PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)
Bangalore Trunk Road, Varadharajapuram,
Poonamallee, Chennai – 600 123.

Department of Computer Science and Engineering
M.E- Computer Science and Engineering

CURRICULUM AND SYLLABUS

REGULATION-2023

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

To provide an academically conducive environment for individuals to develop as technologically superior, socially conscious and nationally responsible citizens.

MISSION

M1: To develop our department as a center of excellence, imparting quality education, generating competent and skilled manpower.

M2: To prepare our students with high degree of credibility, integrity, ethical standards and social concern.

M3: To train our students to devise and implement novel systems based on Education and Research.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: Apply the basic fundamental tools and profound knowledge of computer science & engineering to generate interest in newer areas of research and develop the students into successful professionals.

PEO 2: Develop innovative and advanced software systems by exploring multiple solutions to computational problems with efficient algorithms giving due consideration to the human context in which the systems would work.

PEO 3: Adapt to sustained learning and ever-changing technological and societal requirements which will enable them to attain a dynamic career in academics and research and industries.

PEO 4: Demonstrate and Practice professional and ethical code of conduct towards team work with societal responsibilities.

PEO 5: Engage in continued learning to keep pace with changing landscape of technologies and provide innovative solutions to real-life problems.

PROGRAM OUTCOMES (PO)

PO1 (Research Aptitude): An ability to independently carry out research Investigations identify problems and develop solutions to solve practical problems.

PO2 (Technical documentation): Identify, formulate, research literature, and analyze complex engineering problem reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

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

PO5(Environmental Sustainability and societal Ethics): Ensure development of socially relevant and eco-friendly indigenous products by applying technical knowledge, ethical principles and, sound engineering practices

PO6(Life-long learning): Recognize the need for independent, life-long learning and engage in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1 (Professional Skills): To inculcate technical skills to analyze, design and implement software's related to algorithms, networking, web services, multimedia, big data analytics and recent topics of varying complexity.

PSO 2 (Problem-Solving Skills): To develop the capability to comprehend and solve the interdisciplinary problems through appropriate technology with the understanding of contemporary business environment

PSO 3 (Successful Career and Entrepreneurship): To develop an ability to utilize the latest technology and platforms to become a triumphant professional, successful entrepreneur and an urge for pursuing higher studies.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Programme educational objective and the outcomes is given in the following table

PEO	PO1	PO2	PO3	PO4	PO5	PO6
1.	1	2	3	3	3	3
2.	3	2	3	3	3	3
3.	3	3	3	3	2	3
4.	3	3	2	3	3	2
5.	1	2	3	2	2	2

YEAR	SEMESTER	COURSE TITLE	PO1	PO2	PO 3	PO4	PO5	PO 6
I YEAR	SEM I	Advanced Mathematics for Scientific Computing	2	2	2	2	2	2
		Advanced Data structures and Algorithms	3	2	1	2	1	2
		Database Practices	3	2	2	2	1	1
		Networking Technologies	1	3	2	2	2	2
		Research Methodology and IPR	3	2	2	2	1	2
		Audit Course – I						
		Data Structures and Algorithms Laboratory	3	2	2	2	1	2
		Networking Technologies Laboratory	3	2	2	2	1	2
	SEM II	Cloud Infrastructure Management	3	3	2	2	2	3
		Data Mining and Analytics	2		2	2	3	3
		Machine Learning Techniques	2	2	1	2	1	2

		Professional Elective I						
		Professional Elective II						
		Audit Course – II						
		Machine Learning Techniques Laboratory	1	2	2	2	2	2

YEAR	SEMESTER	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6
II YEAR	SEM 3	Professional Elective – III						
		Professional Elective – IV						
		Professional Elective –V						
		Open Elective						
		Industry Orientation and Technical Seminar						
		Project Work Phase- I						
	SEM 4	Project Work Phase- II						

PANIMALAR ENGINEERING COLLEGE, CHENNAI

(An Autonomous Institution, Affiliated to Anna University, Chennai)

M.E- Computer Science and Engineering

CHOICE BASED CREDIT SYSTEM (CBCS)

I - IV SEMESTERS CURRICULUM AND SYLLABI (REGUALTION 2023)

Semester I							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1	23MA2101	Advanced Mathematics for Scientific Computing	FC	4/0/0	4	4	60/40
2	23CS2101	Advanced Data structures and Algorithms	PCC	3/0/0	3	3	60/40
3	23CS2102	Database Practices	PCC	4/0/0	4	4	60/40
4	23CS2103	Networking Technologies	PCC	3/0/0	3	3	60/40
5	23RM2101	Research Methodology and IPR	RMC	3/0/0	3	3	60/40
Laboratory Course							
6	23CS2111	Data Structures and Algorithms Laboratory	PCC	0/0/4	4	2	40/60
7	23CS2112	Networking Technologies Laboratory	PCC	0/0/4	4	2	40/60
Audit Course							
8		Audit Course – I	AC	2/0/0	2	0	0/100
TOTAL					**27**	**21**	

Semester II							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1	23CS2201	Cloud Infrastructure Management	PCC	3/0/0	3	3	60/40
2	23CS2203	Machine Learning Techniques	PCC	3/0/0	3	3	60/40
3		Professional Elective II	PEC	3/0/0	3	3	60/40
Theory Cum Practical Courses							
4	23CS2202	Data Mining and Analytics	PCC	3/0/2	5	4	50/50
5		Professional Elective I	PEC	3/0/2	5	4	50/50
Laboratory Course							
6	23CS2211	Machine Learning Techniques Laboratory	PCC	0/0/4	4	2	40/60
Audit Course							
7		Audit Course – II	AC	2/0/0	2	0	0/100
TOTAL					**25**	**19**	

Semester III							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1		Professional Elective IV	PEC	3/0/0	3	3	60/40
2		Professional Elective V	PEC	3/0/0	3	3	60/40
3		Open Elective	OEC	3/0/0	3	3	60/40
Theory Cum Practical Courses							
4		Professional Elective III	PEC	3/0/2	5	4	50/50
Laboratory Course							
5	23CS2311	Industry Orientation and Technical Seminar	EEC	0/0/4	4	2	40/60
6	23CS2312	Project Work Phase- I	EEC	0/0/12	12	6	40/60
TOTAL					**30**	**21**	

Semester IV							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int. Weightage**
Laboratory Courses							
1	23CS2411	Project Work Phase- II	EEC	0/0/24	24	12	40/60
TOTAL					**24**	**12**	

TOTAL NO. OF CREDITS: 73

AUDIT COURSE – I

Registration for any of these courses is optional to students

S. No	COURSE CODE	COURSE TITLE	Category	L/T/P	Contact Hours	Credit	Ext / Int Weightage
Theory Courses							
1	23AC2101	English for Research Paper Writing	AC	2/0/0	2	0	0/100
2	23AC2102	Disaster Management	AC	2/0/0	2	0	0/100
3	23AC2103	Sanskrit for Technical Knowledge	AC	2/0/0	2	0	0/100
4	23AC2104	Constitution of India	AC	2/0/0	2	0	0/100

AUDIT COURSE – II

Registration for any of these courses is optional to students

S. No	COURSE CODE	COURSE TITLE	Category	L/T/P	Contact Hours	Credit	Ext / Int Weightage
Theory Courses							
1	23AC2201	Value Education	AC	2/0/0	2	0	0/100
2	23AC2202	Stress Management by Yoga	AC	2/0/0	2	0	0/100
3	23AC2203	Pedagogy Studies	AC	2/0/0	2	0	0/100
4	23AC2204	Personality Development Through Life Enlightenment Skills	AC	2/0/0	2	0	0/100

OPEN ELECTIVE COURSE

S. No	COURSE CODE	COURSE TITLE	Category	L/T/P	Contact Hours	Credit	Ext / Int Weightage
Theory Courses							
1	23OE2001	Business Data Analytics	OEC	3/0/0	3	3	60/40
2	23OE2002	Industrial Safety	OEC	3/0/0	3	3	60/40
3	23OE2003	Operations Research	OEC	3/0/0	3	3	60/40
4	23OE2004	Cost Management of Engineering Projects	OEC	3/0/0	3	3	60/40
5	23OE2005	Composite Materials	OEC	3/0/0	3	3	60/40
6	23OE2006	Waste to Energy	OEC	3/0/0	3	3	60/40

LIST OF ELECTIVES

PROFESSIONAL ELECTIVES (PE) - Professional Elective – I & III

S. No	COURSE CODE	COURSE TITLE	Category	L/T/P	Contact Hours	Credit	Ext / Int Weightage
Theory Cum Practical Courses							
1	23CS2901	Information Security	PEC	3/0/2	5	4	50/50
2	23CS2902	Deep Learning	PEC	3/0/2	5	4	50/50
3	23CS2903	Advanced Software Engineering	PEC	3/0/2	5	4	50/50
4	23CS2904	Adhoc And Wireless Sensor Networks	PEC	3/0/2	5	4	50/50
5	23CS2905	Computer Vision	PEC	3/0/2	5	4	50/50
6	23CS2906	Bio-Metric Systems	PEC	3/0/2	5	4	50/50
7	23CS2907	Data Engineering & Visualization	PEC	3/0/2	5	4	50/50
8	23CS2908	Agile Practices	PEC	3/0/2	5	4	50/50
9	23CS2909	Network Performance Analysis	PEC	3/0/2	5	4	50/50
10	23CS2910	Bio Informatics	PEC	3/0/2	5	4	50/50

PROFESSIONAL ELECTIVES (PE) - Professional Elective – II,IV & V

S. No	COURSE CODE	COURSE TITLE	Category	L/T/P	Contact Hours	Credit	Ext / Int Weightage
Theory Courses							
1	23CS2911	Block chain Technologies And Applications	PEC	3/0/0	3	3	60/40
2	23CS2912	Industry 4.0	PEC	3/0/0	3	3	60/40
3	23CS2913	Software Testing and Quality Assurance	PEC	3/0/0	3	3	60/40
4	23CS2914	Next Generation Networks	PEC	3/0/0	3	3	60/40
5	23CS2915	Computational Intelligence	PEC	3/0/0	3	3	60/40
6	23CS2916	Cyber Physical Systems	PEC	3/0/0	3	3	60/40
7	23CS2917	Information Storage Management	PEC	3/0/0	3	3	60/40
8	23CS2918	Software Reliability Metrics And Models	PEC	3/0/0	3	3	60/40
9	23CS2919	Mobile Application Development	PEC	3/0/0	3	3	60/40
10	23CS2920	Natural Language Processing	PEC	3/0/0	3	3	60/40
11	23CS2921	Digital Forensics	PEC	3/0/0	3	3	60/40
12	23CS2922	Open-Source Programming	PEC	3/0/0	3	3	60/40
13	23CS2923	Social Network Analysis	PEC	3/0/0	3	3	60/40
14	23CS2924	Quantum Computing	PEC	3/0/0	3	3	60/40
15	23CS2925	E Learning Technologies	PEC	3/0/0	3	3	60/40

CREDIT DISTRIBUTION

S.No	Subject Area	Credits Per Semester				Credits Total	%
	Semester	I	II	III	IV		
1.	Professional Core (PCC)	15	12	-	-	27	37
2.	Research Methodology And IPR Course (RMC)	2	-	-	-	2	3
3.	Professional Electives (PEC)	-	7	10	-	17	23
4.	Open Electives (OE)	-	-	3	-	3	4
5.	Foundation Courses (FC)	4	-	-	-	4	6
6.	Employability Enhancement Course (EEC)	-	-	8	12	20	27
7.	Audit Courses (AC)	0	0	-	-	0	0
	TOTAL	**21**	**19**	**21**	**12**	**73**	**100**

SEMESTER I

23MA2101	ADVANCED MATHEMATICS FOR SCIENTIFIC COMPUTING	L	T	P	C
		4	0	0	4

COURSE OBJECTIVE

- To apply mathematical linear programming techniques to solve constrained problems.
- To appreciate the use of simulation techniques
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions with large samples
- To test the statistical hypothesis based on a set of data using small samples, variance of two samples and independence of attributes.
- To analyze the design of experiments through one factor, two factors and three factors.
- To impart knowledge of handling random vectors which represent random variables in multi- dimensional space.

UNIT - I LINEAR PROGRAMMING PROBLEM 12

Formulation – Graphical solution – Simplex method – Two phase method – Duality in Linear programming –Transportation problems (Optimal solution by MODI method), Travelling Salesman Problem and Assignment models.

UNIT - II SIMULATION MODELING 12

Introduction to Simulation - Types of Simulation -Discrete Event Simulation – Monte-Carlo Simulation – Generation of Random numbers - Stochastic Simulation – Applications to real time problems.

UNIT - III TESTING OF HYPOTHESIS 12

Sampling distributions – Estimation of parameters – Statistical hypothesis -Type I and Type II errors – Tests based on large samples(Normal distribution) for mean, difference of means and proportions- Tests based on small samples (t-distribution) for mean and proportions, F-distribution for variances and Chi-square tests for independence of attributes and goodness of fit.

UNIT -IV DESIGN OF EXPERIMENTS 12

Design of experiments - Classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 Factorial design.

UNIT -V MULTIVARIATE ANALYSIS 12

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.

TOTAL: 60 PERIODS

COURSE OUTCOME

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

CO1 Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.

CO2 Simulate appropriate application/distribution problems.

CO3 Apply statistical hypothesis claim based on a set of data points using large samples.

CO4 Apply statistical hypothesis using small samples, variance of two samples and independence of attributes.

CO5 Analyze the design of experiments through one way, two way and three way classifications.

CO6 Get exposure to the principal component analysis of random vectors and matrices

REFERENCE BOOKS

1. Jay L. Devore, ―Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, 9th Edition, Boston, 2016.
2. Johnson, R.A, Irwin Miller and John Freund., ―Miller and Freund‘s Probability and Statistics for Engineers‖, Pearson Education, 9th Edition, New York, 2016.
3. Johnson, R.A., and Wichern, D.W., ―Applied Multivariate Statistical Analysis‖, Pearson Education, Sixth Edition, New Delhi, 2013.
4. Ross. S.M., ―Probability Models for Computer Science‖, Academic Press, SanDiego, 2002.
5. Taha H.A.,, ―Operations Research: An Introduction‖, Prentice Hall of India Pvt. Ltd. 10th Edition, New Delhi, 2017. 6. Winston, W.L., ―Operations Research‖, Thomson – Brooks/Cole, Fourth Edition, Belmont, 2003.
6. K.Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley,2001.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	3			1
CO2	2		2	2		3
CO3			1		3	2
CO4	2	1	3	2	2	2
CO5	2	2	1		1	2
CO6	1	1	1		1	2

23CS2101	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To enhance the students 'understanding of algorithms and data structures.
- To augment their proficiency in algorithmic analysis and algorithm design procedures.
- To comprehend various types of tree and heap structures.
- To learn various types of geometric, randomized and approximation algorithms.
- To infer and apply those algorithms and techniques to solve problems

UNIT - I ALGORITHM COMPLEXITY & ANALYSIS 9

Performance Analysis – Time Complexity & Space Complexity - Properties of Big-Oh, Omega and Theta Notation –Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Probabilistic Analysis – Competitive Analysis – Introduction to NP – Completeness/NP-Hard – Recurrence Equations – Solving Recurrence Equations – Time-Space Trade off.

