SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur, Chengalpattu Dt.-603203, Tamil Nadu.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Post Graduate

CURRICULUM AND SYLLABUS

(REGULATIONS 2023**)**

Programme: M.E., Computer Science and Engineering

SRM VALLIAMMAI ENGINEERING COLLEGE

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

M.E. COMPUTER SCIENCE AND ENGINEERING

REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM

VISION:

To devise captivating, fascinating and unique practices of teaching that discovers the trained talent and inherentcompetences of young minds to evolve as humane professional Computer Science Engineers.

MISSION:

- To provide students with challenging ventures, contributing to the betterment of their selfdom to compete withinternational talents.
- To act as a motivational hub to exhibit practical knowledge with the latest technological updates and researchpublications.
- To render ample knowledge to exhibit their ubiquitous talents for the social prosperity and promote industry-institute harmony to upgrade the standards for the international reputation.

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. **PEO1:** Graduates excel in computer science and engineering to advance in higher education, research, or to succeed in industry and entrepreneurship.
2. **PEO2**: Graduates will be equipped with the skills and mindset needed to stay ahead of emerging technologies in computer science and engineering.
3. **PEO3**: To show leadership, commitment to social and economic issues, and a focus on community service and environmental conservation.
4. **PEO4**: To inculcate lifelong learning skills in graduates, equipping them for success in evolving environments and multidisciplinary teams, thereby enhancing their global employability.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Computer Science and Engineering Graduates will exhibit ability to:

PROGRAM OUTCOMES (POs):

1. **RESEARCH AND DEVELOPMENT**: An ability to independently carry out research / investigation and development work to solve practical problems.
2. **REPORT WRITING**: An ability to write and present a substantial technical report/document.
3. **MASTERY IN COMPUTER SCIENCE AND ENGINEERING**: Students should be able to demonstrate a degree of mastery over the area of Computer Science and Engineering.
4. **DESIGN AND DEVELOPMENT**: Efficiently design, build and develop system application software for distributed and centralized computing environments in varying domains and platforms.
5. **EXPLORING TRENDS IN COMPUTER AUTOMATION**: Learn about industry trends, hardware, software components and design solutions by collaborating engineering professionals. Pursue lifelong research development in computer and automation field
6. **LIFE- LONG LEARNING**: Recognize the need for independent life- long learning and engage in the broadest context of technological change

3. PEOs / POs Mapping:

The given below is the relational table between the programme educational objective mapped along with program outcome.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
I	2	3	2		2	-
II	-	-	1	2	2	2
III	2	-	2		2	-
IV	2	2	3	2	3	3

Contribution 1: Reasonable 2: Significant 3: Strong

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

Approved by AICTE & Affiliated to Anna University, Chennai, ‗A' Grade Accreditation by NAAC,NBA Accredited, ISO 9001:2015 Certified

M.E. COMPUTER SCIENCE AND ENGINEERING
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULA

SEMESTER I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA3162	Advanced Mathematics for Computer Science and Engineering	BSC	4	4	0	0	4
2.	DS3162	Machine Learning	PCC	3	3	0	0	3
3.	CP3161	Advanced Data Structures and Algorithms	PCC	3	3	0	0	3
4.	CP3162	Database Practices	PCC	3	3	0	0	3
5.	CP3163	Network Technologies	PCC	3	3	0	0	3
6.	CP3164	Agile Methodologies	PCC	3	3	0	0	3
PRACTICAL								
7.	CP3165	Advanced Data Structures and Algorithms Laboratory	PCC	3	0	0	3	1.5
8.	DS3165	Machine Learning Laboratory	PCC	3	0	0	3	1.5
			TOTAL	**25**	**19**	**0**	**6**	**22**

SEMESTER II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CP3261	Internet of Things	PCC	3	3	0	0	3
2.	CP3262	Cloud Computing Technologies	PCC	3	3	0	0	3
3.	CP3263	Advanced Data Science	PCC	3	3	0	0	3
4.	PCPXXX	Professional Elective - I	PEC	3	3	0	0	3
5.	PCPXXX	Professional Elective - II	PEC	3	3	0	0	3
6.	PCPXXX	Professional Elective - III	PEC	3	3	0	0	3

PRACTICAL								
7.	CP3241	Mini Project	EEC	3	0	0	3	1.5
8.	CP3264	Advanced Data Science Laboratory	PCC	3	0	0	3	1.5
			TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BA3371	Research Methodology and IPR	RMC	3	3	0	0	3
2.	PCPXXX	Professional Elective - IV	PEC	3	3	0	0	3
3.	PCPXXX	Professional Elective - V	PEC	3	3	0	0	3
PRACTICAL								
4.	CP3341	Project Work Phase - I	EEC	12	0	0	12	6
5.	CP3342	Technical Seminar	EEC	2	0	0	2	1
6.	CP3343	Internship (4 weeks)	EEC	0	0	0	0	2
			TOTAL	**23**	**9**	**0**	**14**	**18**

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	CP3441	Project Work Phase - II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO.OF CREDITS: 73

BASIC SCIENCE COURSES (BSC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1	MA3162	Advanced Mathematics for Computer Science and Engineering	4	0	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1	DS3162	Machine Learning	3	0	0	3	I
2	CP3161	Advanced Data Structures and Algorithms	3	0	0	3	I
3	CP3162	Database Practices	3	0	0	3	I
4	CP3163	Network Technologies	3	0	0	3	I
5	CP3164	Agile Methodologies	3	0	0	3	I
6	CP3165	Advanced Data Structures and Algorithms Laboratory	0	0	3	1.5	I
7	DS3165	Machine Learning Laboratory	0	0	3	1.5	I
8	CP3261	Internet of Things	3	0	0	3	II
9	CP3262	Cloud computing Technologies	3	0	0	3	II
10	CP3263	Advanced Data Science	3	0	0	3	II
11	CP3264	Advanced Data Science Laboratory	0	0	3	1.5	II
TOTAL CREDITS						**28.5**	

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSETITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1	BA3371	Research Methodology and IPR	3	0	0	3	III
TOTAL CREDITS						3	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSETITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1	CP3241	Mini Project	0	0	3	1.5	II
2	CP3341	Project Work Phase - I	0	0	12	6	III
3	CP3342	Technical Seminar	0	0	2	1	III
4	CP3343	Internship (4 weeks)	0	0	0	2	III
5	CP3441	Project Work Phase - II	0	0	24	12	IV
TOTAL CREDITS						**22.5**	

PROFESSIONAL ELECTIVES

SEMESTER II ELECTIVE I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TOTAL CONTACT PERIODS	PERIODS PER WEEK			
					L	T	P	C
1	PCP101	Software Testing and Quality Assurance	PEC	3	3	0	0	3
2	PCP102	Multicore Architectures	PEC	3	3	0	0	3
3	PCP103	Parallel Algorithms	PEC	3	3	0	0	3
4	PCP104	Advanced Operating Systems	PEC	3	3	0	0	3
5	PCP105	Adhoc and Wireless Sensor Networks	PEC	3	3	0	0	3

SEMESTER II ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TOTAL CONTACT PERIODS	PERIODS PER WEEK			
					L	T	P	C
1	DS3263	Big Data Mining and Analytics	PEC	3	3	0	0	3
2	DS3264	Deep Learning	PEC	3	3	0	0	3
3	PCP201	Information Retrieval Techniques	PEC	3	3	0	0	3
4	PCP202	Data Visualization Techniques	PEC	3	3	0	0	3
5	PCP203	Cognitive Computing	PEC	3	3	0	0	3

SEMESTER II ELECTIVE III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TOTAL CONTACT PERIODS	PERIODS PER WEEK			
					L	T	P	C
1	PDS101	DevOps and Micro services	PEC	3	3	0	0	3
2	PDS104	Web Design and Management	PEC	3	3	0	0	3
3	PDS303	Robotic process Automation	PEC	3	3	0	0	3
4	PCP301	Full Stack Web Application Development	PEC	3	3	0	0	3
5	PCP302	Game Development	PEC	3	3	0	0	3

SEMESTER III ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TOTAL CONTACT PERIODS	PERIODS PER WEEK			
					L	T	P	C
1	PDS203	Social Network Security	PEC	3	3	0	0	3
2	PDS204	Block chain Technologies	PEC	3	3	0	0	3
3	PCP401	Cyber Security	PEC	3	3	0	0	3
4	PCP402	Principles of Cryptography	PEC	3	3	0	0	3
5	PCP403	Ethical Hacking	PEC	3	3	0	0	3

SEMESTER III ELECTIVE V

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TOTAL CONTACT PERIODS	PERIODS PER WEEK			
					L	T	P	C
1	PDS301	Augmented Reality and Virtual Reality	PEC	3	3	0	0	3
2	PDS302	3D Printing Technologies	PEC	3	3	0	0	3
3	PCP501	Quantum Computing	PEC	3	3	0	0	3
4	PCP502	Natural Language Processing	PEC	3	3	0	0	3
5	PCP503	Soft Computing	PEC	3	3	0	0	3

SUMMARY

S. NO.	Name of the Programme : M.E. COMPUTER SCIENCE AND ENGINEERING					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	-
1.	BSC	4	-	-	-	4
2.	PCC	18	10.5	-	-	28.5
3.	PEC	-	9	6	-	15
4.	RMC	-	-	3	-	3
5.	EEC	-	1.5	9	12	22.5
	TOTAL CREDIT	**22**	**21**	**18**	**12**	**73**

SEMESTER I

MA3162 ADVANCED MATHEMATICS FOR COMPUTER SCIENCE AND ENGINEERING

L	T	P	C
4	0	0	4

OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
- To enable students to understand the concepts of Probability and Random Variables
- The course gives us the idea of two dimensional Random variables.
- To apply the small / large sample tests through Tests of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis.

UNIT I LINEAR ALGEBRA 12

Vector spaces – Norms – Inner products – QR factorization – Generalized eigenvectors – Singular value decomposition and applications – Pseudo inverse – Least square approximations.

UNIT II ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables– Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions

UNIT III TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t and F distributions for testing of mean, variance and proportions

UNIT V PARAMETRIC TESTS 12

Chi-square tests for independence of attributes and goodness of fit – Design of experiments one way and two way classification.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

- Apply the concepts of Linear Algebra to solve practical problems.
- Basic probability axioms and rules and the moments of discrete and continuous random Variables.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory calculating parametric tests and design of experiments
- The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES

1. Friedberg A.H Insel A.J and Spence L, “Linear Algebra”,Prentice Hall of India, New Delhi, 2004
2. T. Veerarajan, Probability,Statistics and Random Process with Queueing Theory and Queueing Network, Tata McGraw Hill, 4th Edition,2017.
3. Bronson, R.,”Matrix Operation” Schaum’s outline series, Tata McGraw Hill, New York, 2011.
4. Oliver C. Ibe, “Fundamentals of Applied probability and Random Processes”, Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson India Education, Asia, 9th Edition, New Delhi, 2017.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	2	1	-	-
CO2	3	2	2	1	-	-
CO3	3	2	2	1	-	-
CO4	3	2	2	1	-	-
CO5	3	2	2	1	-	-
AVG	3	2	2	1	-	-

No Correlation - Low 1 Medium 2 High 3

DS3162	MACHINE LEARNING	L T P C
		3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 9

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

UNIT II SUPERVISED LEARNING 9

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

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

Introduction - Clustering Algorithms - K - Means - Hierarchical Clustering - Cluster Validity - DimensionalityReduction - Principal Component Analysis - Recommendation Systems - EM algorithm. ReinforcementLearning - Elements - Model based Learning - Temporal Difference Learning.

