Evaluate mobile Internet technologies, wireless security mechanisms, and wireless local loop architectures and Design and interpret advanced mobile communication systems including WCDMA, Bluetooth, ad hoc networks, and 4G systems	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction: Advantages of Digital Information - Introduction to Telephone Systems –Mobile Communication: Need for Mobile Communication – Requirements of Mobile Communication – History of Mobile Communication.

Unit:2	MOBILE COMMUNICATION	12hours

Introduction to Cellular Mobile Communication – Mobile Communication Standards –Mobility Management – Frequency Management – Cordless Mobile Communication Systems.

Unit:3	MOBILE COMPUTING	12hours

Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Change over from one satellite to another – Global Mobile Communication – Interferences in Cellular Mobile Communication.

Unit:4	MOBILE COMMUNICATION SYSTEM	11hours

Important Parameters of Mobile Communication System – Mobile Internet: Working of Mobile IP – Wireless Network Security – Wireless Local Loop Architecture: Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol.

Unit:5	COMMUNICATION TECHNOLOGY	11hours

WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system – Fourth Generation Mobile Communication systems.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars–webinars

	Total Lecture hours	60hours

Text Books

1	T.G. Palani velu, R. Nakkeeran, “Wireless and Mobile Communication”, PHI Limited, 2009.
2	Jochen Schiller, “Mobile Communications,” Second Edition, Pearson Education, 2007.
Reference Books	
1	Asoke K Talukder, Hasan Ahmed, Roopa Yavagal, “Mobile Computing”, TMH,2010.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/mobile_computing/index.htm
2	https://www.javatpoint.com/mobile-computing
3	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/

Mobile Computing

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1(K1,K2)	3	2	1	2	1	1	2
CO2(K3)	3	3	2	3	1	1	2
CO3(K4)	3	3	2	3	1	1	2
CO4(K5,K6)	3	3	3	3	1	2	2
Total Score	12	11	8	11	4	5	8

CO-PSO MAPPING

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1(K1,K2)	3	2	1	1	1	2	1
CO2(K3)	3	2	3	3	1	2	1
CO3(K4)	3	2	3	2	2	2	1
CO4(K5,K6)	2	2	2	3	3	2	2
Total Score	11	8	9	9	7	8	5

Course code		ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	L	T	P	C
Core/Elective/Supportive		Elective 3-1	3	1		4
Pre-requisite		Basics of AI & An Introduction to ML				

Course Outcomes:

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

CO1	Understand the fundamental concepts of Artificial Intelligence, problem solving, state space search, and production systems.	K1, K2
CO2	Apply heuristic search techniques such as hill climbing, best-first search, problem reduction, and constraint satisfaction problems.	K3
CO3	Analyze knowledge representation techniques using predicate logic, rules, and inference mechanisms.	K4
CO4	Understand machine learning concepts including big data, statistical foundations, and learning approaches and Evaluate machine learning applications including data preparation, learning cycles, and real-world AI/ML use cases.	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search State space search - Production Systems - Problem Characteristics - Issues in the design of Search.

Unit:2	SEARCH TECHNIQUES	12hours

Heuristic Search Techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.

Unit:3	PREDICATE LOGIC	12hours

Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming
-Forward vs. backwards reasoning -Matching-Control knowledge.

Unit:4	MACHINE LEARNING	12hours

Understanding Machine Learning: What Is Machine Learning? - Defining Big Data - Big Data in Context with Machine Learning - The Importance of the Hybrid Cloud - Leveraging the Power of Machine Learning - The Roles of Statistics and Data Mining with Machine Learning- Putting Machine Learning in Context-Approaches to Machine Learning.

Unit:5	APPLICATIONS OF MACHINE LEARNING	10 hours

Looking Inside Machine Learning: The Impact of Machine Learning on Applications - Data Preparation -The Machine Learning Cycle.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars –webinars

	Total Lecture hours	**60hours**
Text Books		
1	Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Publishers Company Pvt Ltd, Second Edition, 1991.	
2	George F Luger, "Artificial Intelligence", 4th edition, Pearson Education Publ,2002.	
Reference Books		
1	Machine Learning For Dummies ®, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.ibm.com/downloads/cas/GB8ZMQZ3	
2	https://www.javatpoint.com/artificial-intelligence-tutorial	
3	https://nptel.ac.in/courses/106/105/106105077/	

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

CO-PO MAPPING

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1(K1,K2)	3	2	0	1	1	0	0
CO2(K3)	3	3	2	2	2	0	0
CO3(K4)	2	3	2	3	2	1	0
CO4(K5,K6)	3	3	3	3	3	2	1
Total Score	11	11	7	9	8	3	1