UNIT - II TREE STRUCTURES 9

Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees and B+ Trees – Splay Trees – Tries – Case Study : Binary Search Tree usage in computer Graphics

UNIT - III HEAP STRUCTURES 9

Min/Max heaps – Heaps – Binary Heaps -Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy Binomial Heaps– K Array Heaps- Case Study : Heap application in graph algorithms (A* Algorithm)

UNIT -IV GEOMETRIC ALGORITHMS 9

Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Computing the Overlay of Two Subdivisions – Range Trees – Voronoi Diagram- Pattern Printing – Convex Hull using Divide and Conquer – Case Study : Angular Sweep using geometric algorithmic approach

UNIT -V APPROXIMATION, RANDOMIZED AND ONLINE ALGORITHMS 9

Approximation Algorithms: knapsack problem - Euclidean Travelling Salesperson Problem – Randomized Algorithms: Randomized Quick Sort - Closest Pair Problem & Minimum Spanning Trees – Online Algorithm: Euclidean Spanning Tree – Paging algorithm. **–** Online Sorting Algorithm, Case Study : Random Acyclic Maze Generator with given Entry and Exit point

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Examine algorithms.

CO2 Define algorithm correctness

CO3 Choose appropriate data structures for the problems to be solved

CO4 Design algorithms for problems from different domains

CO5 Identify various research approaches on algorithmic design.

CO6 Recognize the new problems that are amenable to the knowledge and Skills of Algorithms and Data Structures in various application domains.

REFERENCE BOOKS

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C‖, Second Edition, University Press, 2008.

2. Gilles Brassard, Paul Bratley, ―Algorithmics: Theory and Practice‖, Prentice Hall, 1988.

3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, ―Computational Geometry Algorithms and Applications‖, Third Edition, Springer, 2008.

4. R.C.T Lee, S.S Tseng, R.C Chang and Y.T Tsai, ―Introduction to the Design and Analysis of Algorithms‖, Tata McGraw-Hill Edition, 2012.

5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, ―Introduction to Algorithms‖, MIT Press, 2009.

ONLINE COURSES / RESOURCES

1. https://www.udemy.com/course/advanced-algorithms-python
2. https://onlinecourses.nptel.ac.in/noc21_cs21/preview
3. https://www.udacity.com/course/data-structures-and-algorithms
4. https://visualgo.net/en
5. http://cse01-iiith.vlabs.ac.in/
6. https://www.geeksforgeeks.org/

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**2**	**2**	**3**	**1**	**3**
CO2	**3**	**1**			**2**	**3**
CO3	**3**		**1**	**1**		**2**
CO4	**3**	**2**	**1**			**1**
CO5	**3**	**3**	**1**	**1**	**1**	**1**
CO6	**2**	**2**	**1**	**2**	**2**	**2**

23CS2102	DATABASE PRACTICES	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES To impart Knowledge on the following topics

- 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
- Understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT - I RELATIONAL DATA MODEL 12

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language-Database Normalization - Case studies in ER Model.

UNIT - II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASES CONNECTIVITY 12

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. Case studies on Distributed Database.

UNIT - III XML DATABASES 12

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 - XML Schema case study.

UNIT -IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS 12

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. Case studies on NO SQL.

UNIT -V DATABASE SECURITY 12

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 - Case study of Database security in Campus ERP System.

TOTAL: 60 PERIODS

COURSE OUTCOME

On successful completion of the course student will be able 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 Understand the different types of NoSQL databases

CO5 Design and implement secure database systems.

CO6 Use the data control, definition, and manipulation languages of the NoSQL databases

REFERENCE BOOKS

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, —Database System Concepts‖, Sixth Edition, McGraw Hill, 2011.
2. Thomas Cannolly and Carolyn Begg, —Database Systems, A Practical Approach to Design, Implementation and Management‖, Third Edition, Pearson Education, 2007.
3. R. Elmasri, S.B. Navathe, —Fundamentals of Database Systems‖, Addison-Wesley, 2011.
4. Han, Jiawei, Jian Pei, and MichelineKamber. Data mining: Concepts and Techniques. 2011.
5. Fundamentals of Database Management System, Learn Essential Concepts of Database Systems, Mukesh Negi ,2019
6. A Deep Dive Into NoSQL Databases: The Use Cases and Applications, Ganesh Chandra Deka, 2018

ONLINE COURSES / RESOURCES

1. https://www.db-book.com
2. https://www.pearsoned.co.in/prc/book/thomas-m-connolly-database-systems-practical- approach-design-implementation-management-4e--4/9788131720257
3. https://www.wiley.com/en-us/Professional+NoSQL-p-9780470942246
4. https://www.udemy.com/course/advanced-mysql-database-administration-dba/
5. https://www.udemy.com/course/learn-mongodb-leading-nosql-database-from-scratch/.
6. https://www.udemy.com/course/creating-and-querying-databases-with-nosql-and-sql/ 4
7. https://nptel.ac.in/courses/106/106/106106095/

CO	PO1	PO2	PO3	PO4	PO5	PO6
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	3	3	1	1		1
CO6	3	2	2	2	1	1

23CS2103	NETWORKING TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- 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

UNIT - I NETWORKING CONCEPTS 9

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

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

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 Radiospectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.

UNIT -IV SOFTWARE DEFINED NETWORKS 9

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

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

TOTAL: 45 PERIODS

COURSE OUTCOME

On successful completion of the course student will be able 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

CO6 Apply the virtualization techniques to solve network related issues.

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

ONLINE COURSES / RESOURCES

8. https://www.slideshare.net/IndrajaMeghavathula/networking-technologies-basics-complete-notes
9. https://nancydeborah.wordpress.com/cp4153-network-technologies/

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**2**		**1**	
CO2	**1**	**3**	**3**	**3**		**1**
CO3	**1**	**3**	**3**			**1**
CO4	**1**	**2**	**2**	**1**		**1**
CO5	**1**	**3**	**1**	**1**	**1**	**1**
CO6	**1**	**3**	**2**	**2**		**1**

23RM2101	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To impart knowledge on the following topics:

- knowledge and skills required for research and IPR
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT - I RESEARCH PROBLEM FORMULATION 9

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT - II LITERATURE REVIEW 9

Effective literature studies approaches, analysis, Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis-plagiarism, and research ethics

UNIT - III TECHNICAL WRITING 9

Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes-Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

UNIT -IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 9

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT -V INTELLECTUAL PROPERTY RIGHTS (IPR) 9

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 Formulate research problem

CO2 Carry out research analysis

CO3 Follow research ethics

CO4 Understand that the future belongs to those who evolve by ideas, concept, and creativity along with technology

CO5 Write reports by their own

CO6 Understand about IPR and filing patents in R & D.

REFERENCE BOOKS

1. Asimov, —Introduction to Design‖, Prentice Hall, 1962.
2. Ranjit Kumar, 2nd Edition, —Research Methodology: A Step by Step Guide for beginners‖ 2010
3. Mayall, —Industrial Design‖, McGraw Hill, 1992
4. Niebel, —Product Design‖, McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, —Research Methodology: A Step by Step Guide for beginners‖ 2010
6. Research Methodology A Practical and Scientific Approach, Vinayak Bairagi, Mousami V. Munot 2019.
7. Research Methodology and Scientific Writing By C. George Thomas · 2021

ONLINE COURSES / RESOURCES

1. https://www.wipo.int/patents/en/
2. https://ipindia.gov.in/patents.htm

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**2**	**2**	**3**	**2**	**3**
CO2	**3**				**1**	**3**
CO3	**3**			**1**	**1**	**2**
CO4	**3**					**1**
CO5	**3**					**1**
CO6	**3**	**2**	**2**	**1**		**1**

23CS2111	DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To acquire the knowledge of using data structures and algorithmic complexity analysis.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS

Implement the following programs using C/ Python/Java:

1. Iterative and recursive algorithms and its complexity analysis.
2. Binary search tree ,Red-Black tree and AVL Tree
3. Basic Heap operation
4. Algorithm for converting a min heap to a max heap
5. Rearrange characters in a String such that no two adjacent characters are same using Binary Max Heap
6. Pattern printing in Geometric Algorithm approach
7. Line segment Intersection using Geometric Algorithm Approach
8. Reflection of a point about a line using Geometric Algorithm Appraoch
9. Merge sort algorithm analysis using divide and conquer approach.
10. Quick sort algorithm using randomized algorithmic approach.
11. Generate CAPTCHA and verify user using randomized algorithmic approach
12. Strong Password Suggester using randomized algorithmic approach
13. A spanning tree for a given graph using Prim‘s algorithm.
14. Shortest path of a given graph using Dijkstra‘s algorithm and Bellman Ford algorithm.
15. Sorting using online algorithm approach
16. Mini Project

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 Achieve programming skill to convert a problem to a programming logic.

CO2 Apply suitable data structure for the problem in hand.

CO3 Apply divide and conquer technique and Dynamic Programming

CO4 Apply geometric, Randomized and Online Algorithmic approach

CO5 Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

CO6 Apply suitable design strategy for problem solving

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.

ONLINE COURSES / RESOURCES

1. http://www.coursera.org/specializations/data-structures-algorithms
2. http://www.tutorialspoint.com/data_structures_algorithms
3. http://www.geeksforgeeks.org/data-structures

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**2**	**2**	**3**	**2**	**3**
CO2	**3**					**3**
CO3	**3**			**1**		**2**
CO4	**3**					**1**
CO5	**3**					**1**
CO6	**3**			**1**		**2**

23CS2112	NETWORKING TECHNOLOGIES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To develop network utilities
- To design and configure LANs
- To study the various network-based tools for network monitoring and analysis

LIST OF EXPERIMENTS

1. Installation of NS2 and NS3 and Execution of Basic TCL Commands and Scripts.
2. Implement LAN topologies (Ring, Mesh, Star) and analyze the performance.
3. Implement Point to Point network using duplex links between the nodes. Analyze the packet transfer by varying the queue size and bandwidth using NS2 simulator.
4. Implement the Wireless network simulator in NS2.
5. Implement IEEE 802.11 using MAC layer, evaluate the performance and observe the scenario.
6. Implement the Handoff mechanism in WiFi using ns2 simulation and analyze the performance.
7. Create a Wireless Mobile adhoc Network Environment and implement the MANET Routing Protocol using NS3 Simulator.
8. Implement the efficient routing protocols for Vehicular Ad-hoc network and analyze the performance.
9. Implementation of Software Defined Network using Mininet and OpenFlow controllers.
10. Installation of NetSimulyzer (3D Virtualization tool) Software in Ubuntu and NS3.

TOTAL: 60 PERIODS

COURSE OUTCOME

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

CO1 Judge the emerging wireless technology standards.

CO2 Configure functionalities of router and switches.

CO3 Assess the importance of wireless adhoc networks.

CO4 Compare and contrast various wireless technologies.

CO5 Explain and design the considerations for deploying wireless network infrastructure.

CO6 Simulate network topologies

REFERENCE BOOK

1. James Bernstein, “Networking made Easy”, 2018.

ONLINE COURSES / RESOURCE

1. https://www.javatpoint.com/java-networking

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	1
CO2	3	2			1	1
CO3	3	1	2	1	1	2
CO4	3					1
CO5	3	2	1	2		1
CO6	3	2	2	2		1

SEMESTER II

23CS2201	CLOUD INFRASTRUCTURE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the concept of cloud and utility computing.
- To familiarize themselves with mechanism in the cloud infrastructure.
- To enable student to identify the security challenges in the cloud Environment.
- To understand the various frameworks and APIs that can be used for developing cloud-based applications.
- To acquire knowledge of AWS Cloud Provider

UNIT - I INTRODUCTION 9

Introduction- Historical Development – Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics –Cloud Deployment Models: Public, Private, Community, Hybrid Clouds- Introduction to Poly Cloud-Cloud Delivery Models: IaaS, PaaS, SaaS

Case Studies 1) Choose a company that implemented a hybrid cloud solution and explain the reasons behind their decision using Hybrid Cloud Implementation.ii)Explore how customers are reducing cost and becoming more efficient with assistance from Poly.

UNIT - II CLOUD COMPUTING MECHANISM 9

Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, Billing Management System.

Case Studies :Cloud Usage Monitor: AWS CloudWatch monitors various cloud resources, such as compute instances, storage, and databases, to provide insights into their utilization and performance.

UNIT - III CLOUD SECURITY 9

Basic Terms and Concepts – Threat Agents – Cloud Security Threats –Cloud Security Mechanism:Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups, Hardened Virtual Server Images.

Case Studies :Suggest additional security measures and protocols Dropbox could have implemented to enhance cloud security.

UNIT -IV **CLOUD SIMULATORS** **9**

CloudSim and GreenCloud - Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud.

UNIT -V **AWS CLOUD FUNDAMENTALS** **9**

Introduction to Amazon Web Services,Compute in the Cloud,Global Infrastructure and Reliability, Networking,Storage and Databases,Security,Monitoring and Analytics, Pricing and Support, Migration, and Innovation.

Case Studies :Explain the AWS services used by Capital One for secure and compliant data storage, real-time analytics, and customer-facing applications.

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Describe the methods for managing the data in cloud and secure the data in the cloud platform.

CO2 Demonstrate the ability to access the various cloud platforms used.

CO3 Describe the standardization process of cloud platform and various API‘s

CO4 Design, Develop & Deploy real-world applications in the cloud computing platforms they have learnt.

CO5 Apply the concepts of Windows Azure to design Cloud Application

CO6 Develop services using various Cloud computing programming models.

REFERENCE BOOKS

1. Thomas Erl, Zaigham Mahood, Ricardo Puttini, —Cloud Computing, Concept, Technology & Architecture‖, Prentice Hall, 2013.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, —Mastering Cloud Computing‖, Tata McGraw-Hill,2013.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, —Cloud Computing, A Practical Approach‖,Tata McGraw-Hill Edition, 2010.
4. George Reese, —Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (Theory in Practice)‖, O‘Reilly, 2009.
5. ArshdeepBahga,Vijay Madisetti,—Cloud Computing: A Hands-OnApproach‖, Universities Press(India) Private Limited, 2014.
6. James E Smith and Ravi Nair, —Virtual Machines‖, Elsevier, 2005.
7. John Rittinghouse& James Ransome, —Cloud Computing, Implementation, Management and Strategy‖, CRC Press, 2010.
8. Barrie Sosinsky, — Cloud Computing Bible‖ John Wiley & Sons, 2010

ONLINE COURSES / RESOURCES

1. https://cloud.google.com/appengine/docs
2. https://www.chef.io/solutions/cloud-management/
3. http://www.cloudbus.org/cloudsim
4. https://code.google.com/p/cloudsim
5. https://aws.amazon.com/documentation

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1				2	2	1
CO2	2	3	1	2		1
CO3	3		3		1	3
CO4				2	2	3
CO5	3	3	2	2	2	3
CO6	3		2		2	3

23CS2202	DATA MINING AND ANALYTICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- 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

UNIT - I DATA MINING AND LARGE-SCALE FILES 9 + 6

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 + 6

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 + 6

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 + 6

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 + 6

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.