UNIT IV PROBABILISTIC METHODS FOR LEARNING 9

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

UNIT V NEURAL NETWORKS AND DEEP LEARNING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand and outline problems for each type of machine learning
- Design a Decision tree and Random Forest for an application
- Implement Probabilistic Discriminative and Generative algorithms for an application and analyzethe results.
- Use a tool to implement typical Clustering algorithms for different types of applications.
- Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

REFERENCE BOOKS:

1. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”,Cambridge University Press, 2012.
3. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.
4. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
5. Tom Mitchell, “Machine Learning”;, McGraw-Hill, 1997.
6. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”,Springer, Second Edition, 2011**.**

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	3	3	2	-
CO2	3	3	3	3	2	-
CO3	3	3	3	3	2	-
CO4	3	3	3	3	2	-
CO5	3	3	3	3	2	-
AVG	3	3	3	3	2	-

CP3161 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:

- To extend the students' knowledge of algorithms and data structures.
- To enhance their expertise in algorithmic analysis and algorithm design techniques.
- To understand various types of search and heap structures.
- To study various types of geometric, randomized and approximation algorithms.
- To extrapolate from them in order to apply those algorithms and techniques to solve problems.

UNIT I FUNDAMENTALS 9

Properties of Big-oh Notation -Conditional Asymptotic Notation - Algorithm Analysis - Amortized Analysis - Introduction to NP-Completeness/NP-Hard - Recurrence Equations - Solving RecurrenceEquations – Time-Space Tradeoff.

UNIT II SEARCH STRUCTURES 9

Binary Search Trees - AVL Trees - Red-Black trees - Multi-way Search Trees -B-Trees - Splay Trees-Tries.

UNIT III HEAP STRUCTURES 9

Min/Max heaps - Deaps - Leftist Heaps - Binomial Heaps - Fibonacci Heaps - Skew Heaps - LazyBinomial Heaps

UNIT IV GEOMETRIC ALGORITHMS 9

Segment Trees - 1-Dimensional Range Searching - k-d Trees - Line Segment Intersection - Computingthe Overlay of Two Subdivisions - Range Trees - Voronoi Diagram

UNIT V ADDITIONAL TOPICS 9

Approximation Algorithms: Vertex Cover & Euclidean Travelling Salesperson Problem - Randomized Algorithms: Closest Pair Problem & Minimum Spanning Trees - Online Algorithm: Euclidean SpanningTree.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student will be able to
- Analyze algorithms.
- Determine algorithm correctness.
- Choose appropriate data structures for the problems to be solved.
- Design algorithms for problems from different domains.
- Identify various research strategies on algorithmic design.

REFERENCES:

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.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	-	-	-	-
CO2	3	-	-	-	-	-
CO3	3	2	2	2	-	-
CO4	3	2	2	2	-	-
CO5	3	3	2	2	-	-
CO6	3	3	3	3	-	-
AVG	3	2.5	2.2	2.2	-	-

CP3162 **DATABASE PRACTICES** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- 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 No SQL databases
- To understand the different models involved in database security and their applications In real time world to protect the database and information associated with them.

UNIT I RELATIONAL DATA MODEL **9**

Entity Relationship Model - Relational Data Model - Mapping Entity Relationship Model to Relational Model - Relational Algebra - Structured Query Language - Database Normalization.

UNIT II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY **9**

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

UNIT III XML DATABASES **9**

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

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS **9**

NoSQL - Categories of NoSQL Systems - CAP Theorem - Document-Based NoSQL Systems and MongoDB - MongoDB Data Model - MongoDB Distributed Systems Characteristics - NoSQLKey-Value Stores - DynamoDB Overview - Voldemort Key-Value Distributed Data Store - Wide Column NoSQL Systems - Hbase Data Model - Hbase Crud Operations - Hbase Storage andDistributed System Concepts - NoSQL Graph Databases and Neo4j - Cypher Query Language of Neo4j - Big Data - MapReduce - Hadoop - YARN.

UNIT V DATABASE SECURITY **9**

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.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able to

- Convert the ER-model to relational tables, populate relational databases and formulateSQL queries on data.
- Understand query processing in a distributed database system
- Understand and write well-formed XML documents
- Be able to apply methods and techniques for distributed query processing.
- Design and Implement secure database systems.
- Use the data control, definition, and manipulation languages of the NoSQL databases

REFERENCES:

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

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	3	-	2	-
CO2	3	3	-	-	2	-
CO3	2	1		2	3	-
CO4	-	-	2	-	-	1
CO5	-	3	-	-	-	-
CO6	3	3	3	2	2	-
AVG	2.7	2.5	2.6	2	2.2	1

CP3163 **NETWORK TECHNOLOGIES** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn about integrated and differentiated services architectures.
- To understand the working of wireless network protocols.
- To study the developments in cellular networks.
- To get familiarized with next generation networks.
- To know the concepts behind software defined networks

UNIT I NETWORK ARCHITECTURE AND QoS 9

Overview of TCP/IP Network Architecture - Integrated Services Architecture - Approach - Components - Services - Queuing Discipline - FQ - PS - BRFQ - GPS - WFQ - Random Early Detection - Differentiated Services.

UNIT II WIRELESS NETWORKS 9

IEEE 802.16 and WiMAX - Security - Advanced 802.16 Functionalities - Mobile WiMAX - 802.16e - Network Infrastructure - WLAN - Configuration - Management Operation - Security - IEEE 802.11e and WMM - QoS - Comparison of WLAN and UMTS - Bluetooth - LiFi -Protocol Stack - Security - Profiles

UNIT III CELLULAR NETWORKS 9

GSM - Mobility Management and call control - GPRS - Network Elements - Radio Resource Management - Mobility Management and Session Management - Small Screen Web Browsing over GPRS and EDGE - MMS over GPRS - UMTS - Channel Structure on the Air Interface -UTRAN -Core and Radio Network Mobility Management - UMTS Security

UNIT IV 4G NETWORKS 9

LTE - Network Architecture and Interfaces - FDD Air Interface and Radio Networks – Scheduling- Mobility Management and Power Optimization - LTE Security Architecture - Interconnectionwith UMTS and GSM - LTE Advanced(3GPPP Release 10)
- 4G Networks and Composite RadioEnvironment - Protocol Boosters - Hybrid 4G Wireless Networks Protocols - Green WirelessNetworks - Physical Layer and Multiple Access - Channel Modelling for 4G - Introduction to 5G& XG networks.

UNIT V SOFTWARE DEFINED NETWORKS 9

Introduction - Centralized and Distributed Control and Data Planes - Open Flow - SDN Controllers - General Concepts - VLANs - NVGRE - Open Flow - Network Overlays - Types -Virtualization - Data Plane - I/O - Design of SDN Framework

TOTAL : 45 PERIODS

OUTCOMES:

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

- Identify the different features of integrated and differentiated services.
- Demonstrate various protocols of wireless networks.
- Analyze the use of next generation networks.
- Provide solutions using SDN.
- Design protocols for cellular networks.

REFERENCES:

1. William Stallings, “High Speed Networks and Internets: Performance and Quality of Service”, Prentice Hall, Second Edition, 2002.
2. Martin Sauter, “From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband”, Wiley, 2014.
3. Savo G Glisic, “Advanced Wireless Networks - 4G Technologies”, John Wiley & Sons, 2007.
4. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.
5. Martin Sauter, “Beyond 3G - Bringing Networks, Terminals and the Web Together:LTE,
6. WiMAX, IMS, 4G Devices and the Mobile Web 2.0”, Wiley, 2009.
7. Naveen Chilamkurti, SheraliZeadally, HakimaChaouchi, “Next-Generation Wireless Technologies”, Springer, 2013.
8. Erik Dahlman, Stefan Parkvall, Johan Skold, “4G: LTE/LTE-Advanced for Mobile Broadband”, Academic Press, 2013.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	3	-	2	-	2
CO2	-	2	3	-	-	2
CO3	-	3	2	2	2	-
CO4	-	2	2	2	3	-
CO5	2	-	2	2	-	-
AVG	2	2.5	2.2	2	2.5	2

CP3164 AGILE METHODOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:

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

UNIT I AGILE SOFTWARE DEVELOPMENT 9

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

UNIT II AGILE AND SCRUM PRINCIPLES 9

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

UNIT III AGILE PRODUCT MANAGEMENT 9

Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue

UNIT IV AGILE REQUIREMENTS AND AGILE TESTING 9

User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile RiskManagement: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development, User Acceptance Test

UNIT V AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS 9

Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agileapproach to Configuration Management, The Atern Principles, Atern Philosophy, The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools. Scrum of Scrums,Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communicationin Scrum Projects, Best Practices to Manage Scrum.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

REFERENCES:

1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices AlanApt Series (2011)
2. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
3. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering:Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
4. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics inComputer Science, Springer, 2009.
5. Craig Larman, "Agile and Iterative Development: A Managers Guide, Addison-Wesley,2004.
6. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, andManagement, Butterworth-Heinemann, 2007.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	1	-	1	-
CO2	2	3	2	3	1	-
CO3	1	2	3	3	2	-
CO4	2	1	2	2	2	-
CO5	1	-	2	2	2	-
AVG	1.4	2	2	2.5	1.6	-

CP3165 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To familiarize various data structure implementations.
- To implement heap.
- To implement various tree structures like AVL, Red-black, B-Tree.
- To understand efficient implementation of segment Tree.
- To understand various shortest path algorithm.

