ROHINI **COLLEGE OF ENGINEERING AND TECHNOLOGY**

(AUTONOMOUS)

(Anjugramam-Kanyakumari Main Road, Palkulam,Variyoor P.O.-629 401, K.K.Dist.)

Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai

Accredited with A+ Grade by NAAC

M.E. Computer Science and Engineering

(M.E CSE)

Curriculum & Syllabus

(*2024-2025 Admitted Students Onwards*)

Vision Statement of RCET

To be an academic institute of continuous excellence towards education and research in rural regime and provide service to nation in terms of nurturing potentially higher social, ethical and engineering companion graduands.

Mission Statement of RCET

To foster and promote technically competent graduands by imparting the state of art Engineering education in rural regime.

To enunciate research assisted scientific learning by dissemination of knowledge towards science, agriculture, industry and national security.

Vision of the Department

To create young software professionals to compete the global challenges in the field of computer science and engineering and be researcher to meet the need of society.

Mission of the Department

- ✓ To provide quality education to develop software for real time problem in scientific and business application for various needs of industry.
- ✓ To provide learning ambience to enhance innovations, problem solving skill, leadership qualities, team spirit and ethical responsibility to serve the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1	To Produce Postgraduates With enhanced knowledge of real word engineering problems and to apply the knowledge of Computer science and Engineering to solve the problems
PEO2	To produce Postgraduates with the ability to analyze the requirements, understand the technical specification, design, offer an engineering solution, and create a novel product design.
PEO3	To Produce Postgraduates who will be function effectively as an individual, and enhance their leadership skills with ethical values and team spirit

PROGRAMME OUTCOMES (POs)

PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document
PO3	Students should be able to demonstrate a degree of mastery computer science and engineering. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	Students should be able to Function effectively as an individual and have the booming carrier in academia, research and entrepreneurial endeavors.
PO5	Students should be able to demonstrate the knowledge for the sustainable development of the society.

CREDIT INFO		
Sl.No	Category	Credits
1	Foundation Courses (FC)	4
2	Professional Core Courses (PCC)	34
3	Professional Electives (PEC)	13
4	Research Methodology and IPR Courses (RMC)	2
5	Open Electives Courses (OEC)	3
6	Employability Enhancement Courses (EEC)	19
7	Audit Courses (AC)	-
Total Credits		75

Foundation Courses (FC)							
Sl.no	Course Code	Course Title	Course Type	L	T	P	Credit
1	24CP101	Linear Algebra, Probability and Statistics	FC	3	1	0	4
Professional Core Courses (PCC)							
Sl.no	Course Code	Course Title	Course Type	L	T	P	Credit
1	24CP102	Advanced Data Structures and Algorithms	PCC	3	0	0	3
2	24CP103	Advanced Computer Networking and Design	PCC	3	0	0	3
3	24CP104	Advanced Operating Systems	PCC	3	0	0	3
4	24CP105	Database Practices	PCC	3	0	2	4
5	24CP131	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	2
6	24CP201	Advanced Software Engineering	PCC	3	0	0	3
7	24CP202	Internet of Things	PCC	3	0	2	4
8	24CS203	Multicore Architecture and Programming	PCC	3	0	2	4
9	24CS204	Machine Learning	PCC	3	0	2	4
10	24CP252	Software Engineering Laboratory	PCC	0	0	2	1
11	24CP301	Security Practices	PCC	3	0	0	3

Professional Electives (PEC)							
Professional Elective I							
S.No	Course Code	Course Title	Course Type	L	T	P	Credit
1	24CP205	Human Computer Interaction	PEC	3	0	0	3
2	24CP206	Cloud Computing Technologies	PEC	3	0	0	3
3	24CP207	Foundations of Data Science	PEC	3	0	0	3
4	24CP208	Wireless Communications	PEC	3	0	0	3
5	24CP209	Agile Methodologies	PEC	3	0	0	3
6	24CP210	Performance Analysis of Computer Systems	PEC	3	0	0	3
Professional Elective II							
7	24CP212	High Performance Computing for Big Data	PEC	3	0	0	3
8	24CP213	Autonomous Systems	PEC	3	0	0	3
9	24CP214	Web Analytics	PEC	3	0	0	3
10	24CP215	Cognitive Computing	PEC	3	0	0	3
11	24CP216	Quantum Computing	PEC	3	0	0	3
12	24CP217	Big Data Mining and Analytics	PEC	3	0	0	3
Professional Elective III							
13	24CP302	Mobile and Pervasive Computing	PEC	3	0	0	3
14	24CP303	Web Services and API Design	PEC	3	0	0	3
15	24CP304	Data Visualization Techniques	PEC	3	0	0	3
16	24CP305	Compiler Optimization Techniques	PEC	3	0	0	3
17	24CP306	Robotics	PEC	3	0	0	3
18	24CP307	Natural Language Processing	PEC	2	0	2	3
Professional Elective IV							
19	24CP309	Devops and Microservices	PEC	3	0	2	4
20	24CP310	Deep Learning	PEC	3	0	2	4
21	24CP311	Blockchain Technologies	PEC	3	0	2	4
22	24CP312	Embedded Software Development	PEC	3	0	2	4
23	24CP313	Full Stack Web Application Development	PEC	3	0	2	4
24	24CP314	Bioinformatics	PEC	3	0	2	4

Research Methodology and IPR Courses (PCC)							
S.No	Course Code	Course Title	Course Type	L	T	P	Credit
1	24RM101	Research Methodology and IPR	RMC	2	0	0	2
Open Electives Courses (OEC)							
S.No	Course Code	Course Title	Course Type	L	T	P	Credit
1	24CI341	Integrated Water Resources Management	OEC	3	0	0	3
2	24CI342	Water, Sanitation and Health	OEC	3	0	0	3
3	24CI343	Principles of Sustainable Development	OEC	3	0	0	3
4	24CI344	Environmental Impact Assessment	OEC	3	0	0	3
5	24TE342	Vibration and Noise Control Strategies	OEC	3	0	0	3
6	24TE341	Energy Conservation and Management in Domestic Sectors	OEC	3	0	0	3
7	24TE343	New Product Development	OEC	3	0	0	3
8	24CI345	Sustainable Management	OEC	3	0	0	3
9	24IS341	Micro and Small Business Management	OEC	3	0	0	3
10	24IS343	Intellectual Property Rights	OEC	3	0	0	3
11	24IS344	Ethical Management	OEC	3	0	0	3
12	24EM341	IoT for Smart Systems	OEC	3	0	0	3
13	24EM342	Smart Grid	OEC	3	0	0	3
14	24TE344	Design Thinking	OEC	3	0	0	3
15	24CM341	Medical Robotics	OEC	3	0	0	3
16	24EM343	Embedded Automation	OEC	3	0	0	3
17	24CI346	Environmental Sustainability	OEC	3	0	0	3
18	24TE345	Textile Reinforced Composites	OEC	3	0	0	3
19	24TE346	Nanocomposite Materials	OEC	3	0	0	3
20	24TE342	Electric Vehicle Technology	OEC	3	0	0	3
Employability Enhancement Courses (EEC)							
S.No	Course Code	Course Title	Course Type	L	T	P	Credit

1	24CP251	Term Paper Writing and seminar	EEC	0	0	2	1
2	24CP351	Project Work I	EEC	0	0	12	6
3	24CP451	Project Work II	EEC	0	0	24	12
Audit Courses (AC)							
S.No	Course Code	Course Title	Course Type	L	T	P	Credit
1	24AC101	English for Research Paper Writing	AC	2	0	0	0
2	24AC102	Disaster Management	MNC	2	0	0	0
3	24AC103	Constitution of India	MNC	2	0	0	0
4	24AC104	நற்றமிழ் இலக்கியம்	MNC	2	0	0	0

SCHEME OF INSTRUCTION FOR FIRST YEAR M.E.