LIST OF EXPERIMENTS

1. Creation of a Data Warehouse.
2. Apriori Algorithm.
3. FP-Growth Algorithm.
4. K-means clustering.
5. One Hierarchical clustering algorithm.
6. Bayesian Classification.
7. Decision Tree.
8. Support Vector Machines.
9. Applications of classification for web mining.
10. Case Study on Text Mining or any commercial application.

TOTAL: 45+30=75 PERIODS

COURSE OUTCOMES

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

CO1 Design algorithms by employing Map Reduce technique for solving real time 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.

CO6 Apply clustering algorithms and analyze large dataset

REFERENCE BOOKS

1. Introduction to Data Mining and Analytics with Machine Learning in R and Python By Kris Jamsa · 2020,Jones & Bartlett Learning, LLC
2. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 3rd Edition, 2020.
3. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2012.
4. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
5. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001

ONLINE COURSES / RESOURCES

1. https://swayam.gov.in/nd2_arp19_ap60/preview 2.
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf
3. https://examupdates.in/big-data-analytics/
4. https://www.tutorialspoint.com/big_data_analytics/index.htm
5. 3. https://www.tutorialspoint.com/data_mining/index.htm

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1				2	1	3
CO2				2	1	2
CO3				2		3
CO4	1		2	2		3
CO5	2		2	2		3
CO6	2		2	2		3

23CS2203	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To grasp the fundamental concepts of Machine Learning.
- To understand supervised learning and their applications.
- To appreciate the concepts and algorithms of unsupervised learning
- To study applications of machine learning in real world domains
- To aware about how to use machine learning techniques for various issues in the real world
- To Develop CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition

UNIT - I INTRODUCTION 9

Machine learning -Examples of Machine Learning applications-Learning Associations-Classification-Regression-Unsupervised Learning-Reinforcement Learning-Supervised learning: Learning a class from Examples-Regression-Model Selection and Generalization
Case Study: Familiarity with R tool and Python programming language and libraries

UNIT - II CONCEPT LEARNING AND DECISION-TREE LEARNING 9

Concept Learning - Concept learning Task - Concept Learning as search -Finding a maximally specific hypothesis – Version Spaces and Candidate elimination Algorithm - Inductive Bias Decision Tree Learning - Decision Tree representation -Problems for Decision Tree Learning -Hypothesis Search space – Inductive Bias in Decision Tree Learning - Issues in Decision Tree Learning
Case Study: Implementation of decision tree algorithm for problems in Retail Domain.

UNIT - III MULTILAYER PERCEPTRONS 9

The Perceptron-Training a Perceptron-Learning Boolean Functions-Multilayer Perceptrons-MLP as Universal Approximator Back propagation Algorithm
Case Study: Implementation of Back propagation algorithm for problems in financial domain.

UNIT -IV REINFORCEMENT LEARNING 9

Introduction - learning task - Q learning - The Q function - Algorithm for Q learning - convergence - experimentation strategies -updating sequence -Non deterministic rewards and actions -Temporal difference learning -Generalizing from examples -relationship to dynamic programming
Case Study: Implementation of Q learning algorithm/reinforcement learning for problems in automotive domain/games

UNIT -V DEEP LEARNING TECHNIQUES 9

Fundamentals about Deep Learning., How deep learning techniques different from Machine Learning techniques. RCNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO
Case Study: Implementation of CNN for detection and recognition

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Acquire Knowledge in various learning techniques like decision tree, Analytical, Inductive and Reinforced learning.

CO2 Identify and apply the appropriate machine learning techniques for classification, Pattern recognition, optimization, and decision problems.

CO3 Development of techniques in information science applications by applying Computational intelligence and appropriate machine learning techniques.

CO4 Design a learning model appropriate to the application

CO5 Identify applications suitable for different types of Machine Learning with suitable justification

CO6 Understand CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition.

REFERENCE BOOKS

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017.
   Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, September 2014, ISBN 978-0-262-02818-9.(Units1,3(Multilayer Perceptrons) & 4)
2. Mitchell, Tom, "Machine Learning", New York, McGraw-Hill, First Edition, 2003.(Units 2,5)
3. Ian GoodFellow,Yoshua Bengio,Aaron Courville ,"Deep Learning",MIT Press Book (Unit 3 - Convolutional Networks),Nov. 2016
4. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC 2009.
5. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press (MA) 2012.

ONLINE COURSES / RESOURCE

1. https://www.udemy.com/topic/machine-learning/

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**2**	**1**	**3**	**1**	**1**
CO2			**1**	**2**	**1**	**2**
CO3	**1**	**1**	**2**	**1**		
CO4	**2**	**2**				**2**
CO5	**1**		**1**	**1**		
CO6	**1**	**1**	**1**	**1**	**1**	**1**

23CS2211	MACHINE LEARNING TECHNIQUESLABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE

- To apply the concepts of Machine Learning to solve real-world problems
- To implement algorithms emphasizing the use of bagging & boosting in classification & Regression
- To learn fundamental and advanced neural network algorithms for solving real world problems
- To implement algorithms related to dimensionality reduction

LIST OF EXPERIMENTS

1. Study and usage of python and R tool.
2. Implement a decision tree algorithm for sales prediction/classification in retail sector
3. Root Node Attribute Selection for Decision Trees using Information Gain
4. Develop a predictive model for predicting house prices
5. Pattern Recognition Application using Bayesian Inference
6. Bagging, boosting applications using Regression Trees
7. Implement back propagation algorithm for stock prices prediction
8. Using R tool for SVM classification for chosen domain application
9. Develop a traffic signal control system using reinforcement learning techniques
10. Dimensionality Reduction Algorithms in Image Processing applications

NOTE : Datasets for the above exercises available in Kaggle and UCI repository mentioned below NOTE :
i. https://www.kaggle.com
ii. http://archive.ics.uci.edu/ml/datasets.html

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 To learn to use R tool and python for implementing machine learning algorithms related to numeric data

CO2 Apply various classification techniques for problems using tools like R and Python.

CO3 Implement solutions for various prediction problems using tools.

CO4 To use fundamental and advanced neural network algorithms for solving real-world problems.

CO5 To use dimensionality reduction algorithms for image processing applications.

CO6 Design and development of game and traffic control systems using reinforcement learning.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		1	1		2
CO2	2	2	2	2		
CO3	2	1	1	2		
CO4	1	1		1		
CO5	1	1	2		1	2
CO6			3	1	1	2

23CS2311	INDUSTRY ORIENTATION AND TECHNICAL SEMINAR	L	T	P	C
		0	0	4	2

In this course, students will approach the industry and undergo training for a period of minimum four weeks and present a report. They will also develop their scientific and technical reading and writing skills that they need to understand and construct research articles individually. A research 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 analyzing 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
10. Publish their work in standard journals / conferences.

Based on the above, students will explore and perform critical analysis from various resources in the research domains and publish their work in standard journals / conferences.

INTERNAL ASSESSMENT ONLY **TOTAL: 30 PERIODS**

AUDIT COURSES

23AC2101	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVE

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT - I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT - II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT - III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT -IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT -V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission.

TOTAL: 30 PERIODS

COUSRE OUTCOME

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

CO1 Understand that how to improve your writing skills and level of readability.

CO2 Learn about what to write in each section.

CO3 Understand the skills needed when writing a Title.

CO4 Understand the skills needed when writing the Conclusion.

CO5 Ensure the good quality of paper at very first-time submission.

REFERENCE BOOKS

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006.
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006.
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman‘s book1998

23AC2102	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	2

COURSE OBJECTIVE

- To summarize basics of disaster
- To explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To develop the strengths and weaknesses of disaster management approaches.

UNIT - I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude

UNIT - II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT - III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT -IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT -V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People‘s Participation in Risk Assessment. Strategies for Survival

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Ability to summarize basics of disaster.

CO2 Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3 Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4 Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations

CO5 Ability to develop the strengths and weaknesses of disaster management approaches.

REFERENCE BOOKS

1. Goel S. L., Disaster Administration And Management Text And Case Studies‖, Deep& Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, —Disaster Management in India: Perspectives, issues and strategies 'New Royal book Company, 2007.
3. Sahni, Pardeep Et.Al. ,‖ Disaster Mitigation Experiences and Reflections‖, Prentice Hall Of India, New Delhi, 2001.

23AC2103	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
		2	0	0	0

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT - I **ALPHABETS** **6**

Alphabets in Sanskrit

UNIT - II **TENSES AND SENTENCES** **6**

Past/Present/Future Tense - Simple Sentences

UNIT - III **ORDER AND ROOTS** **6**

Order - Introduction of roots

UNIT -IV **SANSKRIT LITERATURE** **6**

Technical information about Sanskrit Literature

UNIT -V **TECHNICAL CONCEPTS OF ENGINEERING** **6**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.

TOTAL: 30 PERIODS

COURSE OUTCOME

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

CO1 Understanding basic Sanskrit language.

CO2 Write sentences.

CO3 Know the order and roots of Sanskrit.

CO4 Know about technical information about Sanskrit literature.

CO5 Understand the technical concepts of Engineering

REFERENCE BOOKS

1. Abhyaspustakam‖ – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. Teach Yourself Sanskrit‖ Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. India‘s Glorious Scientific Tradition‖ Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

23AC2104	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals 'constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT - I HISTORY OF MAKING OF THE INDIAN CONSTITUTION AND PHILOSOPHY OF THE INDIAN CONSTITUTION 6

History, Drafting Committee, (Composition & Working) -Preamble, Salient Features.

UNIT - II CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES 6

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT - III ORGANS OF GOVERNANCE 6

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT -IV LOCAL ADMINISTRATION 6

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT -V ELECTION COMMISSION 6

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOME

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

CO1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2 Discuss the intellectual origins of the framework of argument that informed the conceptualization

CO3 Learning of social reforms leading to revolution in India

CO4 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO5 Discuss the passage of the Hindu Code Bill of 1956.

REFERENCE BOOKS

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

23AC2201	VALUE EDUCATION	L	T	P	C
		2	0	0	0

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Understand value of education and self-development
- Imbibe good values in students
- Let they should know about the importance of character

UNIT - I SELF-DEVELOPMENT 6

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgments.

UNIT - II IMPORTANCE OF HUMAN VALUES 6

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT - III OVERALL PERSONALITY IMPROVEMENT 9

Personality and Behaviour Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship.

UNIT -IV BEHAVIOR DEVELOPMENT 6

Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature- Character and Competence–Holy books vs Blind faith.

UNIT -V DEVELOPING GOOD HEALTH 6

Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

COURSE OUTCOME

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

CO1 Knowledge of self-development.

CO2 Learn the importance of Human values.

CO3 Developing the overall personality.

CO4 Developing the Behavior.

CO5 Developing Good health.

REFERENCE BOOK

1. Chakroborty, S.K. —Values and Ethics for organizations Theory and practice‖, Oxford University Press, New Delhi.

23AC2202	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- To achieve overall health of body and mind
- To overcome stress

UNIT I **ASHTANGA** **10**

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II **YAM AND NIYAM** **10**

Yam and Niyam - Do`s and Don't's in life – Ahinsa, satya, astheya, bramhacharya and aparigraha, Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III **ASAN AND PRANAYAM** **10**

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam.

TOTAL : 30 PERIODS

COURSE OUTCOME

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

CO1 Develop healthy mind in a healthy body thus improving social health also.

CO2 Improve Efficiency.

REFERENCE BOOKS

1. Yogic Asanas for Group Tarining-Part-Ill:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. —Rajayoga or conquering the Internal Nature‖ by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

23AC2203	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Review existing evidence on their view topic to inform program design and policy
- Making under taken by the DfID, other agencies and researchers
- Identify critical evidence gaps to guide the development.

UNIT I **INTRODUCTION AND METHODOLOGY** **6**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II **THEMATIC OVERVIEW** **6**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education

UNIT III **EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES** **6**

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV **PROFESSIONAL DEVELOPMENT** **6**

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.

UNIT V **RESEARCH GAPS AND FUTURE DIRECTIONS** **6**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL : 30 PERIODS

COURSE OUTCOME

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

CO1 What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

CO2 What is the evidence on the effectiveness of these pedagogical practices, in

CO3 What conditions, and with what population of learners?

CO4 How can teacher education (curriculum and practicum) and the school

CO5 Curriculum and guidance materials best support effective pedagogy

REFERENCE BOOKS

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. ChavanM (2003) Read India: Amass scale, rapid, ‗learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

23AC2204	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

COURSE OBJECTIVE

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination.
- To awaken wisdom in students

UNIT - I NEETISATAKAM 10

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont‘s) - Verses- 71,73,75,78 (do‘s)

UNIT - II APPROACH TO DAY TO DAY WORK AND DUTIES 10

Approach to day to day work and duties - Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT - III STATEMENTS OF BASIC KNOWLEDGE 10

Statements of basic knowledge - Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimadbhagwadgeeta - Chapter2-Verses 17,Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

COURSE OUTCOME

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

CO1 Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.

CO2 The person who has studied Geeta will lead the nation and mankind to peace and prosperity.

CO3 Study of Neetishatakam will help in developing versatile personality of students

REFERENCE BOOKS

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari‘s Three Satakam, Niti-sringar- vairagya, New Delhi,2010
2. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

OPEN ELECTIVES

23OE2001	BUSINESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modelling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support
– Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modelling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Identify the real-world business problems and model with analytical solutions.

CO2 Solve analytical problem with relevant mathematics background knowledge.

CO3 Convert any real-world decision-making problem to hypothesis and apply suitable statistical testing

CO4 Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce

CO5 Use open source frameworks for modelling and storing data.