LIST OF EXPERIMENTS:

1. Implementation of a Binary Search Tree
2. Implementation of AVL Tree
3. Implementation of B Tree
4. Red-Black Tree Implementation
5. Min Max Heap Implementation
6. Leftist Heap Implementation
7. Fibonacci Heap Implementation
8. Spanning Tree Implementation
9. Shortest Path Algorithms
10. Implementation of Travelling Salesman Problem Segment Trees

TOTAL : 45 PERIODS

OUTCOMES:

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

- Achieve programming skill to convert a problem to a programming logic.
- Apply suitable data structure for the problem in hand.
- Implement heap and various tree structures like AVL, Red-black, B-Tree and segment trees.
- Understand the usage of data structures for geometric problems.
- Understand the importance of height balancing in search structures.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	–	2	–	–	–
CO2	3	2	2	–	–	–
CO3	3	2	2	2	–	–
CO4	3	3	2	2	–	–
CO5	3	3	2	2	–	–
AVG	3	2.5	2	2	–	–

DS3165 **MACHINE LEARNING LABORATORY** **L T P C**
0 0 3 1.5

OBJECTIVES:

- To Make use of Data sets in implementing the machine learning algorithms
- To implement the machine learning concepts and algorithms in any suitable Language of choice.
- To Understand the reinforcement concept
- To evaluate the classification and clustering algorithms
- Learn the usage of python in implementing machine Learning algorithms

LIST OF EXPERIMENTS:

1. Study and usage of python tool.
2. Implement a classifier.
3. Develop a predictive model.
4. Implement a decision tree algorithm.
5. Implement back propagation algorithm.
6. Implement similarity based clustering algorithm.
7. Implement clustering algorithm for any data set.
8. Apply reinforcement learning.
9. Implement and demonstrate the Candidate-Elimination algorithm
10. Implement k-Nearest Neighbour algorithm
11. Implement the non-parametric Locally Weighted Regression algorithm

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply various classification and clustering techniques for problems using tools like Python.
- Implement solutions for various prediction problems using tools.
- Design and development of game and traffic control system using reinforcement learning.
- Implement the machine learning algorithms using python.
- Design and develop solutions for the machine learning algorithms using various datasets.

LIST OF SOFTWARE FOR A BATCH OF 20 STUDENTS:

SOFTWARE: Python 3 interpreter for Windows/Linux, Open Source tools

HARDWARE: Standalone desktops 20 Nos.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	–	2	–	–	–
CO2	3	2	2	–	–	–
CO3	3	2	2	2	–	–
CO4	3	3	2	2	–	–
CO5	3	3	2	2	–	–
AVG	3	2.5	2	2	–	–

SEMESTER II

CP3261	INTERNET OF THINGS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand the different architectures for IoT.
- To learn various protocols at the different layers for IoT.
- To develop prototype systems using Arduino / Rasberry Pi.
- To apply the use of data analytics in IoT.
- To develop applications of IoT in Industrial contexts.

UNIT I ARCHITECTURES AND MODELS 9

Introduction to IoT - IoT Architectures - Core IoT Functional Stack, Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer - IoT Data Management and Compute Stack, Fog Computing, Edge Computing, Cloud Computing - Sensors, Actuators, Smart Objects, Sensor networks.

UNIT II CONNECTIVITY 9

Communications Criteria - Access Technologies - IP as IoT Network Layer - Business case - Optimization - Profiles and compliances - Application Protocols - Transport Layer - ApplicationTransport Methods.

UNIT III SYSTEM DEVELOPMENT 9

Design Methodology - Case study - Basic blocks of IoT device - Raspberry Pi - Board, Interfaces, Linux, Setting up, Programming - Arduino - Other IoT Devices.

UNIT IV DATA ANALYTICS AND IoT SECURITY 9

Data Analytics for IoT - Big Data Analytics Tools and Technology - Edge Streaming Analytics -Network Analytics, Applications. Security history, challenges, variations - Risk Analysis Structures - Application in Operational Environment.

UNIT V IoT IN INDUSTRY 9

Manufacturing, Architecture, Protocols - Utilities, Grid Blocks - Smart Cities, Architecture, Use cases - Transportation, Architecture, Use cases.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the underlying architectures and models in IoT.
- Analyze different connectivity technologies for IoT.
- Develop simple applications using Arduino / Raspberry Pi.
- Apply data analytics techniques to IoT.
- Study the needs and suggest appropriate solutions for Industrial applications.

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 2017
2. Olivier Hersent, David Boswarthick, Omar Elloum, “The Internet of Things Key applications and Protocols”, Wiley, 2012.
3. Michael Miller, “The Internet of Things”, Pearson Education, 2015.
4. Arshdeep Bahga, Vijay Madisetti, “Internet of Things - A hands-on approach”,Universities Press, 2015.
5. Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle,"From Machine - to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	2	-	1	1
CO2	2	-	-	-	2	1
CO3	3	2	-	-	3	2
CO4	-	3	-	1	2	2
CO5	-	2	2	1	1	2
AVG	2.6	2.3	2	1	1.8	1.6

CP3262 CLOUD COMPUTING TECHNOLOGIES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution.
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the EDGE AND FOG computing architectures.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 9

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

UNIT II CLOUD PLATFORM ARCHITECTURE 9

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

UNIT III EDGE AND FOG COMPUTING 9

Fog Computing, Characteristics, Application Scenarios, Issues and challenges-Fog Computing Architecture: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles. Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing

UNIT IV CLOUD PLATFORMS 9

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes-.WindowsAzure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API

UNIT V PROGRAMMING MODEL 9

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

COURSE OUTCOMES:

- Employ the concepts of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Identify the architecture of FOG and EDGE computing
- Develop the Cloud Application in AWS platform
- Develop services using various Cloud computing programming models.

TOTAL: 45 PERIODS

REFERENCES:

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner
3. to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
4. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.
5. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana
6. Srirama,wiley publication, 2019, ISBN: 9781119524984.
7. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing, MCGraw Hill Education (India) Pvt. Ltd., 2013.
8. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guidell, McGraw-Hill Osborne Media, 2009.
9. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
10. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
11. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
12. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2019

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	-	-	2	-	-
CO2	-	3	3	-	-	-
CO3	2	-	3	-	-	-
CO4	-	-	-	2	-	2
CO5	-	3	-	2	-	-
AVG	2	3	3	2	-	2

CP3263	ADVANCED DATA SCIENCE	L T P C
		3 0 0 3

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION TO DATA SCIENCE 9

Data science process - roles, stages in data science project - working with data from files - working with relational databases - exploring data - managing data - cleaning and sampling for modeling and validation - introduction to NoSQL.

UNIT II MODELING METHODS 9

Choosing and evaluating models - mapping problems to machine learning, evaluating clustering models, validating models - cluster analysis - K-means algorithm, Naïve Bayes - Memorization Methods - Linear and logistic regression - unsupervised methods.

UNIT III INTRODUCTION TO R 9

Reading and getting data into R - ordered and unordered factors - arrays and matrices - listsand data frames - reading data from files - probability distributions - statistical models in R - manipulating objects - data distribution.

UNIT IV MAP REDUCE 9

Introduction - distributed file system - algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling andsorting - Reducing phase execution.

UNIT V DATA VISUALIZATION 9

Documentation and deployment - producing effective presentations - Introduction to graphicalanalysis - plot() function - displaying multivariate data - matrix plots - multiple plots in one window - exporting graph using graphics parameters - Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

REFERENCES:

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

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	-	2	-	-
CO2	3	-	3	2	2	-
CO3	2	-	-	-	3	-
CO4	3	2	-	-	3	-
CO5	2	-	2	-	3	-
AVG	2.4	2	2.5	2	2.7	-

CP3264 **ADVANCED DATA SCIENCE LABORATORY** **L T P C**
0 0 3 1.5

OBJECTIVES:

- To develop data analytic code in python
- To be able to use python libraries for handling data
- To develop analytical applications using python
- To perform data visualization using plots

LIST OF EXPERIMENTS

Tools: Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh
Working with Numpy arrays

1. Working with Pandas data frames
2. Basic plots using Matplotlib
3. Frequency distributions, Averages, Variability
4. Normal curves, Correlation and scatter plots, Correlation coefficient
5. Regression
6. Z-test
7. T-test
8. ANOVA
9. Building and validating linear models
10. Building and validating logistic models
11. Time series analysis

PRACTICAL: 45 PERIODS

OUTCOMES:

Upon successful completion of this course, students will be able to:
Write python programs to handle data using Numpy and Pandas

- Perform descriptive analytics
- Perform data exploration using Matplotlib
- Perform inferential data analytics
- Build models of predictive analytics
- Perform data visualization using plots

CO's-PO's & PSO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	2	3	-	-
CO2	1	2	1	2	2	-
CO3	2	2	2	2	2	-
CO4	2	3	1	3	2	-
CO5	3	1	1	1	2	-
AVG	2	2	1	2	2	-

SEMESTER III

BA3371 RESEARCH METHODOLOGY AND IPR L T P C
3 0 0 3

OBJECTIVES:

1. To familiarise the students with the scientific methodology involved in research process.
2. To help students to understand various concepts related to Research design and measurement.
3. To learn to design and validate data collection tools.
4. To give an idea about IPR, registration and its enforcement.
5. To acquaint the students with basics of intellectual property rights

UNIT I – INTRODUCTION TO RESEARCH AND ITS DESIGN 9

The concept of research – Characteristics of good research – The hallmarks of scientific research – Building blocks of science in research – Concept of applied and Basic research – Quantitative and Qualitative Research techniques – Need for theoretical frame work – Hypothesis development and testing. Research design – Purpose of the study: Exploratory, Descriptive, Experimental Research Design, Hypothesis Testing, Measurement of variables - Scales and measurements of variables - Factorial Design in Research – Taguchi method in Research, Developing scales.

UNIT II – DATA COLLECTION METHODS AND ANALYSIS TECHNIQUES 9

Types of data – Primary Vs secondary data, Advantages and Disadvantages of various Data-Collection Methods, Sampling plan - Sampling Techniques – Probability and non-probability Sampling, Determination of Optimal sample size, Data Analysis – Factor Analysis – Cluster Analysis – Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation – Application of Statistical (SPSS) Software Package in Research.

UNIT III – REPORT WRITING AND CODE OF ETHICS FOR RESEARCH 9

Research report – Different types – Contents of report –Report format – Title of the report – Report Presentation – Proposal- purpose, Topic selection, types and structure – Recommendations and implementation section – Conclusions and Scope for future work - Ethics in research – Ethical behaviour of research– subjectivity and objectivity in research - ethical issues relating to the researcher.

UNIT IV – INTELLECTUAL PROPERTY RIGHTS **9**

Nature of Intellectual Property - Patents, Designs, Trade mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT.

UNIT V – INTELLECTUAL PATENT RIGHTS AND NEW DEVELOPMENT **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.

TOTAL:45 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to:

1. Understand research problem and analyse different research techniques.
2. Develop survey instrument and use appropriate data collection method and use appropriate statistical techniques for data analysis
3. Prepare a detailed research report with the required details and follow research ethics.
4. Explain the ethical principles to be followed while patenting or obtaining copyright.
5. Apply for patent rights and demonstrate New developments in IPR

TEXT BOOKS:

1. C.R. Kothari, “Research Methodology Methods & Techniques”, Second Edition, New Delhi: New Age International Publisher, 4th edition 2019.
2. T. Ramappa, “Intelluctual Property Rights under WTO”, 2nd Edition, S. Chand, 2008.