CO-PSO MAPPING

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1(K1,K2)	2	2	1	0	0	1	0
CO2(K3)	3	3	2	2	1	0	0
CO3(K4)	2	3	3	2	2	1	0
CO4(K5,K6)	3	3	3	3	3	2	2
Total Score	10	11	9	7	6	4	2

Course code		ROBOTIC PROCESS AUTOMATION FOR BUSINESS	L	T	P	C
Core/Elective/Supportive		Elective 3-2	3	1		4
Pre-requisite		Basics of Robots & its applications				

Course Outcomes:

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

CO1	Explain the fundamentals of Robotic Process Automation (RPA), its business applications, benefits, and implementation models.	K1,K2
CO2	Analyze business processes and apply process mapping frameworks to identify automation opportunities.	K3
CO3	Evaluate RPA implementation lifecycle, success metrics, and post-deployment strategies for business automation.	K4
CO4	Design and develop RPA workflows and robots for automating business processes and information handling tasks and Explain the fundamentals of Robotic Process Automation (RPA), its business applications, benefits, and implementation models.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction to RPA -Overview of RPA -Benefits of RPA in a business environment -Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA -Centre of Excellence –Types and their applications -Building an RPA team -Approach for implementing RPA initiatives.

Unit:2	AUTOMATION	12hours

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people.

Unit:3	AUTOMATION IMPLEMENTATION	12hours

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows.

Unit:4	ROBOT	12hours

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

Unit:5	ROBOTSKILL	10hours

Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert, online seminars – webinars		
	Total Lecture hours	**60hours**
Text Books		
1	Alok Mani Tripathi" Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool" Packt Publishing Limited March 2018.	
2	Tom Taulli "The Robotic Process Automation Handbook" Apress, February2020.	
Reference Books		
1	Steve Kaelble "Robotic Process Automation" John Wiley & Sons, Ltd., 2018	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]		
1	https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm	
2	https://www.javatpoint.com/rpa	
3	https://onlinecourses.nptel.ac.in/noc19_me74/preview	

ROBOTIC PROCESS AUTOMATION FOR BUSINESS

CO-PO MAPPING

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	1	1	0
CO2 (K3)	3	3	3	2	2	1	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	10	9	9	7	6

CO-PSO MAPPING

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	1	1	1	1	0
CO2 (K3)	3	3	3	2	2	1	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	3	3
Total Score	12	11	10	9	9	7	6

Course code		CLOUD COMPUTING	L	T	P	C
Core/Elective/Supportive		Elective 3-3	3	1		4
Pre-requisite		Basics of Cloud & its Applications				

Course Outcomes:

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

CO1	Explain the fundamentals of cloud computing, its architecture, service models, and evolution.	K1,K2
CO2	Apply cloud collaboration tools for communication, scheduling, and group-based project management.	K3
CO3	Utilize cloud services for productivity applications such as documents, spreadsheets, databases, and calendars.	K4
CO4	Evaluate cloud communication tools such as webmail, conferencing, groupware, and social networking platforms.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.

Unit:2	CLOUD COMPUTING	12hours

CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloud computing for the community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporations, mapping, schedules, managing projects, and presenting on the road.

Unit:3	CLOUD SERVICES	12hours

USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring online scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.

Unit:4	OUTSIDE THE CLOUD	12hours

Evaluating webmail services, evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating online groupware, collaborating via blogs and wikis.

Unit:5	STORING AND SHARING	10hours

STORING AND SHARING Understanding cloud storage, evaluating online file storage, exploring online bookmarking services, exploring online photo editing applications, exploring photo sharing communities, and controlling it with web-based desktops.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars –webinars

	Total Lecture hours	60hours

Text Books

1. MichaelMiller, “Cloud Computing”, PearsonEducation, NewDelhi, 2009.

ReferenceBooks

1	Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata McGraw-Hill Education Private Limited, 2009.
RelatedOnlineContents[MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

Cloud Computing

CO-PO MAPPING

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	0	0	1	1	0
CO2 (K3)	2	3	2	2	3	1	0
CO3 (K4)	2	3	2	3	3	1	1
CO4 (K5&K6)	2	3	3	3	3	2	2
Total Score	9	11	7	8	10	5	3

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	2	2	1	0	0	1	0
CO2 (K3)	3	3	2	2	2	1	0
CO3 (K4)	2	3	3	2	2	1	1
CO4 (K5&K6)	2	3	3	3	3	2	2
Total Score	9	11	9	7	7	5	3

urse code		INTERNET OF THINGS	L	T	P	C
Core/Elective/Supportive		Elective 4-1	3	1		4
Pre-requisite		Basics of Sensors & their applications				