I SEMESTER

S.no	Course code	Course Title	Category	L	T	P	C
THEORY COURSES							
1	24CP101	Linear Algebra, Probability and Statistics	FC	3	1	0	4
2	24RM101	Research Methodology and IPR	RMC	2	0	0	2
3	24CP102	Advanced Data Structures and Algorithms	PCC	3	0	0	3
4	24CP103	Advanced Computer Networking and Design	PCC	3	0	0	3
5	24CP104	Advanced Operating Systems	PCC	3	0	0	3
6	24AC1XX	Audit Course – I*	AC	2	0	0	0
THEORY COURSE WITH LABORATORY COMPONENT							
7	24CP105	Database Practices	PCC	3	0	2	4
LABORATORY COURSES							
8	24CP131	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	2
TOTAL				19	1	6	21

*Audit Course is Optional

SEMESTER II

S.no	Course code	Course Title	Category	L	T	P	C
THEORY COURSES							
1	24CP201	Software and Data Engineering	PCC	3	0	0	3
2	24CP2XX	Professional Elective I	PEC	3	0	0	3
3	24CP2XX	Professional Elective II	PEC	3	0	0	3
4	24AC1XX	Audit Course – II*	AC	2	0	0	0
THEORY COURSE WITH LABORATORY COMPONENT							
5	24CP202	Internet of Things	PCC	3	0	2	4
6	24CS203	Multicore Architecture and Programming	PCC	3	0	2	4
7	24CS204	Machine Learning	PCC	3	0	2	4
LABORATORY COURSES							
8	24CP251	Term Paper Writing and seminar	EEC	0	0	2	1
9	24CP252	Software and Data Engineering Laboratory	PCC	0	0	2	1
TOTAL				20	0	10	23

*Audit Course is Optional

Course Code:	24CP101	Course Title:	Linear Algebra, Probability and Statistics
Credits:	4	L – T – P	3 – 1 – 0

Course objectives:

- To develop a working knowledge of the central ideas of Linear Algebra.
- To understand basic concepts of Probability theory and Random Variables, how to deal with multiple Random Variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To use the concepts of multivariate normal distribution and principal components analysis.

Teaching-Learning Process:

These are sample strategies which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT I – Linear Algebra	[12 hours]

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization – generalized eigenvectors – Canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

UNIT II – Probability and Random Variables	[12 hours]

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT III – Two Dimensional Random Variables	[12 hours]
Joint distributions – Marginal and conditional distributions – Functions of two-dimensional random variables – Regression curve – Correlation.	

UNIT IV – Testing of Hypothesis	[12 hours]
Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design - 2^2 Factorial design.	

UNIT V – Multivariate Analysis	[12 hours]
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Apply the concepts of Linear Algebra to solve real time problems.	K3
CO2	Apply the ideas of probability and random variables in solving engineering problems.	K3
CO3	Use two dimensional random variables and be equipped for a possible extension to multivariate analysis.	K3
CO4	Apply statistical tests in testing hypotheses on data	K3
CO5	Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.	K3

COs and POs Mapping:

Course Outcomes	Programme Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2			
CO2	3	2	2			
CO3	2		1	1		
CO4	3	2	1	1		
CO5	3	3	2			

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Skill Assessment Components: Individual Assignment / Worksheet / Case Study / Mini Project

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	20
Apply	60	60	60
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

Reference Books:

1. Gupta.S.C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand and Sons, 2020.
2. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2014.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.

4. Johnson, R.A. and Wichern, D. W. “Applied Multivariate Statistical Analysis”, 6th Edition, Pearson Education, Asia, 2012.
5. Rice, J.A. "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.
6. Bronson, R., “Matrix Operation” Schaum’s outline series, Tata McGraw Hill, New York, 2011.

Web Links and Video Lectures (E-Resources):

1. Probability Distributions
   https://www.nptelvideos.com/lecture.php?id=14400
2. Sampling Distributions: :
   https://www.nptelvideos.com/lecture.php?id=14612
3. Testing of Hypothesis
   https://www.nptelvideos.com/lecture.php?id=14425

Equivalent NPTEL/SWAYAM Courses:

S.No.	Course Title	Course Instructor	Host Institute
1	Probability and Statistics	Prof. Somesh Kumar	IIT Kharagpur
2	Statistical Methods for Scientists and Engineers	Prof. Somesh Kumar	IIT Kharagpur

Course Code:	24RM101	Course Title:	Research Methodology and IPR
Credits:	2	L – T – P	2-0-0

Course Objectives:

To impart knowledge on the

- To addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project
- To understand the basic concepts in research process and data collection
- To prepare report writing and framing Research proposals
- To develop an understanding of the ethical dimensions of conducting applied research.
- To demonstrate enhanced Scientific writing skills, academic writing, patenting and avoid the common mistakes in the field of research methodology.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Blended Mode of Learning
3. Project based Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT I – RESEARCH DESIGN	[6 hours]
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.	

UNIT II – DATA COLLECTION AND SOURCES	[6 hours]
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.	

UNIT III – DATA ANALYSIS AND REPORTING	[6 hours]
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.	

UNIT IV – INTELLECTUAL PROPERTY RIGHTS	[6 hours]
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.	

UNIT V – PATENTS	[6 hours]
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Search, select and critically analyze research articles and papers
CO2	Formulate and evaluate research questions.
CO3	Develop the ability to apply the methods while working on a research project work
CO4	Understand the ethical dimensions of conducting applied research
CO5	Develop the Scientific writing skills, academic writing and patents

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	2	3	2	3
CO2	3	-	-	-	1	3

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

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0 Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	60
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	40	40
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching tools & techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013

Course Code:	24CP102	Course Title:	ADVANCED DATA STRUCTURES AND ALGORITHMS
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness of problems

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I-ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS	[9 hours]

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms Asymptotic analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms-Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree

Method- Data structures and algorithms.

UNIT II-HIERARCHICAL DATA STRUCTURES	[9 hours]
Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B - trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation – Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree	

UNIT III-GRAPHS	[9 hours]
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm	

UNIT IV-ALGORITHM DESIGN TECHNIQUES	[9 hours]
Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding	

UNIT V NP COMPLETE AND NP HARD	[9 hours]
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Design data structures and algorithms to solve computing problems.

CO2	Choose and implement efficient data structures and apply them to solve problems.
CO3	Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
CO4	Design one's own algorithm for an unknown problem.
CO5	Apply suitable design strategy for problem solving.

On completion of the course, the student will have the ability to: **COs and POs Mapping:**

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	2	3	1	3
CO2	3	1	-	-	2	3
CO3	3	-	1	1	-	2
CO4	3	2	1	-	2	1
CO5	3	3	1	1	-	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	60
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	40	40
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).

- All the fifteen questions have to be answered.

Reference Books:

.