REFERENCES:

1. Donald H. McBunny, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 7th edition 2006.
2. Ranjit Kumar, “Researc Methodology – A Step by Step for Beginner’s”, 2nd Edition, Pearson, Education, 2016.
3. Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw – Hill Publishing Company Limited, New Delhi, 12th edition 2013.
4. G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999.
5. Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.
6. Raymond-Alain Thie’tart, et. Al., Doing Management Research, Sage Publications, London, 1999.
7. Uma Sekaran, /research Methods for Business, John Wiley and Sons Inc., New York, 2000.
8. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007

SEMESTER II

ELECTIVE I

PCP101	SOFTWARE TESTING AND QUALITY ASSURANCE	L T P C
		3 0 0 3

OBJECTIVES:

The student should be able to

- Know what is software and the usage of different types of software.
- Know the Quality Metrics of various Software's.
- Know the methodologies used in developing software.
- Test the product finally to check the product Quality.

UNIT I INTRODUCTION 9

Introduction to Software Quality - Challenges - Objectives - Quality Factors - Components of SQA - Contract Review - Development and Quality Plans - SQA Components in Project LifeCycle - SQA Defect Removal Policies - Reviews.

UNIT II TESTING METHODOLOGIES 9

Basics of Software Testing - Test Generation from Requirements - Finite State Models - Combinatorial Designs - Test Selection, Minimization and Prioritization for Regression Testing - Test Adequacy, Assessment and Enhancement.

UNIT III TEST STRATEGIES 9

Testing Strategies - White Box and Black Box Approach - Integration Testing - System and Acceptance Testing - Performance Testing - Regression Testing - Internationalization Testing - Ad-hoc Testing - Website Testing - Usability Testing - Accessibility Testing.

UNIT IV TEST AUTOMATION AND MANAGEMENT 9

Test plan - Management - Execution and Reporting - Software Test Automation - Automated Testing tools - Hierarchical Models of Software Quality - Configuration Management -Documentation Control.

UNIT V SQA IN PROJECT MANAGEMENT 9

Project progress control - costs - quality management standards - project process standards -management and its role in SQA - SQA unit.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop Quality plans and use SQA components in project life cycle.
- Analyze the product Quality.
- Judge the use of infrastructure components and use configuration items for Quality control.
- Use various testing methods and verify.
- Assess Quality standards of various software products.

REFERENCES:

1. Daniel Galin, “Software Quality Assurance – from Theory to Implementation” PearsonEducation, 2009
2. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
3. Aditya Mathur, “Foundations of Software Testing”, Pearson Education, 2008
4. Ron Patton, ”Software Testing” , Second Edition, Pearson Education, 2007
5. Srinivasan Desikan, Gopalaswamy Ramesh, “Software Testing – Principles andPractices”, Pearson Education, 2006
6. Alan C Gillies, “Software Quality Theory and Management”, Cengage Learning, SecondEdition, 2003.
7. Robert Furtell, Donald Shafer, and Linda Shafer, “Quality Software Project Management”,Pearson Education Asia, 2002.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	-	-	-	-
CO2	-	3	3	2	-	1
CO3	2	-	-	-	-	2
CO4	-	-	2	1	-	-
CO5	1	-	3	1	3	2
AVG	2	3	2.6	1.3	3	1.6

PCP102 **MULTICORE ARCHITECTURES** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To understand the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.
- To understand how the various forms of parallelism are exploited by the architecture.

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design - Measuring and Reporting Performance - Instruction Level Parallelism and its Exploitation - Concepts and Challenges - Limitations of ILP - Multithreading - SMT and CMP Architectures - The Multicore era.

UNIT II MEMORY HIERARCHY DESIGN 9

Introduction - Optimizations of Cache Performance - Memory Technology and Optimizations - Protection: Virtual Memory and Virtual Machines - Design of Memory Hierarchies – Case Studies.

UNIT III MULTIPROCESSOR ISSUES 9

Symmetric and Distributed Shared Memory Architectures - Cache Coherence Issues - Performance Issues - Synchronization Issues - Models of Memory Consistency - Interconnection Networks - Buses, Crossbar and Multi-stage Interconnection Networks.

UNIT IV MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures - Intel Multicore Architectures - SUN CMP architecture - IBM Cell Architecture. Introduction to Warehouse-Scale computers, Cloud Computing - Architectures and Issues - Case Studies.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

Vector Architecture - SIMD Extensions for Multimedia - Graphics Processing Units - Case Studies - GPGPU Computing - Detecting and Enhancing Loop Level Parallelism - Introduction to Domain Specific Architectures.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Identify the limitations of ILP and the need for multicore architectures.
- Identify the memory organization and optimization
- Discuss the issues related to multiprocessing and suggest solutions.
- Point out the salient features of different multicore architectures and how they exploitparallelism.
- Point out the various optimizations that can be performed to improve the memory hierarchydesign.
- Point out the salient features of vector, GPU and domain specific architectures.

REFERENCES:

1. John L. Hennessey and David A. Patterson, “Computer Architecture – A QuantitativeApproach”, Morgan Kaufmann / Elsevier, 5th edition, 2012.
2. Darryl Gove, “Multicore Application Programming: For Windows, Linux, and Oracle Solaris”, Pearson, 2011.
3. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors”, MorganKauffman, 2010.
4. Wen-mei W.Hwu,“GPU Computing Gems”, Morgan Kaufmann / Elsevier, 2011

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	-	2	-	-
CO2	-	3	3	-	2	-
CO3	2	-	-	2	-	-
CO4	-	-	2	-	-	2
CO5	-	-	3	-	2	-
CO6	-	3	-	2	2	-
AVG	2.5	3	2.6	2	2	2

PCP103 **PARALLEL ALGORITHMS** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn parallel algorithms development techniques for shared memory and DCM models.
- To study the main classes of fundamental parallel algorithms.
- Learn to design efficient parallel algorithms.
- To study the complexity and correctness models for parallel algorithms.
- To understand parallel solutions for bitwise computation.

UNIT I INTRODUCTION **9**

Introduction to Parallel Algorithms - Models of computation - Selection - Merging on EREW and REW - Median of two sorted sequence - Fast Merging on EREW - Analyzing Parallel Algorithms

UNIT II SORTING & SEARCHING **9**

Sorting Networks - Sorting on a Linear Array - Sorting on CRCW, CREW, EREW - Searching a sortedsequence - Searching a random sequence - Bitonic Sort

UNIT III ALGEBRAIC PROBLEMS **9**

Permutations and Combinations - Matrix Transpositions - Matrix by Matrix Multiplications – Matrix byVector Multiplication.

UNIT IV GRAPH & GEOMETRY **9**

Connectivity Matrix - Connected Components - All Pair Shortest Paths - Minimum Spanning Trees -Point Inclusion - Intersection, Proximity and Construction Problems

UNIT V OPTIMIZATION & BIT COMPUTATIONS **9**

Prefix Sums - Job Sequencing - Knapsack - Adding Two Integers - Adding n Integers - MultiplyingTwo Integers — Selection

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the difference between sequential and parallel algorithms.
- Design parallel algorithms in various models of parallel computation.
- Apply a suitable model for developing a parallel algorithm.
- Know the basic issues associated with implementing parallel algorithms.
- Understand the differences among several algorithms used for solving the same problem and recognize which one is better under different conditions.

REFERENCES:

1. Selim G. Akl, “The Design and Analysis of Parallel Algorithms”, Prentice Hall, New Jercy, 1989.
2. Michael J. Quinn, “Parallel Computing: Theory & Practice”, Tata McGraw Hill Edition, 2003.
3. Joseph JaJa, “Introduction to Parallel Algorithms”, Addison-Wesley, 1992.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	-	-	3	-
CO2	3	3	1	2	-	-
CO3	3	3	3	2	3	-
CO4	3	3	3	2	3	-
CO5	3	2	2	2	3	-
AVG	3	3	3	2	3	-

PCP104 ADVANCED OPERATING SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand the concepts of distributed systems.
- To get an insight into the various issues and solutions in distributed operating systems.
- To learn about real-time operating systems.
- To gain knowledge on the design concepts of mobile operating systems.
- To understand cloud operating systems.

UNIT I INTRODUCTION 9

Distributed Operating Systems - Issues - Communication Primitives - Limitations of a Distributed System - Lamport's Logical Clocks - Vector Clocks - Causal Ordering of Messages

UNIT II DISTRIBUTED OPERATING SYSTEMS 9

Distributed Mutual Exclusion Algorithms - Classification - Preliminaries - Simple Solution - Lamport's Algorithm - Ricart-Agrawala Algorithm - Suzuki-Kasami's Broadcast Algorithm - Raymond's Tree- Based Algorithm - Distributed Deadlock Detection - Preliminaries - Centralized Deadlock DetectionAlgorithms - Distributed Deadlock Detection Algorithms - Path Pushing Algorithm - Edge Chasing Algorithm - Hierarchical Deadlock Detection Algorithms - Agreement Protocols - Classification - Solutions to the Byzantine Agreement Problem - Lamport-Shostak- Pease Algorithm

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9

Distributed File Systems - Design Issues - Google File System - Hadoop Distributed File System - Distributed Shared Memory - Algorithms for Implementing Distributed Shared Memory- Load Distributing Algorithms - Synchronous and Asynchronous Check Pointing and Recovery - Fault Tolerance - Two-Phase Commit Protocol - Nonblocking Commit Protocol

UNIT IV REAL TIME OPERATING SYSTEMS 9

Basic Model of Real - Time Systems - Characteristics - Application of Real - Time Systems - Real -Time Task Scheduling - Handling Resource Sharing

UNIT V MOBILE AND CLOUD OPERATING SYSTEMS 9

Android - Overall Architecture - Linux Kernel - Hardware Support - Native User-Space - Dalvik and Android's Java - System Services - Introduction to Cloud Operating Systems.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the features of distributed operating systems.
- Demonstrate the various protocols of distributed operating systems.
- Identify the different features of real time operating systems.
- Discuss the features of mobile operating systems.
- Discuss the features of cloud operating systems.

REFERENCES:

1. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems –Distributed, Database and Multiprocessor Operating Systems”, Tata MC Graw-Hill, 2001.
2. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2006.
3. Karim Yaghmour, “Embedded Android”, O’Reilly, First Edition, 2013.
4. Nikolay Elenkov, “Android Security Internals: An In-Depth Guide to Android’s Security Architecture”, No Starch Press, 2014.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	1	-	1	-	2
CO2	1	2	3	2	2	1
CO3	3	1	-	2	-	2
CO4	2	1	1	2	2	1
CO5	1	2	2	1	2	2
AVG	2	1.4	2	1.6	2	1.6

PCP105 ADHOC AND WIRELESS SENSOR NETWORKS L T P C

3 0 0 3

OBJECTIVES:

- 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 AD HOC NETWORKS 9

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

Description of Various Mobility Models - Simulation and Analysis of Various Mobility Models - Overhead Analysis in Hierarchical Routing Scheme - Overhead Minimization Techniques - EnergyModels

UNIT III WIRELESS SENSOR NETWORKS (WSN) 9

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 PERFORMANCE ANALYSIS AND EVALUATION 9

Overview of IEEE 802.15.4 and its Characteristics - Data Gathering Paradigm - Simulation Environment and Result Analysis of IEEE 802.15.4 - Zigbee Routing Protocols - Traffic Generators -Traffic Model - Simulation Environment and Result Analysis of Zigbee Routing Protocols.