Course Outcomes:

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

CO1	Understand the fundamental concepts of IoT including architecture, frameworks, M2M communication, and enabling technologies.	K1, K2
CO2	Apply communication protocols such as HTTP, REST, SOAP, and WebSockets for IoT connectivity and integration.	K3
CO3	Analyze IoT data acquisition, storage, processing, and cloud computing models for effective data management.	K4
CO4	Design secure and scalable IoT solutions using cloud platforms, prototyping tools, and real-world IoT applications.	K5, K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Internet of Things: An Overview: IoT Conceptual Framework - IoT Architectural View - Technology Behind IoT - Sources of IoT - M2M Communication - Examples of IoT - Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization - Communication Technologies - Data Enrichment, Data Consolidation and Device Management at Gateway

Unit:2	Design Principles for Web Connectivity:	12hours

Communication Protocols for Connected Devices – Message Communication Protocols for Connected Devices – Web Connectivity for Connected Devices – Network Using Gateway , SOAP, REST, HTTP, RESTful and WebSockets - Internet Connectivity Principles : Internet Connectivity - Internet Based Communication – IP Addressing in the IoT – Media Access Control – Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others

Unit:3	Data Acquiring, Organizing, Processing and Analytics :	12hours

Data Acquiring and Storage – Organising the Data – Transactions, Business Processes, Integration and Enterprise Systems – Analytics – Knowledge Acquiring, Managing and Storing Processes - Data Collection, Storage and Computing Using a Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing – Everything as a Service and Cloud Service Models.

Unit:4	SENSORS AND ACTUATORS	10hours

Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks : Sensor Technology – Wireless Sensor Networks Technology - Prototyping the Embedded Devices for loT and M2M :Embedded Computing Basics – Embedded Platforms for Prototyping.

Unit:5	Prototyping and Designing the Software for IoT Applications	12hours

Prototyping Embedded Device Software - Devices, Gateways, Internet and Web/Cloud Services Software Development – Prototyping online Component APIs and Web APIs – Security for IoT : Vulnerabilities, Security Requirements and Threat Analysis – IoT Security Tomography and Layered Attacker Model – Security Models, Profiles and Protocols for IoT – IoT Application Case Study : Design Layers, Design Complexity and Designing using Cloud PaaS – IoT / IIoT Applications in the premises, Supply – Chain and Customer Monitoring – Connected Car and its Applications and Services.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Book	
1	Raj Kamal , " Internet of Things Architecture and Design Principles", McGraw Hill, 2017
Reference Books	
1	Ovidiu Vermesan and Peter Friess, "Internet of Things – From Research and Innovation to Mark Deployement" , River Publishers, 2014.
2	Peter Waher, "Learning Internet of Things" ,Packt Publishing, 2015.
3	Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black", Mc Graw Hill, 2015
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2	https://www.javatpoint.com/iot-internet-of-things
3	https://www.tutorialspoint.com/internet_of_things/index.htm

INTERNET OF THINGS

CO-PO MAPPING

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1,K2)	3	2	1	0	2	0	0
CO2 (K3)	3	3	2	2	3	1	0
CO3 (K4)	3	3	2	3	3	2	1
CO4 (K5,K6)	3	3	3	3	3	2	2
Total score	12	11	8	8	11	5	3

CO-PSO MAPPING

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1,K2)	3	2	1	2	0	0	0
CO2 (K3)	3	3	2	3	2	1	0
CO3 (K4)	3	3	3	2	3	2	1
CO4 (K5,K6)	3	3	3	3	3	3	2
Total score	12	11	9	10	8	6	3

Course code		EMBEDDED SYSTEMS	L	T	P	C
Core/Elective/Supportive		Elective 4-2	3	1		4
Pre-requisite		Basics of Micro Controller				

Course Outcomes:

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

CO1	Explain the architecture of 8051 microcontrollers including ports, timers, interrupts, and memory organization.	K1,K2
CO2	Apply 8051 instruction set and programming concepts for interfacing and embedded applications.	K3
CO3	Analyze real-time operating system concepts including tasks, semaphores, message queues, and memory management.	K4
CO4	Evaluate RTOS scheduling strategies and design considerations for real-time embedded systems and Design and debug embedded systems using development tools, simulators, and testing techniques.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**– Create

Unit:1	8051 MICROCONTROLLERS	12Hours

8051 Microcontroller: Introduction-8051Architecture-Input/Output Pins, Ports and Circuits-External Memory - Counters / Timers - Serial Data Input / Output –Interrupts

Unit:2	PROGRAMMINGBASICS	12Hours

Instruction Set and Programming Moving Data-Addressing Modes-Logical Operations- Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts.