1. S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.
3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.
4. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009
5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms",University Press, 2nd Edition, 2008.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms",Pearson Education, Reprint 2003

Course Code:	**24CP103**	**Course Title:**	**ADVANCED COMPUTER NETWORKING AND DESIGN**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

To impart knowledge on the

- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To learn about Network Function Virtualization
- To understand the paradigm of Software defined networks

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – NETWORKING CONCEPTS	**9 hours]**
Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. Osi Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.	

UNIT II – WIRELESS NETWORKS	**[9 hours]**
Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee	

UNIT III – MOBILE DATA NETWORKS	**[9 hours]**
4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radio- spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.	

UNIT IV – SOFTWARE DEFINED NETWORKS	[9 hours]
SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.	

UNIT V – NETWORK FUNCTIONS VIRTUALIZATION	[9 hours]
Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Explain basic networking concepts
CO2	Compare different wireless networking protocols
CO3	Describe the developments in each generation of mobile data networks
CO4	Explain and develop SDN based applications
CO5	Explain the concepts of network function virtualization

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	3	2	-	1	-

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

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	60
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	40	40
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. James Bernstein, “Networking made Easy”, 2018. (UNIT I)
2. HoudaLabiod, Costantino de Santis, HossamAfifi “Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007 (UNIT 2)
3. Erik Dahlman, Stefan Parkvall, Johan Skold, 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013 (UNIT 3)
4. Saad Z. Asif “5G Mobile Communications Concepts and Technologies” CRC press – 2019 (UNIT 3)
5. William Stallings “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud” 1st Edition, Pearson Education, 2016.(Unit 4 and 5)
6. Thomas D.Nadeau and Ken Gray, SDN – Software Defined Networks, O‟Reilly

Publishers, 2013.
7. Guy Pujolle, “Software Networks”, Second Edition, Wiley-ISTE, 2020

Course Code:	24CP104	Course Title:	ADVANCED OPERATING SYSTEM
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To get a comprehensive knowledge of the architecture of distributed systems.
- To understand the deadlock and shared memory issues and their solutions in distributed environments.
- To know the security issues and protection mechanisms for distributed environments.
- To get a knowledge of multiprocessor operating systems and database operating systems.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – INTRODUCTION	9 hours]

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations - inherent limitations of a distributed system – lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection.

Distributed Mutual Exclusion – introduction – the classification of mutual exclusion and associated algorithms – a comparative performance analysis

UNIT II – DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT	**[9 hours]**
Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems –issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed file systems – design issues – log structured file systems.	

UNIT III – DISTRIBUTED SHARED MEMORY AND SCHEDULING	**[9 hours]**
Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent set of checkpoints – synchronous and asynchronous checkpointing and recovery – checkpointing for distributed database systems- recovery in replicated distributed databases	

UNIT IV – DATA SECURITY	**[9 hours]**
Protection and security -preliminaries, the access matrix model and its implementations. -safety in matrix model- advanced models of protection. Data security – cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard- public key cryptography – multiple encryption – authentication in distributed systems.	

UNIT V – MULTIPROCESSOR AND DATABASE OPERATING SYSTEM	[9 hours]
Multiprocessor operating systems - basic multiprocessor system architectures – interconnection networks for multiprocessor systems – caching – hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads- process synchronization and scheduling. Database Operating systems :Introduction- requirements of a database operating system Concurrency control : theoretical aspects – introduction, database systems – a concurrency control model of database systems- the problem of concurrency control – serializability theory- distributed database systems, concurrency control algorithms – introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms – concurrency control algorithms: data replication.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand and explore the working of Theoretical Foundations of OS.
CO2	Analyze the working principles of Distributed Deadlock Detection and resource management
CO3	Understand the concepts of distributed shared memory and scheduling mechanisms
CO4	Understand and analyze the working of Data security
CO5	Apply the learning into multiprocessor system architectures

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	3	2	2	1	3
CO2	2	2	3	2	1	-
CO3	1	1	-	3	2	1

CO4	1	1	2	1	2	2
CO5	-	-	-	-	-	-

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	60
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	40	40
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
4. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003.

Course Code:	**24CP105**	**Course Title:**	**DATABASE PRACTICES**
Credits:	**4**	**L – T – P**	**3-0-2**

Course objectives:

To impart knowledge on the

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – RELATIONAL DATA MODEL	**[15 hours]**
Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.	

Practical Topics:

- Data Definition Language
- Create, Alter and Drop
- Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
- Creating Views
- Data Manipulation Language
- Insert, Delete, Update
- Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
- Aggregate Functions
- Set Operations
- Nested Queries Transaction Control Language
- Commit, Rollback and Save Points

UNIT II – DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY	**[15 hours]**

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

Practical Topics:

- Distributed Database Design and Implementation
- Row Level and Statement Level Triggers
- Accessing a Relational Database using PHP, Python and R

UNIT III – XML DATABASES	**[15 hours]**

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery

Practical Topics:

- Creating XML Documents, Document Type Definition and XML Schema
- Using a Relational Database to store the XML documents as text
- Using a Relational Database to store the XML documents as data elements
- Creating or publishing customized XML documents from pre-existing relational

databases

- Extracting XML Documents from Relational Databases
- XML Querying

UNIT IV – NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS	[15 hours]
NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.	
Practical Topics: • Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j. • Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.	

UNIT V – DATABASE SECURITY	[15 hours]
Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.	
Practical Topics: • Implementing Access Control in Relational Databases	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.

CO2	Understand and write well-formed XML documents
CO3	Be able to apply methods and techniques for distributed query processing.
CO4	Design and Implement secure database systems.
CO5	Use the data control, definition, and manipulation languages of the NoSQL databases

COs and POs Mapping:

On completion of the course, the student will have the ability to: **COs and POs Mapping:**

COs	**Pos**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	1	3	1	2
CO2	2	2	-	2	1	1
CO3	3	1	2	1	-	1
CO4	3	2	2	1	1	1
CO5	2	3	1	1	-	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) – Theory	CIE – I	100	50	100	25
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment – I	40	40		
	Skill Assessment – II	40			
Continuous Internal	Continuous Assessment	75	75	100	25
	Model Lab Exam	25	25		

Examination (CIE) – Laboratory					
End Semester Examination (ESE)	Theory Exam	100	35	50	50
	Lab Exam	100	15		
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education 2016.
2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2019.
3. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006
4. Raghu Ramakrishnan , Johannes Gehrke "Database Management Systems", Fourth Edition, McGraw Hill Education, 2015.
5. Harrison, Guy, "Next Generation Databases, NoSQL and Big Data" , First Edition, Apress publishers, 2015
6. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Sixth Edition, Pearson Education,2015

Course Code:	**24CP131**	**Course Title:**	**Advanced Data Structures and Algorithms Laboratory**
Credits:	**2**	**L – T – P**	**0-0-4**

Course objectives:

To impart knowledge on the

- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures

- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

S.No	Name of the Experiment
1.	Implementation of recursive function for tree traversal and Fibonacci
2.	Implementation of iteration function for tree traversal and Fibonacci
3.	Implementation of Merge Sort and Quick Sort
4.	Implementation of a Binary Search Tree
5.	Red-Black Tree Implementation
6.	Heap Implementation
7.	Fibonacci Heap Implementation
8.	Graph Traversals
9.	Spanning Tree Implementation
10.	Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11.	Implementation of Matrix Chain Multiplication
12.	Activity Selection and Huffman Coding Implementation