CO6 Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCE BOOKS

1. VigneshPrajapati, —Big Data Analytics with R and Hadoop‖, Packt Publishing, 2013.
2. Umesh R Hodeghatta, UmeshaNayak, —Business Analytics Using R – A Practical Approach‖, Apress, 2017.
3. AnandRajaraman, Jeffrey David Ullman, —Mining of Massive Datasets‖, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson,
5. Essentials of Business Analytics‖, Cengage Learning, second Edition, 2016.
6. U. Dinesh Kumar, —Business Analytics: The Science of Data-Driven Decision Making‖, Wiley, 2017.
7. Ohri, —R for Business Analytics‖, Springer, 2012
8. Rui Miguel Forte, —Mastering Predictive Analytics with R‖, Packt Publication, 2015

23OE2002	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun,

iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment‘s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Ability to summarize basics of industrial safety

CO2 Ability to describe fundamentals of maintenance engineering

CO3 Ability to explain wear and corrosion

CO4 Ability to illustrate fault tracing

CO5 Ability to identify preventive and periodic maintenance

REFERENCE BOOKS

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition,2008

23OE2003	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I **LINEAR PROGRAMMING** **9**

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II **ADVANCES IN LINEAR PROGRAMMING** **9**

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III **NETWORK ANALYSIS – I** **9**

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV **NETWORK ANALYSIS – II** **9**

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V **NETWORK ANALYSIS – III** **9**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: To formulate linear programming problem and solve using graphical method

CO2: To solve LPP using simplex method

CO3: To formulate and solve transportation, assignment problems

CO4: To solve project management problems

CO5: To solve scheduling problems

REFERENCE BOOKS

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

23OE2004	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TOCOSTINGCONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TOPROJECTMANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION ANDCOSTINGCONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETARY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Understand the costing concepts and their role in decision making.

CO2: Understand the project management concepts and their various aspects in selection

CO3: Interpret costing concepts with project execution

CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques

CO5: Become familiar with quantitative techniques in cost management

REFERENCE BOOKS

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A.H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting,1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi,2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting,2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co.Ltd,2007

23OE2005	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength- ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Know the characteristics of composite materials and effect of reinforcement in composite materials.

CO2: Know the various reinforcements used in composite materials.

CO3: Understand the manufacturing processes of metal matrix composites.

CO4: Understand the manufacturing processes of polymer matrix composites.

CO5: Analyze the strength of composite materials

REFERENCE BOOKS

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

23OE2006	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIOENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Understand the various types of wastes from which energy can be generated

CO2: Gain knowledge on biomass pyrolysis process and its applications

CO3: Develop knowledge on various types of biomass gasifiers and their operations

CO4: Gain knowledge on biomass combustors and its applications on generating energy

CO5: Understand the principles of bio-energy systems and their features

REFERENCE BOOKS

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd.,1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd.,1990.

ELECTIVE LIST PROFESSIONAL ELECTIVES I & III

23CS2901	INFORMATION SECURITY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To learn the core fundamentals of system security concepts
- To identify the threats to the network of computers.
- To understand the ways of sharing and storing of files in controlled manner.
- To deploy the security essentials in the IT sectors.
- To perform a detailed study of Storage security and related Issues.
- To be exposed to the concept of database security.

UNIT I SYSTEM SECURITY 9+6

Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers

UNIT II NETWORK SECURITY 9+6

Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security- Optical Network Security- Optical wireless Security

UNIT III OPERATING SYSTEM AND FILE SECURITY 9+6

Process Protection. Controlling Files. The File System - Executable Files and Malware - Sharing and Protecting Files - Security Controls for Files - File Security Controls - Patching Security Flaws. Sharing Files. Controlled Sharing - File Permission Flags.

UNIT IV SECURITY MANAGEMENT 9+6

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System

UNIT V STORAGE SECURITY 9+6

Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials. Issues in Database Security - Fundamentals of Access Control - Database Access Control - Using Views for Access Control - Security Logs and Audit Trails - Encryption - SQL Data Control Language - Security in Oracle - Statistical Database Security - SQL Injection -Database Security and the Internet.

PRACTICAL EXERCISES

1. Implement DES Encryption and Decryption
2. Implement the AES Encryption and decryption
3. Implement RSA Encryption Algorithm

4. Create a virtual private network over WAN
5. Implement ICMP PING
6. Implement SUBNETTING
7. Implement RIP routing protocol to create timed link failures and recoveries.
8. Implement OSPF for load balancing
9. Implement XSS and SQL injection attacks
10. Implement Penetration testing, IDSs

Use the OPEN SOURCE SOFTWARE/JAVA to implement the experiments

TOTAL : 45 + 30 = 75 PERIODS

COURSE OUTCOME

CO1: Explain the core fundamentals of system security concepts
CO2: Identify and mitigate the threats to the network of computers.
CO3: Discuss various the ways sharing and storing of files in controlled manner.
CO4: Deploy the security essentials in the IT sectors.
CO5: Solve the Storage security and related Issues.
CO6: To be explain the concept of database security

REFERENCE BOOKS

1. John R.Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017.
2. "Elementary Information Security", Richard E. Smith, PhD, CISSP, Third Edition, Jones and Bartlett Learning, 2019
3. "Security Engineering":A Guide to building dependable Distributed Systems, Third Edition,Ross Anderson, Wiley,2020
4. "Network Security, Firewalls, and VPNs", Third Edition, J. Michael Stewart, Denise Kinsey , Jones & Bartlett Learning, 2020
5. Michael E. Whitman, Herbert J. Mattord, Principal of Information Security,6th edition, Cengage Learning, 2018

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1				**2**	**1**	**1**
CO2	**2**	**3**	**1**			**1**
CO3	**3**		**2**		**1**	**3**
CO4				**2**		**3**
CO5	**2**	**2**	**1**	**2**		
CO6	**2**		**1**	**2**	**2**	**2**

23CS2902	DEEP LEARNING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To understand the basic ideas and principles of Neural Networks
- To understand the basic concepts of Big Data and Statistical Data Analysis
- To familiarize the student with The Image Processing facilities like Tensorflow and Keras
- To appreciate the use of Deep Learning Applications
- To understand and implement Deep Learning Architectures

UNIT - I BASICS OF NEURAL NETWORKS 9+6

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

UNIT - II INTRODUCTION TO DEEP LEARNING 9+6

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT - III CONVOLUTIONAL NEURAL NETWORKS 9+6

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning

UNIT -IV MORE DEEP LEARNING ARCHITECTURES 9+6

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM

UNIT -V APPLICATIONS OF DEEP LEARNING 9+6

Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

PRACTICAL EXERCISES

1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras.

8. Implement a Simple LSTM using TensorFlow/Keras.
9. Implement an Opinion Mining in Recurrent Neural network.
10 Implement an Object Detection using CNN

TOTAL: 45+30 = PERIODS

COURSE OUTCOME

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

CO1 Understand the role of Deep learning in Machine Learning Applications.

CO2 To get familiar with the use of TensorFlow/Keras in Deep Learning Applications.

CO3 To design and implement Deep Learning Applications.

CO4 Critically Analyse Different Deep Learning Models in Image Related Projects.

CO5 To design and implement Convolutional Neural Networks.

CO6 To know about applications of Deep Learning in NLP and Image Processing.

REFERENCE BOOKS

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, —Deep Learning‖, MIT Press, 2017.
2. Francois Chollet, —Deep Learning with Python‖, Manning Publications, 2018.
3. Phil Kim, —Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence‖, Apress , 2017.
4. Ragav Venkatesan, Baoxin Li, —Convolutional Neural Networks in Visual Computing, CRC Press, 2018.
5. Navin Kumar Manaswi, —Deep Learning with Applications Using Python‖, Apress, 2018.
6. Joshua F. Wiley, —R Deep Learning Essentials‖, Packt Publications, 2016.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	3	1	1
CO2		2	1	2	1	2
CO3	1	1	1	2		
CO4	2	2	1	1		2
CO5	1		2			2
CO6	2	2	1	1	1	2

23CS2903	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To understand Software Engineering Lifecycle Models
- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches
- To be familiar with DevOps practices.

UNIT I INTRODUCTION 9 + 6

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management. Introduction to software Reliability.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION 9 + 6

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modeling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modeling – Data Flow Diagram.

UNIT III ARCHITECTURE AND DESIGN 9 + 6

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client- server - Tiered - Pipe and filter.- User interface design

UNIT IV TESTING 9 + 6

Testing – UNIT testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS 9 + 6

DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture - Building and Testing-Deployment- Case study: Migrating to Microservices.

TOTAL : 45 + 30 = 75 PERIODS

PRACTICAL EXERCISES

Tool Required: Argo UML, Tortoises SVN Subversion Client, Eclipse , MySQL

1. Identify the suitable lifecycle models for a suggested system and also suitable estimation technique to estimate the cost of a particular software project
2. Do Project Planning using Gantt Chat for a suggested system
3. Develop Software Requirements Specification(SRS) for a given problem in IEEE template

4. Create Structured design for the developed DFD model, Develop DFD model (level-0, level-1 DFD and Data dictionary) of the suggested system
5. Perform the user_s view analysis for the suggested system: Use case diagram, Activity diagram
6. Develop UML Interaction diagram , State chart for the suggested system
7. To perform various testing using the testing tool UNIT testing, integration testing for a sample code of the suggested system.
8. Identify To carry out the integration testing, which among the following is necessary? (The coding and UNIT testing of all other modules, sub modules and UNITs of suggested system are completed. The top-down integration is in progress for the suggested model software. The bottom-up integration is to be started for the suggested model software. Mention any stub or driver needed to carry out the integration testing?)
9. Version control using Subversion
10. DevOps provides integration with popular open source and third-party tools and services—across the entire DevOps workflow. Use the tools and languages you know. Spend less time integrating and more time delivering higher-quality software, faster – case study DevOps provides integration with popular open source and third-party tools and services—across the entire DevOps workflow. Use the tools and languages you know. Spend less time integrating and more time delivering higher-quality software, faster – case study

COURSE OUTCOME

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

CO1: Understand the advantages of various Software Development Lifecycle Models
CO2: Gain knowledge on project management approaches as well as cost and schedule estimation strategies
CO3: Perform formal analysis on specifications
CO4: Use UML diagrams for analysis and design Architect and design using architectural styles and design patterns
CO5: Understand software testing approaches Understand the advantages of DevOps practices
CO6: Understand the importance of having a good Software Architecture.

REFERENCE BOOKS

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2 nd edition, Pearson Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2 nd edition, PHI Learning Pvt. Ltd., 2010.
3. CraigLarman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, —DevOps: A Software Architect_s Perspective‖, Pearson Education, 2016
5. Rajib Mall, Fundamentals of Software Engineering, 3 rd edition, PHI Learning Pvt. Ltd., 2009.
6. StephenSchach, Software Engineering 7th ed, McGraw-Hill, 2007.

John D. Musa, Anthony Iannino and KazuhiraOkumoto, —Software Reliability, Measurement, Prediction, Application, Series in Software Engineering and Technology‖, McGraw Hill, 1987.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	1	
CO2				3	2	
CO3		1	2	2	1	2
CO4	2		1			
CO5	1	2	3			2
CO6	2	2	2	2		2

23CS2904	ADHOC AND WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To learn about the issues in the design of wireless ad hoc networks.
- To understand the working of protocols in different layers of mobile ad hoc and sensor networks.
- To expose the students to different aspects in sensor networks.
- To understand various traffic generators and models for sensor networks.
- To understand various security issues in ad hoc and sensor networks and solutions to the issues.

UNIT I FUNDAMENTALS AND ROUTING PROTOCOLS OF WIRELESS ADHOC NETWORKS 9 + 6

Introduction – Applications of Mobile Ad Hoc Networks (MANETs) – Medium Access Control Layer – Topology Control – Routing Protocols – Broadcasting – Multicasting – Internet Connectivity for MANETs – Security in MANETs - Scenario Based Performance Analysis of Various Routing Protocols in MANETs

UNIT II MOBILITY MODELS AND OVERHEAD CONTROL MECHANISMS IN MANETS 9 + 6

Description of Various Mobility Models – Simulation and Analysis of Various Mobility Models – Overhead Analysis in Hierarchical Routing Scheme – Overhead Minimization Techniques – Energy Models.

UNIT III WIRELESS SENSOR NETWORKS (WSN) 9 + 6

Applications of WSNs – Hardware and Software Issues in WSN – Design Issues of MAC Protocols – Deployment – Localization – Synchronization – Calibration – Network Layer Issues – Classification of Routing Protocols – Transport Layer Issues – Data Aggregation and Dissemination – Database Centric and Querying

UNIT IV SENSOR NETWORK SECURITY 9 + 6

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9 + 6

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

TOTAL : 45 + 30 = 75 PERIODS

PRACTICAL EXERCISES

1. Simple design of network using NS2 simulator
2. Nodes creation with MAC layer using NS2
3. Simulating a WSN using Network Simulator 2
4. Study on Mannasim Simulator
5. Error detection using LEACH Protocol
6. DoS Detection using Omnet+ simulator
7. Performance Evaluation of WSN using LEACH protocol

COURSE OUTCOME

At the end of the course, the student should be able to:

CO1: Identifying suitable routing protocols for various scenarios of ad hoc networks.
CO2: To explore various mobility models for MANETs.
CO3: Identify different issues in wireless sensor networks.
CO4: Analyze the performance of IEEE 802.15.4.
CO5: Identify and critique security issues in ad hoc and sensor networks.
CO6: Compare different wireless networking protocols

REFERENCE BOOKS

1. Subir Kumar Sarkar, —Wireless Sensor and Ad Hoc Networks Under Diversified Network
2. Scenarios‖, Auerbach Publications, 2012.
3. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Pearson Education, 2008.
4. Labiod. H, —Wireless Adhoc and Sensor Networks‖, Wiley, 2008.
5. Li, X, —Wireless ad -hoc and sensor Networks: theory and applications‖, Cambridge University Press, 2008.
6. Holger Karl , Andreas willig, —Protocol and Architecture for Wireless Sensor Networks‖, John wiley publication, Jan 2006.
7. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, —Ad Hoc and Sensor Networks: Theory and Applications‖, World Scientific Publishing, Second Edition, 2011.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1			**2**	**2**	**1**	**2**
CO2	**1**	**2**	**3**			
CO3	**2**			**2**	**2**	**3**
CO4	**3**	**2**		**2**		**2**
CO5	**2**	**1**		**2**	**1**	**2**
CO6	**2**	**2**	**3**	**2**	**1**	**3**

23CS2905	COMPUTER VISION	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To review image processing techniques for computer vision
- To understand shape and region analysis
- To understand Hough Transform and its applications to detect lines, circles, ellipses
- To understand the models for stereo vision
- To study some applications of computer vision algorithms.

UNIT I LOW-LEVEL VISION 9+6

Images and Imaging Operations- Basic Image Filtering Operations – The role of Thresholding - Edge Detection - Corner and Interest Point Detection - Textures Analysis.

UNIT II INTERMEDIATE-LEVEL VISION 9+6

Binary Shape Analysis - Boundary Pattern Analysis - Line, Circle and Ellipse Detection- The Generalised Hough Transform.

UNIT III HIGH-LEVEL VISION 9+6

Image Stitching- Motion Models, Global Alignment, Compositing; Depth estimation: Epi polar geometry- Sparse correspondence- Dense correspondence- Local methods- Global optimization; multi-view stereo - 3D reconstruction.