Unit:3	CONCEPTS ON RTOS	12Hours

CONCEPTS ON RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data- Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions - Memory management routines in an RTOS Environment.

Unit:4	DESIGN USING RTOS	10Hours

Basic Design using an RTOS: Principles - Encapsulating semaphores and Queues-Hard real-time scheduling considerations-Saving memory space and power- introductions to RTL &QNX.

Unit:5	SOFTWARE TOOLS	12Hours

SOFTWARE TOOLS: Embedded Software Development Tools: Hosts and Target Machines-

Linker/Locators for Embedded software-getting Embedded software into the Target systems. Debugging Techniques: Testing on your Host machine - Instruction set simulators- The assert macro using laboratory tools.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars –webinars

	Total Lecture hours	60Hours

Text Books

1	David E. Simon, “An Embedded Software Primer” Pearson Education Asia, 2003.
2	Kenneth J Ayala, “The8051 Microcontroller and Architecture programming and application”, Second Edition, Penram International.

Reference Books	
1	RajKamal, “Embedded Systems –Architecture, programming and design”, Tata McGraw–Hill, 2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_cs14/preview
2	https://www.javatpoint.com/embedded-system-tutorial
3	https://www.tutorialspoint.com/embedded_systems/index.htm

Embedded System

CO-PO MAPPING

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1,K2)	3	2	1	0	2	0	0
CO2 (K3)	3	3	2	2	3	1	0
CO3 (K4)	3	3	2	3	3	2	1
CO4 (K5,K6)	3	3	3	3	3	2	2
Total score	12	11	8	8	11	5	3

CO-PSO MAPPING

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1,K2)	3	2	1	2	0	0	0
CO2 (K3)	3	3	2	3	2	1	0
CO3 (K4)	3	3	3	2	3	2	1
CO4 (K5,K6)	3	3	3	3	3	3	2
Total score	12	11	9	10	8	6	3

Course code		BLOCKCHAIN TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Elective 4-3	3	1		4
Pre-requisite		Basics of Block Chain & Crypto Currency				

Course Outcomes:

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

CO1	Explain the fundamentals of blockchain technology, distributed ledger systems, and cryptocurrency ecosystem.	K1,K2
CO2	Analyze blockchain networks, mining mechanisms, consensus algorithms, and security issues in distributed systems.	K3
CO3	Apply cryptographic techniques such as hashing, public-key cryptography, and digital signatures in blockchain applications.	K4
CO4	Evaluate cryptocurrency regulations, economic models, and legal aspects affecting blockchain systems.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major applications are Currency, identity, and chain of custody.

Unit:2	NETWORK AND SECURITY	12hours

Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain.

Unit:3	CRYPTOCURRENCY	12hours

Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain

Unit:4	CRYPTOCURRENCY REGULATION	11hours

Cryptocurrency Regulation-Stake holders, Roots of Bitcoin, Legal views-exchange of crypto currency-Black Market- Global Economy. Crypto economics–assets, supply and Demand, inflation and deflation – Regulation.

Unit:5	CHALLENGES IN BLOCKCHAIN	11hours

Opportunities and challenges in blockchain – Application of blockchain: Industry 4.0 – machine to machine communication –Data management in industry4.0–prospects. Blockchain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for Using Blockchain for Healthcare Data

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**
Text Books		
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press (July 19, 2016).	
2	Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies"	
Reference Books		
1	Satoshi Nakamoto, "Bitcoin: A peer-to-peer Electronic Cash System"	
2	Rodrigo da Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh," Blockchain Technology for Industry 4.0" Springer 2020.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.javatpoint.com/blockchain-tutorial	
2	https://www.tutorialspoint.com/blockchain/index.htm	
3	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/	

BLOCKCHAIN TECHNOLOGY

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1(K1,K2)	3	2	1	2	1	1	2
CO2(K3)	3	3	2	3	1	1	2
CO3(K4)	3	3	3	3	1	1	2
CO4(K5,K6)	3	3	2	2	1	2	2
Total Score	12	11	8	10	4	5	8

CO-PSO MAPPING

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1(K1,K2)	3	2	2	2	1	2	1
CO2(K3)	3	3	3	3	2	2	2
CO3(K4)	3	3	3	2	1	2	1
CO4(K5,K6)	2	2	2	2	3	1	1
Total Score	11	10	10	9	7	7	5