Hardware/Software Requirements

1	64-bit Open source Linux or its derivative
2	Open Source C++ Programming tool like G++/GCC

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Design and implement basic and advanced data structures extensively
CO2	Design algorithms using graph structures
CO3	Design and develop efficient algorithms with minimum complexity using design techniques.
CO4	Develop programs using various algorithms.
CO5	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	1	-	1	1	-
CO2	1	-	1	2	2	1
CO3	1	1	1	1	2	1
CO4	1	2	2	2	2	1
CO5	1	2	3	1	3	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**

Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	60
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Lab Exam	100	40	40	40
				Total	100

Reference Books:

1. Lipschutz Seymour, "Data Structures Schaum's Outlines Series", Tata McGraw Hill, 3rd Edition, 2014.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
3. http://www.coursera.org/specializations/data-structures-algorithms
4. http://www.tutorialspoint.com/data_structures_algorithms
5. http://www.geeksforgeeks.org/data-structures/

Course Code:	**24CP201**	**Course Title:**	**ADVANCED SOFTWARE ENGINEERING**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

To impart knowledge on the

- To understand the rationale for software development process models
- To understand why the architectural design of software is important;
- To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
- To understand the basic notions of a web service, web service standards, and service- oriented architecture;
- To understand the different stages of testing from testing during development of a software system

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – SOFTWARE PROCESS &MODELING	[9 hours]
Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modelling – Principles – Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling – Behavioural Modelling.	

UNIT II – SOFTWARE DESIGN	[9 hours]
Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern- Based Design.	

UNIT III – SYSTEM DEPENDABILITY AND SECURITY	[9 hours]
Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and	

Dependability – Safety and Organizations – Security Requirements – Secure System Design – Security Testing and Assurance – Resilience Engineering – Cybersecurity – Sociotechnical Resilience – Resilient Systems Design

UNIT IV – SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING	**[9 hours]**
Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition – Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.	

UNIT V – SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT	**[9 hours]**
Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing – Black-Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Identify appropriate process models based on the Project requirements
CO2	Understand the importance of having a good Software Architecture.
CO3	Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
CO4	Understand the basic notions of a web service, web service standards, and service-oriented architecture;
CO5	Be familiar with various levels of Software testing

COs and POs Mapping:

COs	**Pos**

	1	2	3	4	5	6
CO1	1	1	-	1	1	-
CO2	1	-	1	2	2	1
CO3	1	1	1	1	2	1
CO4	1	2	2	2	2	1
CO5	1	2	3	1	3	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) – Theory	CIE – I	100	50	100	60
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	40	40
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Somerville, Pearson Education Asia 2016.
3. Software Architecture In Practice, 3rd Edition, Len Bass, Paul Clements and Rick Kazman, Pearson India 2018
4. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, Narosa Publishing House, 2018
5. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI Learning Private Ltd, 2018

Course Code:	**24CP202**	**Course Title:**	**INTERNET OF THINGS**
Credits:	**4**	**L – T – P**	**3-0-2**

Course objectives:

To impart knowledge on the

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To understand the basics of cloud architecture
- To gain experience in Raspberry PI and experiment simple IoT application on it

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – INTRODUCTION	**[9 hours]**
Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure ofIoT– IoT Map Device- IoT System Management with NETCONF-YANG	
Practical Topics: 1. Develop an application for LED Blink and Pattern using Arduino or Raspberry Pi	

UNIT II – IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS	**[9 hours]**
IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics	

Practical Topics: 1. Develop an application for LED Pattern with Push Button Control using Arduinoor Raspberry Pi

UNIT III – IoT PROTOCOLS AND TECHNOLOGY	**[9 hours]**
SCADA and RFID Protocols - BACnet Protocol -Zigbee Architecture - 6LowPAN - CoAP -Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module	
Practical Topics: 1. Develop an application for LM35 Temperature Sensor to display temperature values using arduino or Raspberry Pi 2. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor	

UNIT IV – CLOUD ARCHITECTURE BASICS	**[9 hours]**
The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon, Azure, Google Appcloud platform in industry	
Practical Topics: 1. Develop an application for home intrusion detection web application	

UNIT V – IOT PROJECTS ON RASPBERRY PI	**[9 hours]**
Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representationof sensor values - Persisting data - External representation of sensor values - Exporting sensor data	
Practical Topics: 1. Develop an application for Smart parking application using python and Django for web application	

Laboratory Component: **[30 hours]**

All 6 experiments have to be completed from the following list of experiments.

S.No.	**Name of the Experiment**
1	Develop an application for LED Blink and Pattern using Arduino or Raspberry Pi

2	Develop an application for LED Pattern with Push Button Control using Arduino or Raspberry Pi
3	Develop an application for LM35 Temperature Sensor to display temperature values using arduino or Raspberry Pi
4	Develop an application for Forest fire detection end node using Raspberry Pi device and sensor
5	Develop an application for home intrusion detection web application
6	Develop an application for Smart parking application using python and Django for web application

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand the various concept of the IoT and their technologies
CO2	Develop the IoT application using different hardware platforms
CO3	Implement the various IoT Protocols.
CO4	Understand the basic principles of cloud computing
CO5	Develop and deploy the IoT application into cloud environment

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	**1**	**1**	2	1	1	**3**
CO2	**3**	**2**	1	2	3	**2**
CO3	**1**	**1**	2	1	3	**3**
CO4	**2**	**3**	2	1	2	**2**
CO5	**1**	**2**	1	2	1	**1**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	25
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	25
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Theory Exam	100	35	50	50
	Lab Exam	100	15		
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
4. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd EditionScitech Publishers, 2014
6. Reese, G. (2009).Cloud Application Architectures: Building Applications and Infrastructure

in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009)

Course Code:	**24CS203**	**Course Title:**	**MULTICORE ARCHITECTURE AND PROGRAMMING**
Credits:	**4**	**L – T – P**	**3-0-2**

Course objectives:

To impart knowledge on the

1. To understand the need for multi-core processors, and their architecture.
2. To understand the challenges in parallel and multithreaded programming.
3. To learn about the various parallel programming paradigms,
4. To develop multicore programs and design parallel solutions.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – MULTI-CORE PROCESSORS	**[9 hours]**
Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.	

Practical Topics:

1.Write a simple Program to demonstrate an OpenMP Fork-Join Parallelism.

2. Create a program that computes a simple matrix-vector multiplication b=Ax, either in C/C++. Use OpenMP directives to make it run in parallel.

UNIT II – PARALLEL PROGRAM CHALLENGES	**[9 hours]**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

Practical Topics:

1. Create a program that computes the sum of all the elements in an array A (C/C++) or a program that finds the largest number in an array A. Use OpenMP directives to make it run in parallel.
2. Write a simple Program demonstrating Message-Passing logic using OpenMP.

UNIT III – SHARED MEMORY PROGRAMMING WITH OpenMP	**[9 hours]**

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

Practical Topics:

1. Implement the All-Pairs Shortest-Path Problem (Floyd's Algorithm) Using OpenMP.
2. Implement a program Parallel Random Number Generators using Monte Carlo Methods in OpenMP.

UNIT IV – DISTRIBUTED MEMORY PROGRAMMING WITH MPI	**[9 hours]**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

Practical Topics:

1.Write a Program to demonstrate MPI-broadcast-and-collective-communication in C.