UNIT V SECURITY IN ADHOC AND SENSOR NETWORKS 9

Security Attacks - Key Distribution and Management - Intrusion Detection - Software based Anti- tamper techniques - Water marking techniques - Defence against routing attacks - Secure Ad hocrouting protocols - Broadcast authentication WSN protocols - TESLA - Biba - Sensor Network Security Protocols – SPINS

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identifying suitable routing protocols for various scenarios of ad hoc networks.
- To explore various mobility models for MANETs.
- Identify different issues in wireless sensor networks.
- Analyse the performance of IEEE 802.15.4.
- Identify and critique security issues in ad hoc and sensor networks.

REFERENCES:

1. Subir Kumar Sarkar, “Wireless Sensor and Ad Hoc Networks Under Diversified NetworkScenarios”, Auerbach Publications, 2012.
2. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, WileyIndia Private Limited, 2011.
3. Erdal Çayirci, Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wileyand Sons, 2009.
4. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory andApplications”, World Scientific Publishing, Second Edition, 2011.
5. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theoryand Practice”, Wiley India Private Limited, 2014.
6. Adrian Perrig, J.D. Tygar, “Secure Broadcast Communication: In Wired and Wireless Networks”,Kluwer Academic Publishers, Springer, 2002.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	-	-	-	-
CO2	3	3	2	1	-	-
CO3	3	3	2	1	-	-
CO4	3	2	-	-	-	-
CO5	3	3	2	1	1	3
AVG	3	2.6	2	1	1	3

SEMESTER II

ELECTIVE II

DS3263	**BIG DATA MINING AND ANALYTICS**	**L T P C**
		3 0 0 3

OBJECTIVES:

- 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 analyse and interpret streaming data
- To learn how to handle large data sets in main memory and learn the various clustering techniquesapplicable to Big Data

UNIT - I: DATA MINING AND LARGE-SCALE FILES 9

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

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

Stream Data Model - Sampling Data in the Stream - Filtering Streams - Counting Distance Elementsin a Stream - Estimating Moments - Counting Ones in Window - Decaying Windows.

UNIT - IV: LINK ANALYSIS AND FREQUENT ITEMSETS 9

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 - CountingFrequent Item sets.

UNIT- V: CLUSTERING 9

Introduction to Clustering Techniques - Hierarchical Clustering -Algorithms - K-Means - CURE - Clustering in Non -- Euclidean Spaces - Streams and Parallelism - Case Study: Advertising on theWeb – Recommendation Systems.

TOTAL:45 PERIODS

OUTCOMES:

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

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

REFERENCE BOOKS:

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

WEB REFERENCES:

1. https://swayam.gov.in/nd2_arp19_ap60/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf

ONLINE RESOURCES:

1. https://examupdates.in/big-data-analytics/
2. https://www.tutorialspoint.com/big_data_analytics/index.htm
3. https://www.tutorialspoint.com/data_mining/index.htm

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	-	-	-	-
CO2	3	3	2	1	-	-
CO3	3	3	2	1	-	-
CO4	3	2	-	-	-	-
CO5	3	3	2	1	1	3
AVG	3	3	2	1	1	3

DS3264	DEEP LEARNING	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the basic building blocks and general principles that allow one to design machinelearning algorithms
- To become familiar with specific, widely used machine learning algorithms
- To introduce building blocks of deep neural network architecture
- To understand representation and transfer of knowledge using deep learning
- To learn to use deep learning tools and framework for solving real-life problems

UNIT I INTRODUCTION 9

Basic Concepts, Introduction to Machine Learning, Applications of ML, Design Perspective and Issuesin ML, Supervised, Unsupervised, Semi-supervised learning with applications and issues.

UNIT II DEEP NETWORKS 9

Deep Networks – Introduction to Neural Networks, Feed-forward Networks, Deep Feed-forward Networks - Learning XOR, Gradient Based learning, Hidden Units, Back-propagation and other Differential Algorithms, Regularization for Deep Learning, Optimization for training Deep Models.

UNIT III CONVOLUTIONAL NETWORKS 9

Convolution operation, Motivation, Pooling, Convolution and Pooling as strong prior, Efficient convolution algorithms, Unsupervised features, Sequence Modeling: Recurrent and Recursive Nets, LSTM Networks, Applications - Computer Vision, Speech Recognition, Natural Language Processing.

UNIT IV OPTIMIZATION AND GENERALIZATION 9

Optimization in deep learning- Non-convex optimization for deep networks- Stochastic Optimization. Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT - V: DEEP LEARNING FRAMEWORKS 9

Introduction to Keras and Tensorflow, Deep Learning for computer vision - convnets, Deep Learning for Text and Sequences, Generative Deep Learning - Text Generation with LSTM, 42 Deep Dream, Neural Style Transfer, Generating images with variational auto encoders, Generative Adversarial Networks (GAN).

TOTAL: 45 PERIODS

OUTCOMES:

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

- Ability to implement and apply machine learning algorithms to real-world applications.
- Identify the deep learning algorithms which are more appropriate for various types of learning tasksin various domains
- Identify and understand building blocks of deep neural network architecture
- Incorporate transfer of knowledge in machine learning algorithms Implement deep learning
  algorithms and solve real-world problems
- Understand the deep learning tools and framework for solving real-life problems

TEXT BOOKS:

1. Ethem Alpaydin, —Introduction to Machine Learning‖, PHI, 2005 2. Ian Goodfellow, YoshuaBengio, Aaron Courville, —Deep Learning‖, The MIT Press, 2016.

REFERENCE BOOKS:

1. Tom Mitchell, —Machine Learning‖, McGraw-Hill, 1997
2. Francois Chollet, —Deep Learning with Python, Manning Publications, 2017
3. Aurélien Géron, —Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts,Tools, and Techniques to Build Intelligent Systems, O'Reilly Media; 1 edition (April 9, 2017)
4. Josh Patterson, —Deep Learning: A Practitioner's Approach‖, O'Reilly Media; 1 edition (August 19,2017)

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	1	-	-	-
CO2	-	3	-	2	-	2
CO3	-	-	2	-	3	-
CO4	3	-	1	-	-	3
CO5	-	1	-	-	2	-
AVG	2	2	1.3	2	2.5	2.5

PCP201 INFORMATION RETRIEVAL TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations andindexing.
- To understand the various applications of information retrieval giving emphasis to multimedia IR,web search.
- To learn measuring effectiveness and efficiency of information retrieval techniques.
- To get used to performing Parallel Information Retrieval.
- To understand the concepts of digital libraries.

UNIT I INTRODUCTION 9

Basic Concepts - Practical Issues - Retrieval Process - Architecture - Boolean Retrieval - Retrieval Evaluation - Open Source IR Systems-History of Web Search - Web Characteristics- The impact ofthe web on IR -IR Versus Web Search-Components of a Search engine

UNIT II RETRIEVAL MODELING 9

Taxonomy and Characterization of IR Models - Boolean Model - Vector Model - Term Weighting -

Scoring and Ranking -Language Models - Set Theoretic Models - Probabilistic Models - Algebraic Models - Structured Text Retrieval Models - Models for Browsing

UNIT III INDEXING 9

Static and Dynamic Inverted Indices - Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages - Query Processing Relevance Feedback and Query Expansion - Automatic Local and Global Analysis - MeasuringEffectiveness and Efficiency

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL 9

Traditional Effectiveness Measures - Statistics in Evaluation - Minimizing Adjudication Effect - Nontraditional Effectiveness Measures - Measuring Efficiency - Efficiency Criteria - Queueing Theory - Query Scheduling - Parallel Information Retrieval - Parallel Query Processing – Map Reduce

UNIT V SEARCHING THE WEB 9

Searching the Web -Structure of the Web -IR and web search - Static and Dynamic Ranking - WebCrawling and Indexing - Link Analysis - XML Retrieval Multimedia IR: Models and Languages - Indexing and Searching Parallel and Distributed IR - Digital Libraries

TOTAL : 45 PERIODS

OUTCOMES:

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

- Build an Information Retrieval system using the available tools.
- Identify and design the various components of an Information Retrieval system.
- Measure effectiveness and efficiency of information retrieval techniques.
- Use parallel Information Retrieval approaches in real world problems.
- Design an efficient search engine and analyze the Web content structure.

REFERENCES:

1. Ricardo Baeza - Yates, Berthier Ribeiro - Neto, “Modern Information Retrieval: The Concepts andTechnology behind Search”, (ACM Press Books), Second Edition, 2011.
2. Chrstopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to InformationRetrieval”, Cambridge University Press, First South Asian Edition, 2008.
3. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information RetrievalImplementingandEvaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	-	-	-	-	3	-
CO2	-	-	3	2	-	-
CO3	-	-	-	-	-	-
CO4	3	1	-	-	-	2
CO5	-	-	3	-	-	-
AVG	3	1	3	2	3	2

PCP202 DATA VISUALIZATION TECHNIQUES L T P C

3 0 0 3

COURSE OBJECTIVES

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand technological advancements of data visualization
- To understand various data visualization techniques
- To understand the methodologies used to visualize large data sets

UNIT I INTRODUCTION AND DATA FOUNDATION 9

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo codeConventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets

UNIT II FOUNDATIONS FOR VISUALIZATION 9

Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory A Model of Perceptual Processing.

UNIT III VISUALIZATION TECHNIQUES 9

Spatial Data: One-Dimensional Data - Two-Dimensional Data - Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data - Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques – Line Based Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.

UNIT IV INTERACTION CONCEPTS AND TECHNIQUES 9

Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space -Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.

UNIT V RESEARCH DIRECTIONS IN VISUALIZATIONS 9

Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation, Hardware and Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Visualize the objects in different dimensions.
- Design and process the data for Visualization.
- Apply the visualization techniques in physical sciences, computer science, applied mathematicsand medical sciences.
- Apply the virtualization techniques for research projects.
- Identify appropriate data visualization techniques given particular requirements imposed by the data.