UNIT IV 3-D VISION AND MOTION 9+6

The Three-Dimensional World: Tackling the Perspective n-point Problem - Invariants and Perspective - Image Transformations and Camera Calibration – Motion.

UNIT V PUTTING COMPUTER VISION TO WORK 9+6

Face Detection and Recognition: the impact of deep learning - In Vehicle vision system.

TOTAL : 45 + 30 = 75 PERIODS

PRACTICAL EXERCISES

1. Implement image pre-processing and Edge detection
2. Implement camera calibration methods
3. Implement Segmentation methods
4. Construct 3D model from defocus image
5. Construct 3D model from Images
6. Implement optical flow method
7. Implement object detection and tracking from video using AdaBoost in OpenCV
8. Face detection and Recognition using OpenCV
9. Object detection from dynamic Background for Surveillance

COURSE OUTCOME

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

CO1: Implement fundamental image processing techniques required for computer vision
CO2: Perform shape analysis and Implement boundary tracking techniques
CO3: Apply 3D vision techniques
CO4: Develop applications using computer vision techniques
CO5: Familiar with the use of MATLAB / OpenCV environment
CO6: Design and develop the systems based on vision mechanism

REFERENCE BOOKS

1. Davies E R, Computer & Machine Vision, Academic Press, Fifth Edition, 2018.
2. Szeliski R, Computer Vision: Algorithms and Applications, Springer 2021.
3. Adrian Rosebrock, Deep Learning for Computer Vision with Python Starter Bundle, Pyimagesearch, First Edition, 2017
4. Rafael C Gonzalez and Richard E Woods, Digital Image Processing, Pearson Education, Third Edition, 2008.
5. Mark Nixon and Alberto S Aquado, Feature Extraction & Image Processing for Computer Vision, Academic Press, Third Edition, 2012.
6. John C Russ, The Image Processing Handbook, CRC Press, 2007.
7. Baggio D L et al., Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**2**		**1**		
CO2	**2**		**3**		**2**	**3**
CO3	**2**	**3**		**2**		
CO4	**1**					
CO5	**3**	**2**	**2**	**2**	**1**	**3**
CO6	**2**	**2**	**3**	**2**	**2**	**3**

23CS2906	BIO-METRIC SYSTEMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To understand the basic ideas and principles in biometrics.
- To understand the basic concepts of statistical data analysis for validating the biometrics projects.
- To familiarize the student with the image processing facilities in Matlab and its equivalent open source tools like OpenCV.
- To appreciate the use of biometrics Industrial applications and to understand the role of biometrics in modern security environment.
- To understand the role of multi-biometrics

UNIT I BIOMETRICS FUNDAMENTALS 9+6

Introduction to Biometrics – Benefits of Biometric Security – Types of Biometric Traits – Physiological and Behavioral Biometrics – General Architecture of Biometrics – Biometric Error and Performance Measures –Accuracy – False match rate – False non – match rate – Failure to Enrolment rate – Derived metrics – Applications of Biometrics.

UNIT II FINGERPRINT AND FACIAL SCAN 9+6

Finger Scan – Features – Components – Operation Steps – Competing Finger Scan Technologies Strength and Weakness – Types of Algorithms Used for Interpretation. Facial Scan – Features Components – Operation Steps – Competing Facial Scan Technologies – Strength – Weakness.

UNIT III ADDITIONAL PHYSIOLOGICAL BIOMETRICS 9+6

Retina Biometrics – Iris Scan – Features – Components – Competing Iris Scan Technologies – Strength and Weakness – Vein Pattern of Palm – Basics of Hand Geometry – Sign Language.

UNIT IV BEHAVIOR BIOMETRICS 9+6

Behavior Biometrics – Signature Scan – Keystrokes – Multimodality and Combining Biometrics for Improving Performance – Voice Scan-Features – Components – Operation Steps–Competing Voice Scan Technologies–Strength and Weakness.

UNIT V BIOMETRICS APPLICATION DEVELOPMENT 9+6

Biometrics – Standard Development Organizations – Information Security and Biometric Standards – BioAPI Consortium - Privacy Issues – Comparing Privacy Factor of Different Biometrics Technologies – Designing Privacy Sympathetic Biometric Systems.

PRACTICAL EXERCISES

1. Reading and writing of a biometric image like fingerprint or face.
2. Image Enhancement of biometric image by removing blur and noise.
3. Implementation of finger localization in OpenCV.
4. Implementation of face localizations in OpenCV .
5. Implementation of simple fingerprint and face identification.
6. Extraction of IRIS features in Matlab/OpenCV.
7. Implementation of voice acquisition in Matlab.
8. Implementation of fusion of biometrics in Matlab/OpenCV.
9. Extraction of features of signature in Matlab/Octave.
10. Develop an authentication system using keyboard strokes in Matlab/Octave.

TOTAL : 45+30=75 PERIODS

COURSE OUTCOME

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

CO1: Implement basic biometrics related algorithms.
CO2: Familiar with the types of Physiological and Behavioral Biometrics.
CO3: Design and implement an industrial application that incorporates different concepts of biometrics.
CO4: Critically analyze different approaches of Biometrics to implement mini projects in industrial environment and in security related projects.
CO5: Know the Biometric standards.
CO6: Know the Biometrics Application development.

REFERENCE BOOKS

1. Anil K. Jain, Arun A. Rossand, Karthik Nandakumar, —Introduction to Biometrics‖, Springer, 2011.
2. G. R. Sinha, Sandeep B. Patil, —Biometrics: Concepts and Applications‖, Wiley, 2013.
3. James L. Wayman, Anil K. Jain, Davide Maltoni, Dario Maio, —Biometric Systems: Technology, Design and Performance Evaluation‖, Springer, 2004.
4. Samir Nanavati, Michael Thieme, Raj Nanavati, —Biometrics: Identity Verification in a Networked World‖, John WILEY, 2002.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1				
CO2	1	1	2	2	1	2
CO3	1		1	1		
CO4	1		2	2	2	2
CO5	1	2	1		2	
CO6	1	2				2

23CS2907	DATA ENGINEERING AND VISUALIZATION	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To understand the fundamentals of data visualization.
- To know the working principles of various information visualization tools.
- To acquire knowledge about the issues in data representation.
- To visualize the complex engineering design.
- To gain skill in designing real time interactive information visualization system
- Understanding complex social cues.

UNIT I INTRODUCTION 9+6

Introduction – Visualization Stages – Computational Support – Issues – Different Types of Tasks – Data representation – Limitation: Display Space, Rendering Time, Navigation Link.

UNIT II DATA REPRESENTATION 9+6

Human Factors – Foundation for a Science of Data Visualization – Environment- Optics – Optimal Display – Overview about Lightness, Brightness, Contrast, Constancy, Color –Visual Attention that Pops Out – Types of Data – Data Complexity – The Encoding of Values – Encoding of Relation – Relation and Connection – Alternative Canvass.

UNIT III DATA PRESENTATION 9+6

Human Vision – Space Limitation – Time Limitations – Design – Exploration of Complex Information Space – Figure Caption in Visual Interface – Visual Objects and Data Objects – Space Perception and Data in Space – Images, Narrative and Gestures for Explanation.

UNIT IV COLOR PROCESSING 9+6

Color. Color Processing. Color Spaces. Color Aesthetics. Colors for Visualization-Cognition. Looking vs. Seeing. Image Gist. Gestalt Principles. Visual Attention. Visual Working & Long-Term Memory.

UNIT V DATA VISUALISATION SYSTEM 9+6

Visual Story Telling. Messaging. Effective Presentations. Design for Information Visualization and Arts, Visualization Systems- Database Visualization

PRACTICAL EXERCISES

1. Creating Interoperable Web Visualization Components using Candela tool.
2. Implementing Line and Stacked charts with Labels and Notes using Datawrapper tool.
3. Creating Interactive Charts using Google Chart tool.
4. Use Myheatmap tool to View Geographic Data Interactively.
5. Visualizing TSV, CSV, DSV data using Rawgraph.

6. Working with animation using Chartist.js tool.
7. Visualizing Image data using Matlab.
8. Visualizing Complex Historical Data using Palladio tool.
9. Creating Mobile Friendly Interactive Maps using Leaflet tool.
10. Implementing a Real Time Application using VTK tool as mini project.

TOTAL : 45 + 30 = 75 PERIODS

COURSE OUTCOME

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

CO1: Critically evaluate visualizations and suggest improvements and refinements

CO2: Use standalone visualization applications to quickly explore data

CO3: Apply a structured design process to create effective visualizations

CO4: Conceptualize ideas and interaction techniques using sketching

CO5: Create web-based interactive visualizations using JavaScript and D3

CO6: Identify appropriate data visualization techniques given particular requirements imposed by the data.

REFERENCE BOOKS

1. Robert Spence, ―Information Visualization An Introduction‖, Third Edition, Pearson Education, 2014.
2. Colin Ware, ―Information Visualization Perception for Design‖, Third edition, Margon Kaufmann Publishers, 2012.
3. Robert Spence, ―Information Visualization Design for Interaction‖, Second Edition, Pearson Education, 2006.
4. Benjamin B. Bederson and Ben shneiderman, ―The Craft of Information Visualization‖, Morgan Kaufmann Publishers, 2003.

a. Thomas strothotte, ―Computational Visualization: Graphics, Abstraction and Interactivity‖, Springer, 1998.

5. Matthew O. Ward, George Grinstein, Daniel Keim, ―Interactive Data Visualization: Foundation, Techniques and Applications‖, Second Edition, A. K. Peters/CRC Press, 2015.
6. Joerg Osarek, ―Virtual Reality Analytics‖, Gordon‘s Arcade, 2016

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**3**	**3**	**3**	**2**
CO2	**1**		**1**	**2**	**2**	
CO3						
CO4			**1**			**1**
CO5	**2**	**2**	**3**	**3**	**3**	**2**
CO6	**2**	**2**	**2**	**2**	**3**	**2**

23CS2908	AGILE PRACTICES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To understand the theoretical as well as practical understanding of agile software development practices.
- 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 the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing

UNIT I AGILE METHODOLOGY 9+6

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values-Agile team building activity/game

UNIT II AGILE PROCESSES 9+6

Lean Production – SCRUM, Crystal, and Feature Driven Development- Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices- XP and Scrum scenarios to choose between two.

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT 9+6

Agile Information Systems – Agile Decision Making – Earl S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM)- story card maturity model for given scenario.

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING 9+6

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – requirement prioritization using different techniques- Agile Requirements Modelling and Generation – Concurrency in Agile Requirements Generation.

UNIT V AGILITY QUALITY ASSURANCE AND DevOps 9+6

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Test Driven Development – Agile Approach in Global Software Development- DevOps– Continuous Integration and Continuous Delivery CI/CD: Jenkins Creating pipelines, Setting up runners Containers and container orchestration (Dockers and Kubernetes) for application development and deployment; Checking build status; Fully Automated Deployment; Continuous monitoring with Nagios.

PRACTICAL EXERCISES

Jenkins , Dockers and Kubernetes , Nagios **(All open sources**)

1. Create a team building activity that covers the Agile principles and benefits

2. Identifying the business requirement for given scenario and document the epic and features.
3. Identify the user stories for the features created in UNIT 1 and prioritize the stories with story points.
4. Establish the scrum roles and document the sprint meeting outcomes. (creation of sprint backlog, scrum board, daily stand up notes, retrospective notes, review feedback)
5. Design some scenarios where XP OR Scrum can be chosen.
6. Framing the evaluation cycle for an e commerce portal. (Example Amazon / flip kart)
7. For the story backlog created UNIT 2 frame the story card maturity model.
8. Design the unstable requirements and the impact faced by the same in previous UNITs.
9. Given two scenarios with user stories. Assigning the priority for the requirements using different techniques (MoSCoW , level , numeric etc.)
10. Create a burn down and burn up chart for the story completed in previous UNITs
11. Calculate the velocity of the forthcoming sprint based on completed sprints
12. Write a simple program for registration page creation using java script and commit the same using git.
13. Configure a Jenkins pipeline for pulling the code changes from GitHub and deploy the same.

TOTAL : 45 + 30 = 75 PERIODS

COURSE OUTCOME

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

CO1: Realize the importance of interacting with business stakeholders in determining the requirements for a software system.
CO2: Perform iterative software development processes: how to plan them, how to execute them.
CO3: Point out the impact of social aspects on software development success.
CO4: Develop techniques and tools for improving team collaboration and software quality.
CO5: Perform Software process improvement as an on-going task for development teams and
CO6: Show how agile approaches can be scaled up to the enterprise level.

REFERENCE BOOKS

1. Craig Larman, ―Agile and Iterative Development: A manager_s Guide‖, Addison-Wesley, 2004
2. David J. Anderson; Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results‖, Prentice Hall, 2003
3. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), ―Agile Software Development, Current Research and Future Directions‖, Springer-Verlag Berlin Heidelberg, 2010
4. Hazza& Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics in Computer Science‖, Springer, VIII edition, 2009
5. Kevin C. Desouza, ―Agile information systems: conceptualization, construction, and management‖, Butterworth-Heinemann, 2007
6. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, By Andrew Stellman, Jennifer Greene, 2015, O Reilly
7. DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive By SricharanVadapalli, Packt, 2018
8. DevOps For Beginners: A Step-By-Step Guide To DevOps Best Practices – Liam Foster-2017
9. The Phoenix Project: DevOps For Everyone – Gene Kim, Kevin behr, and George Spafford-2013
10. More Agile Testing: Learning Journeys for the Whole Team By Janet Gregory, Lisa Crispin, Addison Wesley, 2015.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3			1
CO2	2		3	3		
CO3						2
CO4	2		1	2		
CO5	1	3			2	3
CO6	1				2	1

23CS2909	NETWORK PERFORMANCE ANALYSIS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To understand the mathematical basis for analyzing the performance of networks.
- To understand queuing theory and queuing models.
- To analytically model traffic control protocols, and error control protocols using these concepts.
- To model performance of wired and wireless MAC such as 802.3, 802.11 and 802.16.
- To model network traffic and study the performance of different packet scheduling algorithms.

UNIT - I MARKOV CHAINS BASICS 9 + 6

An overview of performance evaluation, Types of workloads and workload election, Work load characterization. Overview of Random Processes, Markov Chains – Markov matrices, State transition matrix, Markov chains at equilibrium – steady state distribution vector.

UNIT - II REDUCIBLE AND PERIODIC MARKOV CHAINS 9 + 6

Reducible Markov chain – Transition matrix, Reducible Composite Markov chain, Transient analysis, Steady state, Periodic Markov chain – Transition matrix, canonical form, Strongly and weakly periodic Markov chains, Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue, M/M/m Queue, M/M/1/B queues, D/M/1/B queues, performance, communicating Markov chains, Advanced Markovian Queueing Models (M[X]/M/1), (M/M[Y]/1), Queuing Networks: Open and Closed Queuing Networks.