2.Write a Program to demonstrate MPI-scatter-gather-and-all gather in C.

UNIT V – PARALLEL PROGRAM DEVELOPMENT	[9 hours]
Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.	
Practical Topics: 1.Write a Program to demonstrate MPI-send-and-receive in C. 2.Write a Program to demonstrate by performing-parallel-rank-with-MPI in C.	

Laboratory Component: **[30 hours]**

All 10 experiments have to be completed from the following list of experiments.

S.No.	Name of the Experiment
1	Write a simple Program to demonstrate an OpenMP Fork-Join Parallelism.
2	Create a program that computes a simple matrix-vector multiplication b=Ax, either in C/C++. Use OpenMP directives to make it run in parallel.
3	Create a program that computes the sum of all the elements in an array A (C/C++) or a program that finds the largest number in an array A. Use OpenMP directives to make it run in parallel.
4	Write a simple Program demonstrating Message-Passing logic using OpenMP.
5	Implement the All-Pairs Shortest-Path Problem (Floyd's Algorithm) Using OpenMP.
6	Implement a program Parallel Random Number Generators using Monte Carlo Methods in OpenMP.
7	Write a Program to demonstrate MPI-broadcast-and-collective-communication in C.
8	Write a Program to demonstrate MPI-scatter-gather-and-all gather in C.
9	Write a Program to demonstrate MPI-send-and-receive in C.
10	Write a Program to demonstrate by performing-parallel-rank-with-MPI in C.

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Describe multicore architectures and identify their characteristics and challenges.
CO2	Identify the issues in programming Parallel Processors.

CO3	Write programs using OpenMP and MPI.
CO4	Design parallel programming solutions to common problems.
CO5	Compare and contrast programming for serial processors and programming for parallel processors.

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	3	4	5	6
CO2	1	1	1	2	1	2
CO3	2	1	-	-	2	2
CO4	1	-	2	1	1	2
CO5	2	1	1	1	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	25
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	25
	Model Lab Exam	25	25		

End Semester Examination (ESE)	Theory Exam	100	35	50	50
	Lab Exam	100	15		
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Text Books:

Reference Books:

- Peter S. Pacheco, "An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier, 2021.
- Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011 (unit 2)
- Michael J Quinn, "Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2003.
- Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
- Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.

Course Code:	**24CS204**	**Course Title:**	**MACHINE LEARNING**
Credits:	**4**	**L – T – P**	**3-0-2**

Course objectives:

To impart knowledge on the

1. To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
2. To explore the different supervised learning techniques including ensemble methods
3. To learn different aspects of unsupervised learning and reinforcement learning
4. To learn the role of probabilistic methods for machine learning
5. To understand the basic concepts of neural networks and deep learning

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – INTRODUCTION AND MATHEMATICAL FOUNDATIONS	**[9 hours]**

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

Practical Topics:

1. Implement a Linear Regression with a Real Datases (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.

UNIT II – SUPERVISED LEARNING	**[9 hours]**

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting /Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms

Practical Topics:

1. Classification with Nearest Neighbors. In this question, you will use the scikit-learn's KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset.
2. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.

UNIT III – UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING	**[9 hours]**

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning

Practical Topics:

1. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
2. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset

UNIT IV – PROBABILISTIC METHODS FOR LEARNING	**[9 hours]**

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models

UNIT V – NEURAL NETWORKS AND DEEP LEARNING	**[9 hours]**

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases

Laboratory Component: **[30 hours]**

All experiments have to be completed from the following list of experiments.

S.No	Name of the Experiment
1.	Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2.	Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness
3.	Classification with Nearest Neighbors. In this question, you will use the scikit-learn's KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4.	In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem
5.	Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
6.	Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
7.	Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data. • Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach. • You can either pick a project of your own design, or you can choose from the set of pre-defined projects • You are free to use any third-party ideas or code that you wish as long as it is publicly available. • You must properly provide references to any work that is not your own in the write-up.

	• Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand and outline problems for each type of machine learning
CO2	Design a Decision tree and Random forest for an application
CO3	Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.
CO4	Use a tool to implement typical Clustering algorithms for different types of applications.
CO5	Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification Understand and outline problems for each type of machine learning

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	1	3	1	1
CO2	2	3	1	2	1	2
CO3	1	1	2	1	-	2
CO4	2	2	-	-	-	3
CO5	3	3	1	1	1	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	25
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	25
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Theory Exam	100	35	50	50
	Lab Exam	100	15		
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
3. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, “Machine Learning”, McGraw Hill Education, 2013.
5. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2015

7. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
8. Hal Daumé III, “A Course in Machine Learning”, 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts,
11. Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

Course Code:	**24CP251**	**Course Title:**	**TERM PAPER WRITING AND SEMINAR**
Credits:	**1**	**L – T – P**	**0-0-2**

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained. Activities to be carried out

Activity	**Instructions**	**Submission week**	**Evaluation**
Selection of area of interest and Topic	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Stating an Objective			

Collecting Information aboutyour area & topic	1 List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia orworkshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must bearea specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Basedon your objective - Search various digital libraries and Google Scholar • When picking papers to read - try to: Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	**6%** (the list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following	5th week	**8%** (the table given should indicate your

	questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next 5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notesfor final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%**(clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce)

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	60
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Lab Exam	100	40	40	40
				Total	100

Course Code:	**24CP252**	**Course Title:**	**Software Engineering Laboratory**
Credits:	**1**	**L – T – P**	**0-0-2**

Course objectives:

To impart knowledge on the

- To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner through the Web.
- Present case studies to demonstrate practical applications of different concepts.
- Provide a scope to students where they can solve small, real-life problems.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

S.No	Name of the Experiment
1.	Write a Problem Statement to define a title of the project with bounded scope of project
2.	Select relevant process model to define activities and related task set for assigned project
3.	Prepare broad SRS (Software Requirement Specification) for the above selected projects
4.	Prepare USE Cases and Draw Use Case Diagram using modelling Tool
5.	Develop the activity diagram to represent flow from one activity to another for software development
6.	Develop data Designs using DFD Decision Table & ER Diagram.
7.	Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagram for the assigned project
8.	Write Test Cases to Validate requirements of assigned project from SRS Document
9.	Evaluate Size of the project using function point metric for the assigned project
10.	Estimate cost of the project using COCOMO and COCOCMOII for the assigned project
11.	Use CPM/PERT for scheduling the assigned project

12.	Use timeline Charts or Gantt Charts to track progress of the assigned project

Hardware/Software Requirements

1	64-bit Open source Linux or its derivative
2	Open Source C++ Programming tool like G++/GCC

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Can produce the requirements and use cases the client wants for the software being Produced.
CO2	Participate in drawing up the project plan. The plan will include at least extent and work assessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture
CO3	Create and specify such a software design based on the requirement specification that the software can be implemented based on the design..
CO4	Can assess the extent and costs of a project with the help of several different assessment methods.