REFERENCES

1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations,Techniques, Applications”, 2010.
2. Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan KaufmannPublishers, 2021.
3. Robert Spence “Information visualization - Design for interaction”, Pearson Education, 2nd Edition,2007.
4. Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	1	-	-	-
CO2	-	3	-	2	-	2
CO3	-	-	2	-	3	-
CO4	3	-	1	-	-	3
CO5	-	1	-	-	2	-
AVG	2	2	1.3	2	2.5	2.5

PCP203 **COGNITIVE COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition**.**

UNIT I PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE 9

Philosophy: Mental-physical Relation - From Materialism to Mental Science - Detour before the naturalistic turn - The Philosophy of Science - The Mind in Cognitive Science - Logic and the Sciencesof the Mind - Psychology: Place of Psychology within Cognitive Science - Science of Information Processing - Neurosciences: Cognitive Neuroscience - Perception - Decision - Learning and Memory - Language Understanding and Processing.

UNIT II COMPUTATIONAL INTELLIGENCE 9

Machines and Cognition - Artificial Intelligence - Architectures of Cognition - Knowledge Based Systems - Logical Representation and Reasoning - Logical Decision Making - Decision making under Uncertainty - Learning - Language - Vision - Robotics.

UNIT III PROBABILISTIC PROGRAMMING LANGUAGE 9

WebPPL Language - Syntax - Using Javascript Libraries - Manipulating probability types and distributions - Finding Inference - Exploring random computation - Coroutines: Functions that receive continuations -Enumeration - Other basic computation.

UNIT IV IMPLEMENTING THE INFERENCE MODELS OF COGNITION 9

Generative Models - Conditioning - Causal and statistical dependence - Conditional dependence -Data Analysis – Algorithms for Inference.

UNIT V IMPLEMENTING THE LEARNING MODELS OF COGNITION 9

Learning as Conditional Inference - Learning with a Language of Thought - Hierarchical Models -Occam's Razor - Learning (Deep) Continuous Functions - Mixture Models.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the underlying theory behind cognition.
- Connect to the cognition elements computationally.
- Implement mathematical functions through WebPPL.
- Develop a cognitive inference model.
- Develop a cognitive learning model

REFERENCES:

1. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”, The MIT Press, 1999.
2. Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/.
3. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	-	2	-	-
CO2	3	2	-	3	3	-
CO3	-	2	2	3	3	-
CO4	-	2	2	3	-	-
CO5	3	2	2	-	-	-
AVG	3	2	2	3	3	-

SEMESTER II

ELECTIVE III

PDS101	DEVOPS AND MICRO SERVICES	L T P C
		3 0 0 3

OBJECTIVES:

- Explain an overview of Micro services and Containers.
- Understand the key concepts and principles of DevOps
- List the most common DevOps tools
- Identify the business benefits of DevOps and continuous delivery.
- Recall the specific DevOps methodologies and frameworks.

UNIT I INTRODUCTION TO MICROSERVICES 9

Definition of Micro services - Characteristics - Micro services and Containers - Interacting with OtherServices - Monitoring and Securing the Services - Containerized Services - Deploying on Cloud.

UNIT II MICROSERVICES ARCHITECTURE 9

Monolithic architecture- Micro service architectural style- Benefits - Drawbacks of Micro service architectural style - decomposing monolithic applications into Micro services.

UNIT III BASICS OF DEVOPS 9

History of DevOps- DevOps and software development life cycle- water fall model - agile model - DevOps life cycle - DevOps tools: distributed version control tool -Git- automation testing tools - Selenium - reports generation - TestNG - User Acceptance Testing - Jenkins.

UNIT IV MICRO SERVICES IN DEVOPS ENVIRONMENT 9

Evolution of Micro services and DevOps – Benefits of combining DevOps and Micro services working of DevOps and Micro services in Cloud environment - DevOps Pipeline representation for a NodeJS based Micro services.

UNIT V VELOCITY AND CONTINUOUS DELIVERY 9

Velocity - Delivery Pipeline- test stack - Small/Unit Test - medium /integration testing - system testing- Job of Development and DevOps - Job of Test and DevOps - Job of Op and Devops-Infrastructure andthe job of Ops.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the Microservices and containers.
- Explain the architecture of Microservices.
- Describe DevOps and the common tools used in DevOps.
- Apply Microservices in DevOps.
- Develop, integrate and deploy projects using DevOps.

TEXT BOOKS:

1. Namit Tanasseri, RahulRai, “Microservices with Azure”, 1st Edition, Packt Publishing, UK, 2017.
2. Eberhard Wolff, “Microservices: Flexible Software Architecture”, 1st Edition, Pearson Education,2017

REFERENCE BOOKS:

1. James A Scott, “A Practical Guide to Microservices and Containers”, Map R Data Technologies,
   e-book:https://mapr.com/ebook/microservicesandcontainers/assets/microservices-and-containers.pdf.
2. Joyner Joseph, Devops for Beginners, First Edition, Mihails Konoplovs publisher, 2015.
3. Gene Kim, Kevin Behr, George Spafford, The Phoenix Project, A Novel about IT, DevOps, 5th Edition, IT Revolution Press, 2018.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	-	-	-	-
CO2	3	3	-	-	-	-
CO3	3	3	2	-	2	-
CO4	3	3	2	-	-	-
CO5	3	3	-	-	-	-
AVG	3	3	2	-	2	-

PDS104	WEB DESIGN AND MANAGEMENT	L T P C 3 0 0 3

OBJECTIVES:

- Understand the design principles and interaction.
- To explore the detailed design practices, standards.
- To gain an insight into Content Management System for content design.
- To use any Content Management System tool for better content management.
- To get familiarized with Web Analytics for better management.

UNIT I PRINCIPLES OF WEB DESIGN 9

User Centered Design, Web Medium, Information Architectures, Site Types and Architectures, Page Structure, Site Maps, Navigation, Search, Web Design Process, Designing for Multiple ScreenResolutions, Creating A Unified Site Design, Evaluating Web Sites.

UNIT II ELEMENTS OF PAGE DESIGN 9

Elements Of Page Design, Adding Styles With CSS, Pages And Layout, Typography, Color, Images, GUI Widgets and Forms, Responsive Web Designs, User Input Forms, Working With Data Tables, Web Standards And Styles.

UNIT III WEB CONTENT DESIGN 9

Features - Automated Templates - Template Processor -Front Controller Pattern - Content Modeling- Content Aggregation - Plug-Ins - Search Engine Optimization - Recommended Usage Of Tools - WORDPRESS

UNIT IV WEB CONTENT MANAGEMENT 9

Work Flow Management - Document Management - Collaboration - Versioning – Recommended Usage Of Tools – WORDPRESS

UNIT V WEB ANALYTICS 9

Web Analytics Process - Data Collection - Qualitative Analysis - Log File Analysis - Page Tagging - Hybrid Methods - Click Analytics - Onsite And Offsite Analytics - Web Analytics Methods.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design web pages that follow standards and are usable.
- Design web sites that are appealing.
- To be able to use Content management System for designing web Content.
- To take advantage of Content Management System tools for managing content for large websites.
- To be able to use analytics tools for better management.

TEXT BOOKS:

1. Patrich J. Lynch, Sarah Horton, "Web Style Guide-Foundations of User Experience Design", YaleUniversity Press, 4th Edition, 2016.
2. Thomas A. Powell, "The Complete Reference- Web Design", Tata McGraw Hill, Second Edition,2003.
3. Joel Sklar, "Principles of Web Design, Cengage Learning", Web Warrior Series, 6th Edition,2015.

REFERENCE BOOKS:

1. Deane Barker, "Web Content management-Systems, Features and Best Practices", O'reillyMedia, 1st Edition, 2016.
2. Brian Clifton, "Advanced web Metrics with Google Analytics", Third Edition, Sybex Publishers,2012.
3. Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability and Science of Customer
   Centricity", 1st edition, Sybex publishers, 2009.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	1	2	3	2	-
CO2	2	1	2	3	2	1
CO3	2	-	3	3	3	1
CO4	1	-	3	3	3	3
CO5	3	-	3	3	3	3
AVG	2	1	2.6	3	2.6	2

PDS303 ROBOTIC PROCESS AUTOMATION L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts associated with the design, functioning, applications andsocial aspects of robots
- To study about the electrical drive systems and sensors used in robotics for various applications
- To learn about analyzing robot kinematics, dynamics through different methodologies andstudy various design aspects of robot arm manipulator and end-effector
- To learn about various motion planning techniques and the associated control architecture
- To understand the implications of AI and other trending concepts of robotics

UNIT I FOUNDATION FOR BEGINNERS 9

Introduction - brief history, definition, anatomy, types, classification, specification and need based applications - Role and need of robots for the immediate problems of the society, future of mankind and automation - Ethical issues - Industrial scenario local and global - case studies on mobile robot research platform and industrial serial arm manipulator.

UNIT II BUILDING BLOCKS OF A ROBOT 9

Types of electric motors - DC, Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators - Sensorsfor localization, navigation, obstacle avoidance and path planning in known and unknown environments optical, inertial, thermal, chemical, biosensor, other common sensors - Case study on choice of sensors and actuators for maze solving robot and self-driving cars.

UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS 9

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics - Mechanical design aspects of a 2R manipulator, WMR - End-effector - Common types and design case study.

UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 9

Mapping & Navigation - SLAM, Path planning for serial manipulators - Types of control architectures- Cartesian control, Force control and hybrid position/force control - Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot.

UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids

TOTAL:45 PERIODS

OUTCOMES:

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

- Explain the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation
- Examine different sensors and actuators for applications like maze solving and self-driving cars
- Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots
- Explain navigation and path planning techniques along with the control architectures adopted
  for robot motion planning
- Describe the impact and progress in AI and other research trends in the field of robotics

TEXT BOOKS:

1. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations,2002
2. Roland Siegwart, Illah Reza Nourbakhsh, Introduction to Autonomous Mobile Robots, MITPress, 2011

REFERENCE BOOKS:

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic engineering: an integrated approach, Prentice Hall, 1989
2. Craig, J. J., Introduction to Robotics: Mechanics and Control, 2nd Edition, Addison-Wesley,1989.
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
4. Wesley E Snyder R, Industrial Robots, Computer Interfacing and Control, Prentice HallInternational Edition, 1988.
5. Robin Murphy, Introduction to AI Robotics, MIT Press, 2000.
6. N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005.
7. Stefano Nolfi, Dario Floreano, Evolutionary Robotics — The Biology, Intelligence and Technology of Self–Organizing Machines (Intelligent Robotics and Autonomous Agents series), ess, 2004.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	3	3	2	-
CO2	3	3	3	3	2	-
CO3	3	3	3	3	2	-
CO4	3	3	3	3	2	-
CO5	3	3	3	3	2	-
AVG	3	3	3	3	2	-

PCP301	FULL STACK WEB APPLICATION DEVELOPMENT	L T P C 3 0 0 3

COURSE OBJECTIVES:

- Develop TypeScript Application
- Develop Single Page Application (SPA)
- Able to communicate with a server over the HTTP protocol
- Learning all the tools need to start building applications with Node.js
- Implement the Full Stack Development using MEAN Stack

UNIT I FUNDAMENTALS & TYPESCRIPT LANGUAGE 9

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums.Iterators. Generators.