UNIT - III TRAFFIC CONTROL, ERROR CONTROL AND MAC MODELING 9 + 6

Modeling traffic control protocols – Modeling leaky bucket and token bucket algorithms, Modeling Error control protocols - Stop and wait and GBN ARQ performance, Modeling media access control protocols –802.1p, ALOHA, 802.3.

UNIT -IV NETWORK TRAFFIC AND SCHEDULING 9 + 6

Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis.

UNIT -V PERFORMANCE ANALYZER TOOLS AND CASE STUDY 9+6

Other aspects of Performance analysis on networks (random walk on graph, dynamics on network) – Network Performance Analyzer Tools. Case study of performance evaluation of some real-world applications (such as BitTorrent simulation and evaluation, Internet worm modeling and simulation).

PRACTICAL EXERCISES

1. Basics of Network Simulation
2. Simulating a Local Area Network
3. Measuring Network Performance
4. Evaluation using NS-2
5. Simulation of Queues in NS2 - Simulation of various queues in NS2 and analyzing their
6. Performances on various performance metrics such as throughput, average delay and packet loss
7. Simulation of various queue Scheduling Algorithms
8. Simulating a Wi-Fi Network
9. Simulating a WiMAX Network

TOTAL: 45+30=75 PERIODS

COURSE OUTCOME

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

CO1 Apply markov chain models and analyse the behavior of network systems

CO2 Perform queuing theory based analysis of various L2 layer functions, such as flow control, error control, and MAC

CO3 Build network traffic models

CO4 Analyse QoS functions such as scheduling and traffic control

CO5 Understand the performance of different packet scheduling algorithms.

CO6 Design wired and wireless networks

REFERENCE BOOKS

1. Anurag Kumar, D. Manjunath, Joy Kuri, Communication Networking: An analytical Approach, Elsevier, 2004.
2. Bertsekas D and Gallager R, Data Networks, 2nd Edition, Prentice-Hall, 1992.
3. Fayez Gebali, Analysis of computer networks, 2nd Edition, Springer, 2015.
4. Harrison P G and Patel N M, Performance Modelling of Communication Networks and Computer Architectures, Addison-Wesley, 1993.
5. Robertazzi T G, Computer Networks and Systems: Queuing Theory and Performance Evaluation, 2nd, Edition, Springer-Verlag, 1994.
6. Performance Analysis of Communications Networks and Systems , Piet Van Mieghem, Technische Universiteit Delft, The Netherlands
7. Raj Jain, The Art of Computer Systems Performance Analysis, John Wiley & Sons, 1991.
8. Fundamentals of Queueing Theory, 4th Edition Donald Gross, John F. Shortle, James M. Thompson, Carl M. Harris
9. Performance Evaluation by Simulation and Analysis with Applications to Computer Networks, Ken Chen, 2015

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	1
CO2		2		2	2	1
CO3	2	2	2		2	
CO4	1		3		2	1
CO5	1			2		1
CO6	2	2	2			1

23CS2910	BIOINFORMATICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- To get exposed to Bioinformatics Technologies.
- To solve various problems in biological sciences- sequence analysis.
- To solve various problems in gene expression analysis, biomedical image analysis.
- To solve various problems in metabolic pathway analysis.
- To be familiar with working of bioinformatics models in MATLAB

UNIT - I INTRODUCTION 9 + 6

Need for Bioinformatics Technologies – Overview of Bioinformatics Technologies – Structural Bioinformatics – Data Format and Processing – Secondary Resources and Applications – Role of Structural Bioinformatics – Biological Data Integration System.

UNIT - II BIOINFORMATICS TOOL BOX 9 + 6

Sequence Analysis – NGS – Graph Theory – Gene Ontology – Importing Data and Deploying.

UNIT - III BIOLOGICAL DATA ANALYSIS 9 + 6

Microarray Data Analysis – Mass Spectrometry Data Analysis – Statistical Classification of Biological Data.

UNIT -IV IMAGE PROCESSING 9 + 6

Key Features of Image Processing – Importing and Exporting Images – Image File Formats and Format Conversion – Pre and Post Processing Images – Spatial Transformations and Image Registration – Microarray Image Analysis.

UNIT -V SYSTEMS BIOLOGY 9 + 6

Basics of Enzyme Kinetics – Kinetic Laws – Modeling Biological System: Simulation, Sensitivity Analysis, Parameter Estimation using Simbiology – Pharmacokinetic Modeling: Simulation, Population Study – Model of the Yeast Heterotrimeric G Protein Cycle and Glycolysis

PRACTICAL EXERCISES

1. MATLAB basic commands.
2. Sequence analysis tools including functions for pairwise, MSA and phylogenetic tree construction.
3. Microarray data import from GEO and affymetrix and expression analysis and normalization.
4. Microarray image analysis.
5. Gene expression data analysis from gene ontology.
6. Mass spectrometry data import and base line correction and normalization.
7. Model creation and simulation using simbiology.
8. Node knock out of model generated in simbiology using graph theory.
9. Pharmakokinetic model building.
10. Pharmakokinetic population fitting.

TOTAL: 45+30=75 PERIODS

COURSE OUTCOME

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

CO1 Develop models for Biological Data.

CO2 Implement Image Processing Techniques to Bioinformatics Data.

CO3 Implement Micro Array analysis over Genome Expression.

CO4 Understand the study of Symbiology.

CO5 Understand the Pharmacokinetic Modeling

CO6 Understand the working model of Biological Data in MATLAB.

REFERENCE BOOKS

1. Gautam B. Singhm —Fundamentals of Bioinformatics and Computational Biology: Methods and Exercises in MATLAB‖, Springer International Publishing, 2015
2. Michael R. King, Nipa A. Mody, —Numerical and Statistical Methods for Bioengineering: Applications in MATLAB‖, Cambridge University Press, 2011.
3. G. Alterovitz, M. F. Ramoni, —Systems Bioinformatics: An Engineering Case-Based Approach‖, Artech House, 2007.
4. John L. Semmlow, —Biosignal and Medical Image Processing‖, CRC Press, 2004.
5. Frank C. Hoppensteadt, Charles S. Peskin, —Modeling and Simulation in Medicine and Life Sciences‖, Springer, 2010.
6. C. Gibas, Per Jambeck, —Developing bioinformatics computer skills‖, O'Reilly Media, 2001.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		**1**				**1**
CO2		**1**	**2**	**2**	**1**	**2**
CO3	**1**		**1**	**1**	**3**	
CO4	**1**		**2**	**2**	**2**	**1**
CO5		**2**	**1**		**2**	
CO6	**1**	**2**				**2**

PROFESSIONAL ELECTIVE - II, IV and V

23CS2911	BLOCK CHAIN TECHNOLOGIES AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To learn the fundamentals of Block chain.
- To explain the details of Bitcoin and its different components.
- To incorporate the consensus of Block chain
- To understand the Ethereum development environment
- To learn the applications of Block chain

UNIT I INTRODUCTION 9

Block chain history, basics, architectures, Types of block chain ,Basic Cryptographic primitives used in Block chain –Secure- Collision Resistant hash functions - Digital signature - Public key cryptosystems – Zero knowledge proof systems - Need for Distributed Record Keeping - Modelling faults and adversaries- Byzantine Generals problem - Consensus algorithms and their scalability problems - Why Nakamoto Came up with Block chain based crypto currency.

UNIT II BITCOIN 9

Fundamentals, aspects of bit coins, properties of bit coins, Digital Keys and Addresses – Transactions, life cycle, data structure, types – Structure of the block chain – Mining – Bitcoin Networks and Payments – Wallets – Alternative coins – Smart Contracts – Definition – Recardian contracts.

UNIT III BITCOIN CONSENSUS 9

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases, Design issues for Permissioned Blockchains, Execute contracts- Consensus models for permissioned blockchain-Distributed consensus in closed environment Paxos.

UNIT IV ETHEREUM 9

Setting up Ethereum development tools – Solidity language. – Ethereum accounts, key pairs, working with Externally Owned Accounts (EOA), contract accounts – Smart contracts, structure, setting up and interaction, examples – Decentralised applications, implementation, case studies – Whisper protocol – Swarm architecture and concepts.

UNIT V APPLICATIONS 9

Applications of block chain in cyber security- integrity of information- E-Governance, Finance,

Internet of things, Health and other contract enforcement mechanisms.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Define and Explain the fundamentals of Blockchain
CO2: Explain the different steps in the use of Bitcoins.
CO3: Describe the consensus of Blockchain
CO4: Analyze and demonstrate the Ethereum
CO5: Analyze various applications of Block chain.
CO6: Using Python Libraries to develop Block Chain Application.

REFERENCE BOOKS

1. S.Shukla,n M.Dhawan, S.Sharma, S. Venkatesan —Blockchain Technology: Cryptocurrency and Applications‖ ,Oxford University Press 2019 .
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,
3. ‖Bitcoin and cryptocurrency technologies: a comprehensive introduction‖,Princeton University Press,2016.
4. Imran Bashir, —Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained‖, Second Edition, Packt Publishing, 2018.
5. Alex Leverington, —Ethereum Programming‖ Packt Publishing Limited, 2017.
6. Arshdeep Bahga and Vijay Madisetti, —Blockchain Applications : A Hands-On Approach‖, 2017

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		**1**	**1**		**2**	**2**
CO2	**2**	**1**	**1**			
CO3		**1**		**1**		
CO4		**1**		**3**		**2**
CO5	**2**	**1**	**2**	**1**	**1**	**1**
CO6	**2**	**1**	**2**	**2**	**2**	**1**

23CS2912	INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the rudiments and overview of Industry 4.0.
- To gain knowledge of Industry 4.0 architecture, Cyber-Physical Systems, and IoT framework.
- To explore the transformation of industrial processes through modern technologies.
- To understand the necessity of the human factor towards Industry 4.0 and its scope in various sectors.

UNIT - I FUNDAMENTALS OF INDUSTRY 4.0 9

Introduction - Definition - Key Paradigm – Evolution of Industry 4.0, Framework of Industry 4.0 - Nine Pillars - Macro and Micro Perspective of Industry 4.0 - Components - Design Principles - Reference Architecture Model Industry 4.0 (RAMI 4.0)

UNIT - II INDUSTRY 4.0 ARCHITECTURE AND CYBERPHYSICAL SYSTEMS 9

Cyber-Physical Systems - CPS 5C Level Architecture - Implementation of 5C CPS Architecture in Factories - Classification of CPS in Context of Industry 4.0 - Operational Technology and Information Technology

UNIT - III INTERNET OF THINGS 9

Internet of Things - IoT Technologies - IoT Framework - Architecture of IoT – Key Technologies involved in 5G for IoT - IoT Cloud Platforms – Ethics in IoT Technologies.

UNIT -IV OPERATOR 4.0 AND HUMAN FACTORS IN INDUSTRY 4.0 9

Augmented Reality - Wearable Devices - Wearable and Localization Devices - Sensors used in Wearable Devices. Interfaces of Industry 4.0 and Humans - Inclusion of Human Factor - Human Factor Specialist.

UNIT -V COLLABORATIVE ROBOTS (COBOT) 9

Introduction - Characteristics of Cobots - Cobots in Complex Environments - Working Alongside Humans - Level of Automation and Collaboration - Conflicts and Trust - Guidelines for Designing a Cobot - Cobots in Industry Operations - Cobots as Workforce - Applications of Cobots

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Understand the fundamentals and framework of Industrial 4.0.

CO2 Comprehend various architectures of Cyber-Physical Systems connecting Industrial 4.0.

CO3 Study the IoT technologies and framework to value Industry 4.0 and Operator 4.0.

CO4 Evaluate and design Cobot for automating industrial operations.

CO5 Make interface of human factors and realize the impact of Industry 4.0 across the sectors.

CO6 Explore the transformation of industrial processes through modern technologies

REFERENCE BOOKS

1 Diego Galar Pascual, Pasquale Daponte, Uday Kumar, "Handbook Of Industry 4.0 and Smart Systems", CRC Press, 2020.

2 Peter Matthews, Steven Greenspan, "Automation and Collaborative Robotics: A Guide to the Future of Work", Apress Publisher, 2020

3 Jesús Hamilton Ortiz, Industry 4.0 Current Status and Future Trends, Intech open publisher, 2020.

ONLINE COURSES / RESOURCES

1. https://www.ibm.com/topics/industry-4-0
2. https://www.sap.com/india/products/scm/industry-4-0/what-is-industry-4-0.html
3. https://rskr.irimee.in/sites/default/files/Industry%204.0%20Silabhadra%20das.pdf
4. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SEEA1403.pdf

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**2**	**1**	**1**	**3**
CO2	**3**		**1**	**2**		**2**
CO3	**1**		**2**	**1**		
CO4		**3**	**1**		**2**	
CO5		**2**	**1**	**2**		**1**
CO6	**2**			**2**	**2**	**2**

23CS2913	SOFTWARE TESTING AND QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the basics of testing, test planning & design and test team organization.
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing ,execution and usage of automation tools
- To learn the software quality assurance, metrics, defect prevention techniques.
- To learn the techniques for quality assurance and applying for applications.

UNIT I SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES 9

Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black ,test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group ,System Test Team Hierarchy, Team Building

UNIT II SYSTEM TESTING 9

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built- in Testing. functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models

UNIT III SYSTEM TEST CATEGORIES AND TOOLS 9

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests , Regulatory Tests . Test Generation from FSM models- State-Oriented Model. Finite- State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote. System test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. system test execution- Modeling Defects, Metrics for Monitoring Test Execution .Defect Reports,
Defect Causal Analysis, Beta testing, measuring Test Effectiveness. Software Testing tools- Automation and Testing Tools –JMetra, JUNIT and Cactus.

UNIT IV SOFTWARE QUALITY 9

Software quality - People‗s Quality Expectations, Frameworks and ISO-9126, McCall‗s Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000‗ Software Quality Standard. Maturity models- Test Process Improvement ,Testing Maturity Model.

UNIT V SOFTWARE QUALITY ASSURANCE 9

Quality Assurance - Root Cause Analysis, modelling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Perform functional and nonfunctional tests in the life cycle of the software product.
CO2: Understand system testing and test execution process.
CO3: Identity defect prevention techniques and software quality assurance metrics
CO4: Understand software testing and Automation tools
CO5: Apply techniques of quality assurance for typical applications.
CO6: Understand the software quality assurance, metrics, defect prevention techniques

REFERENCE BOOKS

1. Software Testing And Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008
2. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
3. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004
4. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011
5. Software Automation Testing Tools for Beginners, Rahul Shende, Shroff Publishers and Distributors, 2012.
6. Software Testing Tools, K.V.K.K. Prasad, Dream Tech Press, 2008
7. Software Testing Concepts and Tools, Nageswara Rao Pusuluri, Dream Tech press, 2007.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**		**2**	
CO2		**2**	**2**	**3**		**3**
CO3		**1**	**1**		**1**	
CO4	**2**		**2**	**2**		**1**
CO5	**1**	**1**	**1**	**3**	**1**	**2**

23CS2914	NEXT GENERATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

1. To learn the technical, economic and service advantages of next generation networks
2. To learn the evolution of technologies of 4G and beyond.
3. To learn Software defined Mobile Network issues and integrating challenges with LTE.
4. To explore the NGN framework catering the services of end user with QoS provisioning.
5. To learn about the NGM management and standards.