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	3	3	3	3
CO2	2	3	3	3	2	2
CO3	3	1	2	2	1	2
CO4	2	3	1	2	-	-

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	60
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Lab Exam	100	40	40	40
				Total	100

Course Code:	24CP205	Course Title:	HUMAN COMPUTER INTERACTION
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To learn the foundations of Human Computer Interaction
- Understanding Interaction Styles and to become familiar with the design technologies forindividuals and persons with disabilities.
- To understand the process of Evaluation of Interaction Design.
- To clarify the significance of task analysis for ubiquitous computing
- To get insight on web and mobile interaction.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Interactive Simulations
4. Lab experiment videos
5. Blended Mode of Learning
6. Project based Learning
7. Experiential Learning
8. NPTEL and Other Videos
9. Smart Class Room
10. Flipped Class

UNIT I – FOUNDATIONS OF HCI	[9 hours]

Context of Interaction –Ergonomics - Designing Interactive systems – Understanding Users-cognition and cognitive frameworks, User Centred approaches Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories. Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design.

UNIT II – INTERACTION STYLES	[9 hours]
GUI: Popularity of graphics - The concept of direct manipulation - Graphical system - Characteristics - Web user - Interface Popularity - Characteristics and Principles of User Interface. Understanding interaction styles, Direct Navigation and Immersive environments, Fluid navigation, Expressive Human and Command Languages, Communication and Collaboration Advancing theuser experience, Timely user Experience, Information search, Data Visualization Design process:Human Interaction with computers - Importance of Human Characteristics - Human Consideration -Human Interaction Speeds and Understanding Business Junctions.	

UNIT III – EVALUATION OF INTERACTION	[9 hours]
Evaluation Techniques- assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models. Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models	

UNIT IV - MODELS AND THEORIES	[9 hours]
Task analysis, dialog notations and design, Models of the system, Modeling rich interaction, Ubiquitous computing	

UNIT V - WEB AND MOBILE INTERACTION	[9 hours]
Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions-Lookup patterns-Feedback patterns Mobile apps, Mobile navigation, content and control idioms, Multi-touch gestures, Inter- app integration, Mobile web	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand the basics of human computer interactions via usability engineering and cognitive modeling.
CO2	Understand the basic design paradigms, complex interaction styles.
CO3	Understand the models and theories for user interaction

CO4	Examine the evaluation of interaction designs and implementations.
CO5	Elaborate the above issues for web and mobile applications

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	**3**	**3**	3	3	3	**3**
CO2	**1**	**-**	1	2	2	**1**
CO3	**2**	**3**	2	2	-	**1**
CO4	**2**	**3**	1	2	-	**2**
CO5	**2**	**2**	3	3	3	**3**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	60
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	40	40
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Pearson Education, 2016.
2. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.
3. Helen Sharp Jennifer Preece Yvonne Rogers, “Interaction Design: Beyond Human-Computer Interaction”, Wiley, 5th Edition, 2019.
4. Alan Cooper,RobertReimann, David Cronin, Christopher Noessel,“About Face: The Essentials of Interaction Design”, 4th Edition, Wiley, 2014.
5. Donald A. Norman, “Design of Everyday Things”, MIT Press, 2013.
6. Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.
7. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Pearson Education, 2016.
8. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.

Course Code:	24CP206	Course Title:	CLOUD COMPUTING TECHNOLOGIES
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE	[6 hours]

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT II – CLOUD PLATFORM ARCHITECTURE	[12 hours]

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development –

Architectural Design Challenges

UNIT III – AWS CLOUD PLATFORM - IAAS	[9 hours]
Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager	

UNIT IV – PAAS CLOUD PLATFORM	[9 hours]
Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops	

UNIT V – PROGRAMMING MODEL	[9 hours]
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Employ the concepts of virtualization in the cloud computing
CO2	Identify the architecture, infrastructure and delivery models of cloud computing
CO3	Develop the Cloud Application in AWS platform
CO4	Apply the concepts of Windows Azure to design Cloud Application
CO5	Develop services using various Cloud computing programming models

COs and POs Mapping:

COs	POs

	1	2	3	4	5	6
CO1	-	-	-	2	2	1
CO2	2	3	1	-	-	1
CO3	3	-	3	-	1	3
CO4	-	-	-	2	-	3
CO5	3	2	-	-	-	-

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.

4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.

5. Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
6. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

Course Code:	24CP207	Course Title:	Foundations of Data Science
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To apply fundamental algorithms to process data.
- Learn to apply hypotheses and data into actionable predictions.
- Document and transfer the results and effectively communicate the findings using visualization techniques.
- To learn statistical methods and machine learning algorithms required for Data Science.
- To develop the fundamental knowledge and understand concepts to become a data science professional.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – INTRODUCTION TO DATA SCIENCE	[9 hours]
Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.	

UNIT II – MODELING METHODS	[9 hours]
Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.	

UNIT III – INTRODUCTION TO R	[9 hours]
Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data	

frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.

UNIT IV – MAP REDUCE	**[9 hours]**
Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.	

UNIT V – DATA VISUALIZATION	**[9 hours]**
Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph using graphics parameters - Case studies.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Obtain, clean/process and transform data
CO2	Analyze and interpret data using an ethically responsible approach
CO3	Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues
CO4	Apply computing theory, languages and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses.
CO5	Formulate and use appropriate models of data analysis to solve business-related challenges.

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	3	-	2	2
CO2	-	-	2	3	-	-
CO3	1	-	-	-	3	3

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

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
2. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
3. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd., 2014.
5. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011

Course Code:	24CP208	Course Title:	WIRELESS COMMUNICATIONS
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To understand the basic concepts in cellular communication.
- To learn the characteristics of wireless channels.
- To understand the impact of digital modulation techniques in fading.
- To get exposed to diversity techniques in wireless communication.
- To acquire knowledge in multicarrier systems.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – CELLULAR CONCEPTS	[9 hours]

Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring- Repeaters for Range Extension-Microcell Zone Concept.

UNIT II – THE WIRELESS CHANNEL	[9 hours]

Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT III – PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS	[9 hours]
Performance of flat fading and frequency selective fading – Impact on digital modulation techniques –- Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference.	

UNIT IV – DIVERSITY TECHNIQUES	[9 hours]
Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combing – Maximal-Ratio Combining – Equal - Gain Combining – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems	

UNIT V – MULTICARRIER MODULATION	[9 hours]
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Design solutions for cellular communication
CO2	Determine the capacity of wireless channels
CO3	Analyze the performance of the digital modulation techniques in fading channels
CO4	Apply various diversity techniques in wireless communication
CO5	Design multicarrier systems in wireless communication.

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	-	-	2	2	3	2

CO2	3	2	3	-	-	-
CO3	2	-	-	2	3	3
CO4	3	3	-	2	3	3
CO5	2	3	3	2	3	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Theodore.S. Rappaport, “Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2010.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.

3. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Wiley Series in Telecommunications, Cambridge University Press, 2005.
4. Saad Z. Asif, “5G Mobile Communications Concepts and Technologies” CRC press – 2019.
5. Keith Q. T. Zhang, “Wireless Communications: Principles, Theory and Methodology” 1st edition, John Wiley & Sons, 2016.
6. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House, 2004.
7. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”,John Wiley & Sons Inc., 2013.

Suggested Skill Activities:

1. Survey on various features of cellular networks
2. Study the nature of cellular networks
3. A comparative study on the performance of different digital modulation techniques
4. Perform a review of various diversity techniques in wireless communication
5. Presentation on design of multicarrier systems for 5G

Course Code:	24CP209	Course Title:	AGILE METHODOLOGIES
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To learn the fundamental principles and practices associated with each of the agile development methods
- To apply the principles and practices of agile software development on a project of interest and relevance to the student.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand Agile development and testing

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – AGILE SOFTWARE DEVELOPMENT	[9 hours]

Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges. Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality

UNIT II – AGILE AND SCRUM PRINCIPLES	[9 hours]

Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values.