UNIT II ANGULAR 9

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. HttpClient. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III NODE.js 9

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and TypedArrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

UNIT IV EXPRESS.Js 9

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser.express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router.route(path). Router Class. Request Object. Response Object. Error Handling.

UNIT V MONGODB 9

Introduction to MongoDB. Documents. Collections. Subcollections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Develop basic programming skills using Javascript
- Implement a front-end web application using Angular.
- Will be able to create modules to organise the server
- Build RESTful APIs with Node, Express and MongoDB with confidence.
- Will learn to Store complex, relational data in MongoDB using Mongoose

REFERENCES

1. Adam Freeman, Essential TypeScript, Apress, 2019
2. Mark Clow, Angular Projects, Apress, 2018
3. Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
4. Pro Express.js, Azat Mardan, Apress, 2015
5. MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins,Manning Publication, Second edition, 2016

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	1	2	1	-	-
CO2	2	1	3	1	-	-
CO3	2	2	1	2	1	-
CO4	1	2	1	2	-	-
CO5	1	3	3	1	3	-
AVG	2	2	2	2	2	-

PCP302 **GAME DEVELOPMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and toolkits.
- To learn and develop simple games using the Pygame environment.

UNIT I 3D GRAPHICS FOR GAME PROGRAMMING 9

Game - Definition - Genres of Games, Basics of 2D and 3D Graphics, Game Objects Design - 2D and3D Transformations - Projections - Colour Models - Illumination and Shader Models - Animation - Controller based Animation.

UNIT II GAME DESIGN PRINCIPLES 9

Character Development, Storyboard Development for Gaming - Script Design - Script Narration - Game Balancing -Core Mechanics - Principles of Level Design - Proposals - Writing for Preproduction, Production and Post-Production

UNIT III GAME ENGINE DESIGN 9

Rendering Concept - Software Rendering - Hardware Rendering - Spatial Sorting Algorithms - Algorithms for Game Engine - Collision Detection - Game Logic - Game AI - Path Finding

UNIT IV OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 9

Pygame Game development - Unity - Unity Scripts -Mobile Gaming, Game Studio, Unity -Single playerand Multiplayer games.

UNIT V GAME DEVELOPMENT USING PYGAME 9

Developing 2D and3D Interactive Games using Pygame - Avatar Creation - 2D and 3D Graphics Programming - Incorporating Music and Sound - Asset Creations - Game Physics Algorithms Development - Device Handling in Pygame - Overview of Isometric and Tile Based Games -Overview of Puzzle Games.

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:

1 External learning - Writing Unity scripts and assets.
2. Practical - Implementation of simple games.
3. External learning on Unity Game Engine.
4. Practical - Installation of Unity and scripts.
5. Practical - Pygame routines for character rendering, transformations and sound processing.

COURSE OUTCOMES:

- To have a fundamental understanding of the concepts of 2D and 3D graphics.
- Apply design and development principles in the construction of games.
- Understand the implementation of gaming engines.
- Understand foundational language and platforms of game development technology.
- Will gain experience with various game developments like Pygame and Unity.

REFERENCES:

1. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.
2. Ernest Adams, “Fundamentals of Game Design”, 3rd Edition, New Riders Press, 2013.
3. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press, 2006.
4. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress Publishers, 2007.
5. Paul Craven, “Python Arcade games”, Apress Publishers, 2016.
6. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison-Wesley Professional, 1st Edition, 2013.
7. Tracy Fullerton, Game Design Workshop: A Playcentric Approach to Creating Innovative Games, A K Peters/CRC Press, 4th Edition, 2018.
8. Paris Buttfield-Addison, Jon Manning, Tim Nugent, “Unity Game Development Cookbook: Essentials for Every Game”, OReilly, 1st edition, 2019.
9. Jesse Schell, “The Art of Game Design: A Book of Lenses”, 3rd Edition, CRC Press, 2019

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	2	1	2	-
CO2	1	2	2	1	2	-
CO3	1	1	1	2	1	-
CO4	3	3	1	3	3	-
CO5	3	3	2	1	3	-
AVG	2.2	2.2	1.6	1.6	2.2	-

SEMESTER III

ELECTIVE IV

PDS203	SOCIAL NETWORK SECURITY	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the component of the social network.
- To gain knowledge from disciplines as diverse as sociology
- To learn various risks in social media.
- Identify the various ways to manage the risk in Social networks
- Understand Social Network Privacy Policies And Security

UNIT I INTRODUCTION 9

Overview: Social network- Paths and Connectivity- Distance and Breadth-First Search- Network Datasets - Strong and Weak Ties - Triadic Closure - The Strength of Weak Ties - Tie Strength and Network Structure in Large-Scale Data - Tie Strength, Social Media, and Passive Engagement - Closure, Structural Holes, and Social Capital.

UNIT II SOCIAL INFLUENCE 9

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

UNIT III RISKS OF SOCIAL MEDIA 9

Risks of social media-public embarrassment-false information-information leakage-retention and archiving content-backing up social media-loss of data. The dark side of social media-cybercrime-social engineering-hacked accounts.

UNIT IV OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 9

Risk management -Assessing risks -Laws and regulations -Insurance -Forensics -Police use of social media - Malware, viruses, and exploit distribution-Scareware/ ransomware -Baiting-Browser hijacking.

UNIT V PRIVACY POLICIES AND SECURITY 9

Policy and privacy: Policies- Policies affected by social network-Antidiscrimination and Anti-harassment privacy -blocking users-controlling app privacy-location awareness-Security: security-fake accounts-passwords-privacy and information sharing-content security.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop semantic web related simple applications
- Address Privacy and Security issues in Social Networking
- Explain the data extraction and mining of social networks
- Discuss the prediction of human behavior in social communities
- Describe the applications of social networks

TEXT BOOKS:

1. Easley and Kleinberg, "Networks, Crowds, and Markets: Reasoning about a highly connected world", Cambridge Univ. Press, 2010.
2. Michael Cross, "Social Media Security: Leveraging Social Networking While Mitigating Risk" Elsevier

REFERENCE BOOKS:

1. Wasserman, S., & Faust, K, ¯Social Network Analysis: Methods and Applications, CambridgeUniversity Press; 1 edition, 1994
2. Borgatti, S. P., Everett, M. G., & Johnson, J. C., ¯Analyzing social networks, SAGE PublicationsLtd; 1 edition, 2013.
3. Robert A. Hanneman and Mark Riddle, "Introduction to social network methods", University ofCalifornia, 2005

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	3	3	3	-	-
CO2	3	3	2	3	-	-
CO3	3	3	2	3	-	-
CO4	3	3	2	3	-	-
CO5	3	3	2	3	-	-
AVG	3	3	2.2	3	-	-

PDS204 **BLOCKCHAIN TECHNOLOGIES** **L T P C**
3 0 0 3

OBJECTIVES:

- Understand emerging abstract models for Blockchain Technology.
- To acquire the basic knowledge and understandings of Bitcoin
- It provides conceptual understanding of the function of Blockchain
- To understand the mechanisms of Bitcoin, Ethereum, Hyperledger.
- To develop familiarity of current technologies, tools, and implementation strategies.

UNIT I INTRODUCTION TO BLOCKCHAIN ANDCRYPTOCURRENCY 9

Cryptography and Cryptocurrency- Digital Signatures-Crypto currency Hash Codes-Bitcoin-ecosystem A basic crypto currency, Creation of coins,-Block chain- An Introduction Distinction between databases and Block chain- Distributed ledger-Blockchain ecosystem Blockchain structure- Cryptocurrency to Blockchain 2.0- Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT II BITCOIN AND BLOCKCHAIN 9

Bitcoin – history- Bitcoin- usage, storage, selling, transactions, working- Invalid Transactions-Parameters that invalidate the transactions- Scripting language in Bitcoin Applications of Bitcoin script- Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

UNIT III BITCOIN CONSENSUS 9

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

UNIT IV DISTRIBUTED CONSENSUS 9

Distributed consensus in open environments -RAFT Consensus-Byzantine general problem, Byzantine fault tolerant system-Agreement Protocol, Lamport-Shostak-Pease BFT Algorithm-BFT over Asynchronous systems, Practical Byzantine Fault Tolerance.

UNIT V HYPER LEDGER FABRIC & ETHERUM 9

Hyperledger Architecture, chain code- Ethereum: Ethereum network, EVM, Transaction fee, MistBrowser, Ether, Gas, Solidity, Smart contracts, Truffle Design and issue Crypto currency, Mining, DApps, DAO. Internet of Things-Medical Record Management System-Blockchain in Government and Blockchain Security-Blockchain Use Cases -Finance.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand block chain technology.
- Develop block chain based solutions and write smart contract using Hyper ledger Fabric and Ethereum frameworks.
- Identify and analyze the applications of Bitcoin script
- Integrate ideas from various domains and implement them using block chain technologyin different perspectives.
- Develop private Block chain environment and develop a smart contract on Ethereum

TEXT BOOKS:

1. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015.
2. Josh Thompsons, “Blockchain: The Blockchain for Beginners- Guide to Blockchain Technology and Leveraging Blockchain Programming”, 2017

REFERENCE BOOKS:

1. Bashir, Imran “”Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks”,2017.
2. Blockchain Technology: Cryptocurrency and Applications by S.Shukla, M.Dhawan, S.Sharma, Venkatesan, Oxford University Press 2019.
3. Joseph Bonneau et al, “SoK: Research perspectives and challenges for Bitcoin and crypto currency”, IEEE Symposium on security and Privacy, 2015.
4. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas M Antonopoulos2018 Dreas Antonopoulos, Mastering Ethereum: Building Smart Contracts and Dapps, O’Reilly 2018.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	3	3	-	-
CO2	3	3	3	3	-	-
CO3	3	3	3	3	-	-
CO4	3	3	3	3	-	-
CO5	3	3	3	3	-	-
AVG	3	3	3	3	-	-

PCP401 **CYBER SECURITY** **LT P C**
3 0 0 3

OBJECTIVES:

- To understand the nature of threats and cyber security management goals and technology
- To understand the landscape of hacking and perimeter defense mechanisms
- To develop strategies for cyber security and protecting critical infrastructure
- To understand policies to mitigate cyber risks
- To understand the IT Act, scheme, amendments and emerging cyber law and desired cyber ecosystem capabilities.

UNIT I OVERVIEW OF CYBER SECURITY 9

Introduction - Cyberspace - Cyber Crime - Nature of Threat - Cyber security - Policy, Mission and Vision of Cyber security Program. Cyber security management system - goals, technology categories - perimeter defense and encryption. Cyber security management framework.

UNIT II ATTACKS AND COUNTERMEASURES 9

Malicious Attacks, Threats, and Vulnerabilities - Scope of cyber-attacks - Tools used to attack computer systems - security breach - Risks, vulnerabilities and threats. Malware - malicious software attack - social engineering attack - wireless network attack – web application attack -Countermeasures- Types of Network Security Devices -Firewalls, Intrusion Detection Systems, Content Filtering, Virtual Private Networks – Encryption.