UNIT I INTRODUCTION 9

Evolution of public mobile services -motivations for IP based services, Wireless IP network architecture –3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.

UNIT II 4G and BEYOND 9

Introduction to LTE-A –Requirements and Challenges, network architectures –EPC, E-UTRAN architecture-mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure. Overview of Potential 5G Communications System Architecture – 5G wireless communication systems, Massive MIMO, cognitive radio networks, and device-to-device communications. Security Issues and Challenges in 5G Communications Systems.

UNIT III SDMN-LTE INTEGRATION 9

SDN paradigm and applications, SDN for wireless-challenges, Leveraging SDN for 5G networks ubiquitous connectivity-mobile cloud-cooperative cellular network-restructuring mobile networks to SDN-SDN/LTE integration benefits.

UNIT IV MULTI SERVICE NETWORKS 9

Origin of multi service ATM, Next Generation Multi service Networks, Next Generation Multi service ATM switching, Multiprotocol Label switching, Networks, Frame Based MPLS, Cell based MPLS, MPLS services and their benefits, multi service provisioning platforms (MSPP) & Multi service switching platform (MSSP).

UNIT V NGN MANAGEMENT AND STANDARDIZATION 9

Evolution towards NGN-Technology requirements, NGN functional architecture- Transport stratum, service stratum, service/ content layer and customer terminal equipment function. NGN entities, Network and Service evolution -fixed, mobile, cable and internet evolution towards NGN. NGN Applications, UTMS, WAP, WiMAX-Security and directory Enabled networks.

TOTAL : 45 PERIODS

COURSE OUTCOME

At the end of the course, the student should be able to:

CO1: Understand the issues and challenges of wireless domain in future generation network design
CO2: Explore the LTE concepts and technologies.
CO3: Understand the integration of SDN with LTE.
CO4: Understand the NGN management and standardizations.
CO5: Learn and understand Multi service networks
CO6: Analyze and Design networks

REFERENCE BOOKS

1. Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, January 2008.
2. Madhusanga Liyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015.
3. Martin Sauter,"3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.
4. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
5. Thomas Plavyk, —Next generation Telecommunication Networks, Services and Managementǁ, Wiley & IEEE Press Publications, 2010.
6. Jonathan Rodriguez, —Fundamentals of 5G Mobile Networksǁ, Wiley, 2015.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		2			
CO2	1			2	1	2
CO3		2		1		3
CO4			2	2	2	2
CO5	1		1	1		
CO6	1	2	2	2		

23CS2915	COMPUTATIONAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To provide a strong foundation on fundamental concepts in Computational Intelligence.
- To enable Problem-solving through Genetic Algorithms.
- To provide basic techniques, theory and computational models of Fuzzy systems.
- To apply neural networks to design classification problems.
- To apply Computational Intelligence techniques primarily for machine learning.

UNIT I INTRODUCTION 9

Artificial Intelligence – a brief review – Pitfalls of traditional AI -Introduction to CI- History of CI- Basic techniques and applications of CI- Introduction to Machine learning.

UNIT II EVOLUTIONARY COMPUTING 9

Introduction to Genetic Algorithms (GA) – Applications of GA - Building block hypothesis Representation– Fitness Measures – Genetic Operators-. GA based Machine Learning.

UNIT III FUZZY SYSTEMS 9

Fuzzy Logic: Fuzzy sets, properties, membership functions, fuzzy operations - Fuzzy logic and fuzzy inference and applications - Evolutionary Computation - constituent algorithms - Swarm intelligence algorithms - Overview of other bio-inspired algorithms - Hybrid Intelligent systems (Rough fuzzy hybridization & Reinforcement learning).

UNIT IV NEURAL NETWORKS 9

Neural Networks-Neuro-fuzzy Inference- Biological and artificial neuron, neural networks, supervised and unsupervised learning. Single layer Perceptron, Multilayer Perceptron – Back propagation learning. Neural networks as associative memories - Hopfield networks, Bidirectional Associative Memory. Topologically organized neural networks – competitive learning, kohonen maps.

UNIT V PROBLEM SOVING 9

Adversial Search- Game Playing Cycle- A simple Game Tree- MINMAX Procedure- Additional pruning of game tree- Illustration of alpha beta cut off- Additional refinements- Horizon effect- Iterative deepening.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Provide a basic exposition to the goals and methods of Computational Intelligence.
CO2: Apply Genetic Algorithms to design intelligent computational systems.
CO3: Apply fuzzy principles and thinking to deal with vulnerability and tackle real-time issues.
CO4: Apply neural networks to design classification problems.
CO5: Improve problem solving skills using the acquired knowledge in the areas of, reasoning, natural
CO6: language understanding, gaming and machine learning.

REFERENC BOOKS

1. Russell Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, 2020. Pearson Education
2. A classical approach to Artificial Intelligence, Munesh Chandra Trivedi, Khanna Publications,2020
3. Machine Learning, Rajiv Chopra, Khanna Publishing House, 2020.
4. Michael Negnevitsky ,Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition,2020
5. Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson, Pearson Education, 2015.
6. Neural Networks and Learning Machines, Simon Haykin, Pearson Education, 3rd Edition,2016.
7. Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Jyh-Shing Roger Jang, 1st Edition, 2015, Pearson Education.
8. David E. Goldberg, ―Genetic Algorithms in Search, Optimization and Machine Learning‖, Pearson Education, 2008
9. Meta-heuristic and Evolutionary Algorithms for Engineering Optimization, Omid Bozorg-Haddad, Mohammad Solgi, Hugo A. Loáiciga,wiley publishers, 2017
10. Rajashekaran S and Vijayalakshmi Pai G A, ―Neural Networks, Fuzzy Logic and Genetic Algorithms‖, PHI, 2003.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	2		2	
CO2	2	2		3		3
CO3	1	2				
CO4			2	2		1
CO5		2	1		1	2
CO6	2		1	3	1	3

23CS2916	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To learn about design of cyber-physical systems
- Introduce modeling of CPS
- Introduce ability to analyze and simulate CPS systems
- To learn about CPS implementation issues
- To learn about secure deployment of CPS

UNIT I INTRODUCTION 9

Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS Industry 4.0, AutoSAR, IIOT implications, Building Automation, Medical CPS, Principles of Dynamical Systems: Dynamical Systems and Stability Controller Design Techniques Performance under Packet drop and Noise.

UNIT II CPS - PLATFORM COMPONENTS 9

CPS HW platforms - Processors, Sensors, Actuators, CPS Network - WirelessHart, CAN, Automotive Ethernet Scheduling Real Time CPS tasks

UNIT III CPS IMPLEMENTATION ISSUES 9

From features to automotive software components, Mapping software components to ECUs, CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion Building real-time networks for CPS.

UNIT IV INTELLIGENT CPS 9

Safe Reinforcement Learning, Robot motion control, Autonomous Vehicle control, Gaussian Process Learning, Smart Grid Demand Response, Building Automation

UNIT V SECURE DEPLOYMENT OF CPS 9

Secure Task mapping and Partitioning, State estimation for attack detection, Automotive Case study: Vehicle ABS hacking, Power Distribution Case study : Attacks on Smart Grids.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Understand the core principles behind CPS
CO2: Identify safety specifications and critical properties
CO3: Understand abstraction in system designs
CO4: Express pre- and post-conditions and invariants for CPS models
CO5: Analyze CPS by with holistic models of cyber and physical components.
CO6: Deploy secure CPS

REFERENCE BOOKS

1. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
2. R. Rajkumar, D. de. Niz and M. Klein, (2017), Cyber Physical Systems, Addision-Wesely.
3. E.A.Lee and S A Shesia, (2018), Embedded system Design: A Cyber-Physical Approach,
4. Second Edition, MIT Press.
5. André Platzer, Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics., Springer, 2010. 426 pages,ISBN 978-3-642-14508-7.
6. Jean J. Labrosse, Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C, The publisher, Paul Temme, 2011.

ONLINE RESOURCES

1. A.Platzer, (2017), Logical Foundations of Cyber Physical Systems, Springer.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		1	3		1	
CO2	2	2		1	1	
CO3	1		1	1		1
CO4		2		1		1
CO5	2		3	3	3	3
CO6	2	2	3	2	2	2

23CS2917	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the storage architecture and available technologies
- To learn to establish & manage data center
- To learn security aspects of storage & data center.
- To study how to manage data in various application domains
- To study about various virtualization techniques

UNIT I STORAGE TECHNOLOGY 9

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

UNIT II STORAGE SYSTEMS ARCHITECTURE 9

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,High-level architecture and working of an intelligent storage system.

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS 9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Select from various storage technologies to suit for required application.
CO2: Apply security measures to safeguard storage & farm
CO3: Analyze QoS on Storage.
CO4: Know about various backup and recovery technologies
CO5: Gain knowledge about various threats in different domains
CO6: Analyze various real-time problems and give solutions

REFERENCE BOOKS

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Marc Farley, —Building Storage Networks‖, Tata McGraw Hill , Osborne, 2001.
3. Robert Spalding, —Storage Networks: The Complete Reference—, Tata McGraw Hill, Osborne, 2003.

ONLINE COURSES / RESOURCES

1. https://www.my-mooc.com
2. Introduction to Data Storage and Management Technologies | My Mooc (my-mooc.com)
3. http://www.ictacademy.in/pages/Information-Storage-and-Management.aspx
4. https://www.classcentral.com

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1		1	
CO2			1			1
CO3		1		3	2	
CO4	1	1		1	2	
CO5	2	2	3	3		1
CO6			2	3	2	2

23CS2918	SOFTWARE RELIABILITY METRICS & MODELS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To learn about the software reliability fundamentals & to measure the reliability of software systems.
- To learn about basics of Software Reliability Modeling.
- To Learn the concepts of Comparison Criteria
- To Learn software metrics & understand the concepts of Measurements in Software Engineering.
- To Understand the Measurement of Internet Product Attributes and Quality Management Models.

UNIT - I SOFTWARE RELIABILITY FUNDAMENTALS 9

Basic Concepts – Failure and Faults – Environment – Availability –Modeling –uses – requirements reliability metrics – design & code reliability metrics – testing reliability metrics. Computation of software reliability, Functional and Operational Profile.

UNIT - II SOFTWARE RELIABILITY MODELING 9

Concepts – General Model Characteristic – Historical Development of models – Model Classification scheme – Markovian models – General concepts – General Poisson Type Models – Binomial Type Models – Poisson Type models – Fault reduction factor for Poisson Type models. Software Reliability Modeling: A general procedure for reliability modelling

UNIT - III COMPARISON OF SOFTWARE RELIABILITY MODELS 9

Comparison Criteria – Failure Data – Comparison of Predictive Validity of Model Groups – Recommended Models – Comparison of Time Domains – Calendar Time Modeling – Limiting Resource Concept – Resource Usage model – Resource Utilization – Calendar Time Estimation and confidence Intervals

UNIT -IV MEASUREMENTS THEORY 9

Measurements in Software Engineering – Scope of Software metrics – Measurements theory – Goal based Framework – Software Measurement Validation

UNIT -V MEASURING SOFTWARE PRODUCT 9

Measurement of Internet Product Attributes – Size and Structure – External Product Attributes – Measurement of Quality – Software Reliability: Measurement and Prediction.

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Evaluate the reliability of any given software product

CO2 Compare and select the right reliability model for evaluating the software

CO3 Design reliability models for software systems

CO4 Perform some simple statistical analysis relevant to software measurement data.

CO5 Understand from practical examples both the benefits and limitations of software metrics for quality control and assurance

CO6 Compare and analyze different software

REFERENCE BOOKS

1. John D. Musa, ―Software Reliability Engineering‖, Tata McGraw Hill, 1999
2. John D. Musa, Anthony Iannino, KazuhiraOkumoto, ―Software Reliability – Measurement, Prediction, Application, Series in Software Engineering and Technology‖, McGraw Hill, 1987
3. Norman Fenton, James Bieman, ―Software Metrics: A Rigorous and Practical Approach‖, 3rd edition, CRC Press, 2015
4. H. Pham, Software Reliability, Springer Verlag, New York , 2000
5. Patric D. T.O Connor, Practical Reliability Engineering, 4th Edition, John Wesley & Sons , 2003
6. D. Reled, Software Reliability Methods, Springer Verlag, New York , 2001

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1				3
CO2	1	1	2	2	1	2
CO3	1	2	1	1	3	3
CO4	1	2	2	2	2	2
CO5	1	2	1		2	3
CO6	1	2	2	2	2	3

23CS2919	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the need and characteristics of mobile applications.
- To design the right user interface for mobile application.
- To understand the design issues in the development of mobile applications.
- To understand the development procedures for mobile application.
- To develop mobile applications using various tools and platforms.

UNIT I INTRODUCTION 9

Mobile applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Device Profiles – Frameworks and Tools- Introduction to Android.

UNIT II USER INTERFACE 9

Generic UI development – Designing the right UI – Multimodal and Multichannel UI – Gesture based UI – Screen Elements and Layouts – Voice XML.

UNIT III APPLICATION DESIGN 9

Memory Management – Design Patterns for Limited Memory – Work Flow for Application Development – Java API – Dynamic Linking – Plug-ins and Rule of Thumb for using DLLs – Concurrency and Resource Management.

UNIT IV APPLICATION DEVELOPMENT I 9

Mobile OS: Android, Ios – Android Application Architecture – Android basic Components – Intents and Services – Storing and Retrieving data – Packaging and Deployment – Security and Hacking-Testing and publishing android applications.

UNIT V APPLICATION DEVELOPMENT II 9

Communication via the Web – Notification and Alarms – Graphics and Multimedia: Layer animation, Event Handling and Graphics Services – Telephony – Location Based Services.