UNIT III – AGILE PRODUCT MANAGEMENT	[9 hours]
Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue	

UNIT IV – AGILE REQUIREMENTS AND AGILE TESTING	[9 hours]
User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development, User Acceptance Test.	

UNIT V – AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS	[9 hours]
Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools. Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Analyze existing problems with the team, development process and wider organization
CO2	Apply a thorough understanding of Agile principles and specific practices
CO3	Select the most appropriate way to improve results for a specific circumstance or need
CO4	Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems
CO5	Evaluate likely successes and formulate plans to manage likely risks or problems

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**

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

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011)
2. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
3. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.

4. Hazza and Dubinsky, “Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.

5. Craig Larman, “Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004.
6. Kevin C. Desouza, “Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

Course Code:	24CP210	Course Title:	PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – OVERVIEW OF PERFORMANCE EVALUATION	[9 hours]

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little‘s Law and other Operational Laws –Modification for Closed Systems

UNIT II – MARKOV CHAINS AND SIMPLE QUEUES	[9 hours]

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

UNIT III – MULTI-SERVER AND MULTI-QUEUE SYSTEMS	[9 hours]
Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke‘s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues	

UNIT IV – REAL-WORLD WORKLOADS	[9 hours]
Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.	

UNIT V – SMART SCHEDULING IN THE M/G/1	[9 hours]
Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - . Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Identify the need for performance evaluation and the metrics used for it
CO2	Distinguish between open and closed queuing networks
CO3	Apply Little‘e law and other operational laws to open and closed systems
CO4	Use discrete-time and continuous-time Markov chains to model real world systems
CO5	Develop analytical techniques for evaluating scheduling policies

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	1	1	1	1	1
CO2	2	2	3	2	2	1
CO3	2	2	2		2	

CO4	1		3		3	1
CO5	2	2	2	1	2	

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. K. S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications‖, John Wiley and Sons, 2001.
2. Krishna Kant, "Introduction to Computer System Performance Evaluation‖, McGraw-Hill, 1992.
3. Lieven Eeckhout, "Computer Architecture Performance Evaluation Methods‖, Morgan and Claypool Publishers, 2010.
4. Mor Harchol - Balter, "Performance Modeling and Design of Computer Systems –Queueing Theory in Action‖, Cambridge University Press, 2013.
5. Paul J. Fortier and Howard E. Michel, "Computer Systems Performance Evaluation and Prediction‖, Elsevier, 2003.

6. Raj Jain, “The Art of Computer Systems Performance Analysis: Techniques forExperimental Design, Measurement, Simulation and Modeling‖, Wiley-Interscience, 1991.
7. Raj Jain, Art of Computer Systems Performance Analysis: Techniques For Experimental Design Measurements Simulation and Modeling,2nd edition, wiley, 2015

Course Code:	24CP212	Course Title:	HIGH PERFORMANCE COMPUTING FOR BIG DATA
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To learn the fundamental concepts of High Performance Computing.
- To learn the network & software infrastructure for high performance computing.
- To understand real time analytics using high performance computing.
- To learn the different ways of security perspectives and technologies used in HPC.
- To understand the emerging big data applications.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – INTRODUCTION	[9 hours]

The Emerging IT Trends- IOT/IOE-Apache Hadoop for big data analytics-Big data into big insights and actions – Emergence of BDA discipline – strategic implications of big data – BDA Challenges – HPC paradigms – Cluster computing – Grid Computing – Cloud computing – Heterogeneous computing – Mainframes for HPC - Supercomputing for BDA – Appliances for BDA.

UNIT II – NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA	[9 hours]

Design of Network Infrastructure for high performance BDA – Network Virtualization – Software Defined Networking – Network Functions Virtualization – WAN optimization for transfer of big data –started with SANs- storage infrastructure requirements for storing big data – FC SAN – IP SAN – NAS – GFS – Panasas – Luster file system – Introduction to cloud storage

UNIT III – REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING	[9 hours]
Technologies that support Real time analytics – MOA: Massive online analysis – GPFS: General parallel file system – Client case studies – Key distinctions – Machine data analytics – operational analytics – HPC Architecture models – In Database analytics – In memory analytics	

UNIT IV – SECURITY AND TECHNOLOGIES	[9 hours]
Security, Privacy and Trust for user – generated content: The challenges and solutions – Role of real time big data processing in the IoT – End to End Security Framework for big sensing data streams – Clustering in big data.	

UNIT V – EMERGING BIG DATA APPLICATIONS	[9 hours]
Deep learning Accelerators – Accelerators for clustering applications in machine learning - Accelerators for classification algorithms in machine learning – Accelerators for Big data Genome Sequencing	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand the basics concepts of High Performance computing systems
CO2	Apply the concepts of network and software infrastructure for high performance computing
CO3	Use real time analytics using high performance computing.
CO4	Apply the security models and big data applications in high performance computing
CO5	Understand the emerging big data applications.

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	3	1	-	-
CO2	-	-	2	3	2	3

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

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, "High- Performance Big-Data Analytics: Computing Systems and Approaches", Springer, 1st Edition, 2015.
2. "Big Data Management and Processing", Kuan-Ching Li , Hai Jiang, Albert Y. Zomaya, CRC Press,1st Edition,2017.
3. "High Performance Computing for Big Data: Methodologies and Applications", Chao wang ,CRC Press,1st Edition,2018
4. "High-Performance Data Mining And Big Data Analytics" , Khosrow Hassibi, Create Space Independent Publishing Platform,!st Edition,2014

5. "High performance computing: Modern systems and practices", Thomas Sterling, Matthew Anderson, Morgan Kaufmann publishers,1st Edition,2017

WEB REFERENCES:

1. https://www.hpcwire.com/

ONLINE RESOURCES:

1. http://hpc.fs.uni-lj.si/sites/default/files/HPC_for_dummies.pdf
2. https://www.nics.tennessee.edu/computing-resources/what-is-hpc

Course Code:	24CP213	Course Title:	AUTONOMOUS SYSTEMS
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To impart knowledge on the functional architecture of autonomous vehicles
- To impart knowledge on Localization and mapping fundamentals
- To impart knowledge on process end effectors and robotic controls
- To learn Robot cell design, Robot Transformation and Sensors
- To learn Micro/Nano Robotic Systems

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – INTRODUCTION AND FUNCTIONAL ARCHITECTURE	[9 hours]

Functional architecture - Major functions in an autonomous vehicle system, Motion Modeling - Coordinate frames and transforms, point mass model, Vehicle modeling (kinematic and dynamic bicycle model - two-track models), Sensor Modeling - encoders, inertial sensors, GPS.

UNIT II – PERCEPTION FOR AUTONOMOUS SYSTEMS	[9 hours]

SLAM - Localization and mapping fundamentals, LIDAR and visual SLAM, Navigation – Global path planning, Local path planning, Vehicle control - Control structures, PID control, Linear quadratic regulator, Sample controllers

UNIT III – ROBOTICS INTRODUCTION, END EFFECTORS AND CONTROL	[9 hours]

Robot anatomy-Definition, law of robotics, Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers- Vacuum

grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems- Robot controls-Point to point control, Continuous path control, Intelligent robotControl system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDTMotion Interpolations- Adaptive control.