TOTAL : 45 PERIODS

COURSE OUTCOME

At the end of the course, the student should be able to:

CO1: Design the right user interface for mobile application.
CO2: Implement mobile application using UI toolkits and frameworks
CO3: Design a mobile application that is aware of the resource constraints of mobile devices.
CO4: Develop web based mobile application that accesses internet and location data.
CO5: Implement android application to use telephony for SMS communication.
CO6: Create interactive applications in android using databases with multiple activities including audio, video and notifications and deploy them in marketplace

REFERENCE BOOKS

1. Reto Meier, —Professional Android 4 Application Development‖, Wiley, 2012.
2. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, Programming Android‖, O'Reilly, 2011.
3. Alasdair Allan, —iPhone Programming‖, O'Reilly, 2010.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**2**		**3**	**1**	
CO2			**1**	**3**		**2**
CO3			**3**		**2**	**1**
CO4	**1**	**1**	**1**			**3**
CO5	**2**	**2**	**2**		**1**	
CO6	**2**	**2**	**2**	**2**	**2**	**3**

23CS2920	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Learn the techniques in natural language processing.
- Be familiar with the natural language generation.
- Be exposed to machine translation.
- Understand the information retrieval techniques

UNIT I OVERVIEW AND LANGUAGE MODELING 8

Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages-NLP Applications-Information Retrieval. Language Modelling: Various Grammar- based Language Models-Statistical Language Model

UNIT II WORD LEVEL AND SYNTACTIC ANALYSIS 9

Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word Classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

UNIT III SEMANTIC ANALYSIS AND DISCOURSE PROCESSING 10

Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure

UNIT IV NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION 9

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations Application of NLG. Machine Translation: Problems in Machine Translation-Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Language

UNIT V INFORMATION RETRIEVAL AND LEXICAL RESOURCES 9

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net Stemmers-POS Tagger- Research Corpora. Applications: Automatic Text Summarization, Question- Answering System

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1: Understand text with basic Language features
CO2: Design an innovative application using NLP components
CO3: Implement a rule-based system to tackle morphology/syntax of a language
CO4: Design a tag set to be used for statistical processing for real-time applications

CO5: Compare and contrast the use of different statistical approaches for different types of NLP applications.

CO6: Implement a simple chatbot using dialogue system concepts

REFERENCE BOOKS

1. Introduction to Natural Language Processing (Adaptive Computation and Machine Learning series), Eisenstein, Jacob, MIT Press, 2019
2. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrievalǁ, Oxford University Press, 2008.
3. Daniel Jurafsky and James H Martin, —Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognitionǁ,2 nd Edition, Prentice Hall, 2008
4. James Allen, —Natural Language Understandingǁ, 2nd edition, Benjamin /Cummings publishing company, 1995

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**2**	**2**	**3**	**1**	**1**	
CO2		**2**	**2**	**2**		**2**
CO3			**1**			**1**
CO4	**1**		**1**			**1**
CO5	**1**			**2**		**3**
CO6	**2**	**2**		**1**	**1**	

23CS2921	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices
- To understand how to examine digital evidences such as the data acquisition, identification analysis
- To learn different techniques and procedures that enable them to perform a digital investigation
- To perform the analysis of physical storage media and volume analysis.

UNIT I FUNDAMENTALS OF COMPUTER FORENSICS 9

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

UNIT II FORENSICS ACQUISITION TOOLS 9

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

UNIT III INVESTIGATION 9

Introduction to Cyber Crime Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking

UNIT IV DIGITAL FORENSICS 9

Introduction to Digital Forensics, Open Source Examination Platform - Using Linux and Windows as the Host, Disk and File System Analysis, Media Analysis Concepts , Sleuth Kit, Partitioning and Disk Layouts, Special Containers, Hashing, Forensic Imaging, Internet Artifacts, Browser & Mail Artifacts, File Analysis, Image, Audio, Video, Archives, Documents, Graphical Investigation Environments, PyFLAG, Fiwalk, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition

UNIT V LAWS AND ACTS 9

Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1: Knowledge about Forensics Acquisition Tools.
CO2: Analysis about investigation, Encryption and Decryption Methods.
CO3: Familiarity in Open source Digital Forensics Platform and tools.
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Implement and Manage the security essentials in IT Sector
CO6: Be aware of Privacy and Storage security Issues.

REFERENCE BOOKS

1. Warren G. Kruse II and Jay G. Heiser, —Computer Forensics: Incident Response Essentials‖, Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., —Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.
3. Bernadette H Schell, Clemens Martin, —Cybercrime‖, ABC – CLIO Inc, California, 2004. Understanding Forensics in IT —, NIIT Ltd, 2005
4. Cory Altheide and Harlan Carvey,Digital Forensics with Open Source Tools‖ Elsevier publication, April 2011
5. Kevin Mandia, Chris Prosise, Matt Pepe, —Incident Response and Computer Forensics —, TataMcGraw -Hill, New Delhi, 2006.
6. Nelson Phillips and Enfinger Steuart, —Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.
7. Robert M Slade,‖ Software Forensics‖, Tata McGraw - Hill, New Delhi, 2005

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**2**	**1**	**1**	**2**	**1**
CO2		**1**		**1**	**1**	**2**
CO3	**2**	**2**		**3**		
CO4		**2**	**2**	**2**		**2**
CO5	**2**	**2**	**2**		**2**	
CO6	**2**			**2**		**2**

23CS2922	OPEN-SOURCE PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Open-source community easy to adoption and use in creating (and running) much of the modern internet.
- Allow anyone to modify, enhance or re-engineer a program's code
- Understand about open-source products on the Internet by using a search engine
- Understand about Free open-source content-management system
- Understanding about web security applications

UNIT I INTRODUCTION 9

Introduction to open source programming languages, advantages and drawbacks of open source programming, threats and vulnerabilities in open source languages, Operating System – Ubuntu Linux – Introduction to shell programming.

UNIT II PHP 9

Language Basics, Functions - calling a function, variable function, and anonymous function, Strings - cleaning, encoding and escaping, and comparing strings, Arrays – storing data in arrays, extracting multiple values, traversing, and sorting arrays, Objects – creation, introspection, and serialization, Web Techniques – processing forms and maintaining state.

UNIT III WEB DATABASE APPLICATIONS 9

Three-tier architecture, Introduction to Object oriented programming with PHP 5, Database basics, MYSQL - querying web databases, writing to web databases, validation with JavaScript, Form based authentication, protecting data on the web.

UNIT IV PERL, TCL, AND PYTHON 9

Numbers and Strings, Control Statements, Lists and Arrays, Files, Pattern matching, Hashes, Functions. Introduction to TCL/TK, Introduction to Python.

UNIT V SECURITY IN WEB APPLICATIONS 9

Recognizing web application security threats, Code Grinder, Building functional and secure web applications, Security problems with JavaScript, vulnerable GCI scripts, Code Auditing and Reverse Engineering, types of security used in applications.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1: Implement various applications using build systems
CO2: Understand the installation of various packages in open source operating systems
CO3: Create simple GUI applications using php, mysql
CO4: Understand the concept of Scripting language like JavaScript and GCI

CO5: Learn Scripting language like JavaScript
CO6: Design web security applications

REFERENCE BOOKS

1. Kevin Tatroe, Peter MacIntyre, RasmusLerdorf, —Programming PHP‖, O'Reilly Media, 2012.
2. Michael Cross, —Developer's Guide to Web Application Security‖, Syngress Publishers, 2007.
3. Hugh E. Williams, David Lane, —Web Database applications with PHP and MYSQL‖, Second Edition, O'Reilly Media, 2004.CSE

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**1**	**3**	**1**	**2**
CO2	**1**		**2**			
CO3		**2**	**1**	**2**		
CO4	**1**	**1**		**2**	**1**	**2**
CO5	**1**		**2**	**2**	**2**	**2**
CO6	**1**	**2**				

23CS2923	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To make sense of the social and information networks that have been fuelled and rendered accessible by the internet.
- To Analyze social networks by finding communities, identifying important nodes and influence propagation.
- To understand the concept of social network mining.
- To learn knowledge representation using network dynamics.
- To understand human behavior in social web and related communities.

UNIT - I INTRODUCTION 9

Overview: Social network data-Formal methods- Paths and Connectivity-Graphs to represent social relations-Working with network data- Network Datasets-Strong and weak ties - Closure, Structural Holes, and Social Capital.

UNIT - II SOCIAL INFLUENCE 9

Homophily: Mechanisms Underlying Homophily, Selection and Social Influence, Affiliation,Tracking Link Formation in OnLine Data, Spatial Model of Segregation - Positive and Negative Relationships - Structural Balance - Applications of Structural Balance, Weaker Form of Structural Balance.

UNIT - III INFORMATION NETWORKS AND THE WORLD WIDE WEB 9

The Structure of the Web- World Wide Web- Information Networks, Hypertext, and Associative Memory-Web as a Directed Graph, Bow-Tie Structure of the Web- Link Analysis and Web Search- Searching the Web: Ranking, Link Analysis using Hubs and Authorities-Page Rank- Link Analysis in Modern Web Search, Applications, Spectral Analysis, Random Walks, and Web Search.

UNIT -IV SOCIAL NETWORK MINING 9

Clustering of Social Network graphs: Betweenness, Girvan newman algorithm-Discovery of communities-Cliques and Bipartite graphs-Graph partitioning methods-Matrices-Eigen values Simrank

UNIT -V NETWORK DYNAMICS 9

Cascading Behavior in Networks: Diffusion in Networks, Modeling Diffusion - Cascades and Cluster, Thresholds, Extensions of the Basic Cascade Model- Six Degrees of Separation-Structure and Randomness, Decentralized Search- Empirical Analysis and Generalized Models- Analysis of Decentralized Search

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Understand the Evolution of Social Networks

CO2 Analyze the structure of Social Networks

CO3 Explore the knowledge from disciplines as diverse as sociology, mathematics, computer science

CO4 Discuss the Online interactive demonstrations and hands-on analysis of real-world data sets.

CO5 Understand the Cascading Behavior in Social Networks.

CO6 Gain knowledge about social networks and interactions in networks.

REFERENCE BOOKS

1. Easley and Kleinberg, “Networks, Crowds, and Markets: Reasoning about a highly connected world”, Cambridge Univ. Press, 2010.
2. Robert A. Hanneman and Mark Riddle, “Introduction to social network methods”, University of California, 2005.
3. Jure Leskovec,StanfordUniv.AnandRajaraman, Milliway Labs, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2 edition, 2014.
4. Wasserman, S., & Faust, K, “Social Network Analysis: Methods and Applications”, cambridge University Press; 1 edition, 1994.
5. Borgatti, S. P., Evercloudett, M. G., & Johnson, J. C., “Analyzing social networks”, SAGE Publications Ltd; 1 edition, 2013.
6. John Scott , “Social Network Analysis: A Handbook” , SAGE Publications Ltd; 2nd edition, 2000.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**		**1**	**1**	**1**
CO2	**1**		**2**	**2**	**2**	**2**
CO3		**2**	**1**	**1**		
CO4			**2**	**2**	**2**	**2**
CO5	**2**		**1**		**1**	**2**
CO6	**2**	**2**	**2**	**2**		

23CS2924	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To impart Knowledge on the following topics:

- Understand the basics of Quantum Computing and the paradigm.
- Learn how the Quantum Computing will differ from Conventional Computing.
- Understand the concepts of Qubits and various Quantum Computation algorithms
- Be aware of Quantum Computing on various fields such as Computer Security and Machine learning

UNIT - I FOUNDATION 9

Overview of traditional computing – Church-Turing thesis – circuit model of computation– reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem –functions of operators – tensor products – Schmidt decomposition theorem

UNIT - II QUBITS AND QUANTUM MODEL OF COMPUTATION 9

State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits.

UNIT - III QUANTUM ALGORITHMS - I 9

Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch- Jozsa algorithm – Simon's algorithm – Quantum phase estimation and quantum Fourier Transform – eigenvalue estimation.

UNIT -IV QUANTUM ALGORITHMS – II 9

Order-finding problem – eigenvalue estimation approach to order finding – Shor's algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover's quantum search algorithm – amplitude amplification – quantum amplitude estimation – quantum counting – searching without knowing the success probability.

UNIT -V QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION 9

Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault tolerant quantum computation.

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 The basic principles of quantum computing.

CO2 The fundamental differences between conventional computing and quantum computing

CO3 Several basic quantum computing algorithms

CO4 Concept of Qubits and various computing models.

CO5 The classes of problems that can be expected to be solved well by quantum computers

CO6 Apply deep quantum algorithms for real world problems

REFERENCE BOOKS

1. P. Kaye, R. Laflamme, and M. Mosca, “An introduction to Quantum Computing”, Oxford University Press, 1999
2. P. Kaye, R. Laflamme, and M. Mosca, “An introduction to Quantum Computing”, Oxford University Press, 1999
3. Scott Aaronson, “Quantum Computing Since Democritus”, Cambridge University Press, 2013.

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**2**	**3**		**1**	
CO2	**1**	**2**	**1**			
CO3		**1**		**2**	**1**	**2**
CO4	**2**		**2**	**2**		**3**
CO5	**1**		**1**	**2**		**3**
CO6	**2**	**2**	**1**	**2**	**2**	**3**

23CS2925	E-LEARNING TECHNOLOGIES	L	T	P	C
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COURSE OBJECTIVE

- To learn the various E-learning approaches and Components.
- To understand the key elements of Design Thinking.
- To explore the models for E-learning courseware development.
- To design E-learning courses using Authoring tools
- To analyze various E-learning solutions for design and development
- To Develop an evaluation plan for the E-Learning

UNIT – I INTRODUCTION 9

Introduction to E- Learning - Need for E-Learning – Types of E-Learning – Strategies of E-Learning Components of ELearning– Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content. Design Thinking: Introduction – Actionable Strategy – Act to Learn – Leading Teams to Win.

UNIT - II DESIGNING E-LEARNING CONTENT / COURSE 9

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis –Analyzing the Target Audience – Identifying Course Content - Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

UNIT - III CREATING INTERACTIVE E- CONTENT 9

Preparing content: Tips for Content Development and Language Style – Creating storyboards: Structure of an interactive Multimedia E-lesson – Techniques for presenting Multimedia content – Integrating multimedia elements -Developing Practice and Assessment Tests – Courseware Development – Authoring tools – Types of Authoring Tools – Selecting an Authoring Tool.

UNIT -IV LEARNING PLATFORMS 9

Types of Learning Platforms – Proprietary vs. Open – Introduction Learning Management System (LMS) – Content management System – CMS vs LMS – LMS solutions – Functional Areas of LMS.

UNIT -V COURSE DELIVERY AND EVALUATION 9

Components of an Instructor Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-learning Methods and Delivery Formats – Using Communication Tools for E-learning – Course Evaluation -Developing Evaluation Instruments – Evaluating E- Learning Development – Evaluating E-Learning Course

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Distinguish the phases of activities in models of E-learning

CO2 Identify appropriate E-Learning instructional methods and delivery strategies

CO3 Choose appropriate E-learning Authoring tools

CO4 Create interactive E-Learning courseware

CO5 Evaluate the E-learning courseware

CO6 Determine the quality, effectiveness, and continuous improvement of the e-Learning

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CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**				**1**
CO2		**1**	**2**	**2**	**1**	**2**
CO3	**1**	**2**	**1**	**1**		
CO4			**2**	**2**	**2**	**2**
CO5	**1**		**1**		**2**	**1**
CO6	**1**	**2**				**2**