UNIT IV – ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN	**[9 hours]**
Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile, Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software	

UNIT V – MICRO/NANO ROBOTICS SYSTEM	**[9 hours]**
Micro/Nano robotics system overview-Scaling effect-Top down and bottom up approach Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in targeted drug delivery system.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand architecture and modeling of autonomous systems
CO2	Employ localization mapping techniques for autonomous systems
CO3	Design solutions for autonomous systems control.
CO4	Analyze Robot Transformations, Sensors and Cell Design.
CO5	Explain the working principles of Micro/Nano Robotic system.

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	3	2	3	3
CO2	2	1	2	3	2	2

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

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.,2009
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.
3. Karsten Berns, Ewald Puttkamer, Springer, Autonomous Land Vehicles: Steps towards Service Robots, 2009
4. Sebastian Thrun, Wolfram Burgard, Dieter Fox., Probabilistic robotics. MIT Press, 2005
5. Steven M. LaValle., Planning algorithms, Cambridge University Press, 2006
6. Daniel Watzenig and Martin Horn (Eds.), Automated Driving: Safer and More Efficient Future Driving, Springer, 2017
7. Markus Maurer, Autonomous driving: technical, legal and social aspects. Springer, 2016
8. Jha, Theory, Design and Applications of Unmanned Aerial Vehicles, CRC Press, 2016

Course Code:	24CP214	Course Title:	WEB ANALYTICS
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To understand the Web analytics platform, and their evolution.
- To learn about the various Data Streams Data.
- To learn about the benefits of surveys and capturing of data
- To understand Common metrics of web as well as KPI related concepts.
- To learn about the various Web analytics versions.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – INTRODUCTION	[9 hours]

Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, on site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations..

UNIT II – DATA COLLECTION	[9 hours]

Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

UNIT III – QUALITATIVE ANALYSIS	[9 hours]
Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.	

UNIT IV – WEB METRICS	[9 hours]
Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.	

UNIT V – WEB ANALYTICS 2.0	[9 hours]
Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand the Web analytics platform, and their evolution.
CO2	Use the various Data Streams Data.
CO3	Know how the survey of capturing of data will benefit.
CO4	Understand Common metrics of web as well as KPI related concepts
CO5	Apply various Web analytics versions in existence

COs and POs Mapping:

COs	POs					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	3	2	3	2
CO2	2	2	3	1	1	1
CO3	3	-	3	2	2	2
CO4	1	2	3	1	1	1
CO5	2	-	3	2	2	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed, 2012.
2. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed, 2010.
3. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons, 2002

Course Code:	24CP215	Course Title:	COGNITIVE COMPUTING
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To familiarize Use the Innovation Canvas to justify potentially successful products.
- To learn various ways in which to develop a product idea.
- To understand about how Big Data can play vital role in Cognitive Computing
- To know about the business applications of Cognitive Computing
- To get into all applications of Cognitive Computing

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – FOUNDATION OF COGNITIVE COMPUTING	[9 hours]

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services

UNIT II – NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS	[9 hours]

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.

UNIT III – BIG DATA AND COGNITIVE COMPUTING	[9 hours]
Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics	

UNIT IV – BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING	[9 hours]
Preparing for change ,advantages of new disruptive models , knowledge meaning to business, difference with a cognitive systems approach , meshing data together differently, using business knowledge to plan for the future , answering business questions in new ways , building business specific solutions , making cognitive computing a reality , cognitive application changing the market The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing	

UNIT V – APPLICATION OF COGNITIVE COMPUTING	[9 hours]
Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Explain applications in Cognitive Computing
CO2	Describe Natural language processor role in Cognitive computing.
CO3	Explain future directions of Cognitive Computing
CO4	Evaluate the process of taking a product to market
CO5	Comprehend the applications involved in this domain

COs and POs Mapping:

COs	POs					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	3	2	-	2	-
CO2	2	-	3	1	3	-
CO3	1	2	-	-	3	-
CO4	-	-	2	2	1	1
CO5	2	2	1	-	1	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive computing and Big Data Analytics”, Wiley, 2015
2. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”, The MIT Press, 1999.
3. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.

Course Code:	24CP216	Course Title:	QUANTUM COMPUTING
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To introduce the building blocks of Quantum computers and highlight the paradigm change between conventional computing and quantum computing
- To understand the Quantum state transformations and the algorithms
- To understand entangled quantum subsystems and properties of entangled states
- To explore the applications of quantum computing

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – QUANTUM BUILDING BLOCKS	[9 hours]
The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere	

UNIT II – QUANTUM STATE TRANSFORMATIONS	[9 hours]
Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations	

UNIT III – QUANTUM ALGORITHMS	[9 hours]
Computing with Superpositions, Quantum Subroutines, Quantum Fourier Transformations, Shor's Algorithm and Generalizations, Grover's Algorithm and Generalizations	

UNIT IV – ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATION	[9 hours]
Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graph states and codes, CSS Codes, Stabilizer Codes, Fault Tolerance and Robust Quantum Computing	

UNIT V – QUANTUM INFORMATION PROCESSING	[9 hours]
Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Understand the basic principles of quantum computing
CO2	Gain knowledge of the fundamental differences between conventional computing and quantum computing
CO3	Understand several basic quantum computing algorithms.
CO4	Understand the classes of problems that can be expected to be solved well by quantum computers.
CO5	Simulate and analyze the characteristics of Quantum Computing Systems

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	3	-	1	-
CO2	1	2	3	-	2	-
CO3	-	1	3	2	3	2
CO4	2	-	2	2	1	3
CO5	3	-	1	2	3	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
2. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021
3. Parag Lala, Quantum Computing, 2019
4. Eleanor Rieffel and Wolfgang Polak, QUANTUM COMPUTING A Gentle Introduction, 2011
5. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.2002
6. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004
7. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000

Course Code:	24CP217	Course Title:	BIG DATA MINING AND ANALYTICS
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

- To understand the computational approaches to Modeling, Feature Extraction
- To understand the need and application of Map Reduce
- To understand the various search algorithms applicable to Big Data
- To analyze and interpret streaming data
- To learn how to handle large data sets in main memory and learn the various clustering techniques applicable to Big Data

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – DATA MINING AND LARGE SCALE FILES	[9 hours]

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II – SIMILAR ITEMS	[9 hours]

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

UNIT III – MINING DATA STREAMS	[9 hours]
Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.	

UNIT IV – LINK ANALYSIS AND FREQUENT ITEMSETS	[9 hours]
Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.	

UNIT V – CLUSTERING	[9 hours]
Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non -– Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Design algorithms by employing Map Reduce technique for solving Big Data problems
CO2	Design algorithms for Big Data by deciding on the apt Features set
CO3	Design algorithms for handling petabytes of datasets.
CO4	Design algorithms and propose solutions for Big Data by optimizing main memory consumption.
CO5	Design solutions for problems in Big Data by suggesting appropriate clustering techniques

COs and POs Mapping:

COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	**-**	**-**	-	2	3	**3**
CO2	**-**	**-**	-	-	2	**2**
CO3	**-**	**-**	-	2	3	**3**

CO4	**1**	**-**	2	2	3	**3**
CO5	**2**	**3**	2	2	3	**3**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Reference Books:

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2012.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001.