UNIT III STRATEGIES FOR CYBER SECURITY 9

Creating a Secure Cyber, Types of Attacks, Comparison of Attacks, Creating an Assurance Framework, Encouraging Open Standards, Strengthening the Regulatory framework, Creating Mechanisms for IT Security, Securing E-Governance Services, and Protecting Critical Information Infrastructure. Areas for Intervention - Legal Responses - Harmonization of Legislation - Criminalization of Cyber Offences - National Security and issues related to Privacy and Freedom of Expression - Investigation Procedures - International Cooperation - Electronic Evidence - Liability of ISPs-Recommendations

UNIT IV POLICIES TO MITIGATE CYBER RISK 9

Promotion of R&D in Cyber security - Reducing Supply Chain Risks - Mitigate Risks through Human Resource Development - Creating Cyber security Awareness- Information sharing - Implementing a Cyber security Framework. Signatures- Digital Signature, Electronic Signature

UNIT V CRITICAL INFORMATION INFRASTRUCTURE PROTECTION 9

National Security - Information Sharing and Coordination - Innovation In Regulatory Approach - Innovation in Security Programs - Proactive Threat and Vulnerability Management - Promoting Best Practices in Critical Infrastructure Sectors - Assessing and Monitoring Security Preparedness of Sectors (Security Index) - Security in Information Technology Supply Chain -Taking Leadership and Participating in International Efforts - Capacity Building in Security Skills

and training and Awareness. The Indian Cyberspace- Cyber Threats – Need for a Comprehensive Cyber Security Policy - Need for a Nodal Authority - Need for an International Convention on Cyberspace - Cyber War - Fifth Domain of Warfare - Meeting the Cyber Warfare Challenges.

TOTAL: 45 PERIODS

OUTCOMES:

- Gain knowledge on the nature of threats and cyber security management goals and framework
- Knowledge on the landscape of hacking and perimeter defense mechanisms
- Ability to differentiate and integrate strategies for cyber security and protecting critical infrastructure
- Able to understand policies to mitigate cyber risks
- Knowledge on IT Act, and amendments, copy rights, IPR and cyber law to deal with offenses.

REFERENCES:

1. David Kim and Michael G. Solomon, Fundamentals of Information Systems Security, Third Edition Transition Guide, Jones &Bartlett Learning, 2018.
2. Peter Trim and Yang - Im Lee, —Cyber Security Management- A Governance, Risk andCompliance Framework, Gower Publishing, England 2014.
3. Institute for Defence Studies and Analysis Report, India's Cyber Security Challenge, 2012https://idsa.in/system/files/book/book_indiacybersecurity.pdf
4. John G. Voeller, Cyber Security, John Wiley & Sons, England, 2014.
5. Carol C. Woody, Nancy R. Mead, Cyber Security Engineering: A Practical Approach forSystems and Software Assurance, Addison-Wesley, 2016.
6. Edward Griffor, Handbook of System Safety and Security, Syngress an Elsevier Publications, 1st edition, 2017.
7. Thomas A. Johnson Cyber Security- Protecting Critical Infrastructures from Cyber Attackand Cyber Warfare, CRC Press, 2015.
8. NIST Cyber security Framework, Version 1.0, 2014.
9. CGI, —Cyber security in Modern Critical Infrastructure Environments, 2014.
10. Stuart Broderick J, Cyber Security Program, Cisco Security Solutions, June 2016.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	1	1	3	3
CO2	2	2	1	1	-	3
CO3	2	2	1	1	3	3
CO4	2	2	1	1	-	3
CO5	2	2	1	1	-	3
AVG	2	2	1	1	3	3

PCP402 PRINCIPLES OF CRYPTOGRAPHY L T P C

3 0 0 3

OBJECTIVES:

- To understand the mathematical foundations of security principles.
- To appreciate the different aspects of encryption techniques.
- To understand various attacks present over encryption and authentications techniques.
- To understand the role played by authentication in security.
- To appreciate the current trends of security practices.

UNIT I CLASSICAL ENCRYPTION AND BLOCKCIPHERS 9

Classical Encryption - Substitution Cipher - One-time-pad Encryption - Block Ciphers -DES KeyRecovery Attacks on Block Ciphers - Iterated-DES and DESX - AES - Limitations of Key-Recovery based Security.

UNIT II PSEUDO RANDOM FUNCTIONS AND SYMMETRIC ENCRYPTION 9

Random Functions - Permutations - Pseudo Functions - Pseudo-random Permutations – ModellingBlockciphers - Security against Key Recovery - The Birthday Attack - Symmetric Encryption Schemes - Chosen Plaintext Attacks - Semantic Security - Security of CTR and CBC - Chosen Ciphertext Attack.

UNIT III HASH FUNCTIONS AND MESSAGE AUTHENTICATION 9

Hash Function SHA1 - Collision resistant Hash Functions - Collision Finding Attacks - Onewaynessof Collision resistant Hash Functions - MD Transform - Syntax for message Authentication - PRF asa MAC Paradigm - CBC MAC - Universal-hashing Approach - Authenticated Encryption.

UNIT IV NUMBER THEORY AND ASYMMETRIC ENCRYPTION 9

Computational Number Theory - Number Theoretic Primitives - Diffie Hellman Problem – Asymmetric Encryption Schemes - Hybrid Encryption - ElGamal Scheme and its Variants– Homomorphic Encryption – Digital Signatures

UNIT V SECURITY PRACTICES AND ADVANCED TOPICS 9

Electronic Mail Security - IP Security - Digital Cash - Schnorr's Identification Protocol and Signature-Blind Signature - Distributed Ledger and Bitcoin -- Secret Sharing – Shamir Threshold Scheme -Security in Routing – Mixnet

TOTAL : 45 PERIODS

OUTCOMES:

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

- Understand the mathematical foundations of security principles
- Demonstrate the various classical encryption techniques and the adversary capabilities.
- Apply computational secrecy and semantic security to find out the probability of how strong are thesecurity schemes.
- Illustrate the various MAC and HASH functions and apply the Birthday attack over Hash.
- Apply number theory in public key encryption techniques.
- Analyze the application of cryptography for secure E-Commerce and other secret transactions.

REFERENCES:

1. MihirBellare and Phillip Rogaway, “Introduction to Modern Cryptography”, 2005.
2. Jonathan Katz and Yehuda Lindell, “Introduction to Modern Cryptography ”,Chapman and Hall/CRCPress Second Edition, 2015.
3. Hans Delfts and Helmut Knebl, “Introduction to Cryptography – Principles and Applications”,Springer, Third Edition by, 2015.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	2	-	2	2
CO2	2	1	3	-	-	-
CO3	2	3	2	2	-	-
CO4	2	3	3	-	2	-
CO5	-	2	-	2	2	2
CO6	-	2	-	-	2	3
AVG	2	3	3	2	2	2

PCP403 **ETHICAL HACKING** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing.

UNIT I INTRODUCTION TO HACKING 9

Introduction to Hacking - Importance of Security - Elements of Security - Phases of an Attack - Typesof Hacker Attacks - Hacktivism - Vulnerability Research - Introduction to Footprinting - InformationGathering Methodology - Footprinting Tools - WHOIS Tools - DNS Information Tools Locating the Network Range - Meta Search Engines

UNIT II SCANNING AND ENUMERATION 9

Introduction to Scanning - Objectives - Scanning Methodology - Tools - Introduction to Enumeration- Enumeration Techniques - Enumeration Procedure - Tools

UNIT III SYSTEM HACKING 9

Introduction - Cracking Passwords - Password Cracking Websites - Password Guessing - Password Cracking Tools - Password Cracking Countermeasures - Escalating Privileges - Executing Applications – Keyloggers and Spyware

UNIT IV PROGRAMMING FOR SECURITY PROFESSIONALS 9

Programming Fundamentals - C language - HTML - Perl - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities - Countermeasures - Linux OS Vulnerabilities - Tools for Identifying Vulnerabilities — Countermeasures

UNIT V PENETRATION TESTING 9

Introduction - Security Assessments - Types of Penetration Testing- Phases of Penetration Testing-Tools - Choosing Different Types of Pen-Test Tools – Penetration Testing Tools

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify threats to computers.
- Defend hacking attacks.
- Protect data assets.
- Defend a computer against a variety of security attacks using various tools.
- Practice and use safe techniques on the World Wide Web.

REFERENCES:

1. EC-Council, “Ethical Hacking and Countermeasures: Attack Phases”, Cengage Learning, 2010.
2. Jon Erickson, “Hacking, 2nd Edition: The Art of Exploitation”, No Starch Press Inc., 2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking and NetworkDefense”, Cengage Learning, 2013.
4. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking andPenetration Testing Made Easy”, Second Edition, Elsevier, 2013.
5. Rafay Boloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	3	-	-	-
CO2	-	-	-	-	2	-
CO3	-	-	-	2	-	-
CO4	-	-	-	-	-	2
CO5	-	-	-	-	-	-
AVG	3	2	3	2	2	2

PDS301 AUGMENTED REALITY AND VIRTUAL REALITY L T P C
3 0 0 3

OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION 9

Introduction to Virtual Reality and Augmented Reality - Definition - Introduction to Trajectories andHybrid Space-Three I's of Virtual Reality - Virtual Reality Vs 3D Computer Graphics - Benefits of Virtual Reality - Components of VR System - Introduction to AR-AR Technologies-Input Devices - 3D Position Trackers - Types of Trackers - Navigation and Manipulation Interfaces - Gesture Interfaces - Types of Gesture Input Devices - Output Devices - Graphics Display - Human Visual System -Personal Graphics Displays - Large Volume Displays - Sound Displays - Human Auditory System.

UNIT II VR MODELING 9

Modeling - Geometric Modeling - Virtual Object Shape - Object Visual Appearance - KinematicsModeling - Transformation Matrices - Object Position - Transformation Invariants - Object Hierarchies - Viewing the 3D World - Physical Modeling - Collision Detection - Surface Deformation – Force Computation - Force Smoothing and Mapping - Behavior Modeling - Model Management.

UNIT III VR PROGRAMMING 9

VR Programming - Toolkits and Scene Graphs - World ToolKit - Java 3D - Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS 9

Human Factors in VR - Methodology and Terminology - VR Health and Safety Issues - VR and Society-Medical Applications of VR - Education, Arts and Entertainment - Military VR Applications -Emerging Applications of VR - VR Applications in Manufacturing - Applications of VR in Robotics -Information Visualization - VR in Business - VR in Entertainment - VR in Education.

UNIT - V: AUGMENTED REALITY **9**

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the basic concepts of AR and VR
- Understand the tools and technologies related to AR/VR
- Know the working principle of AR/VR related Sensor devices
- Design of various models using modeling techniques
- Develop AR/VR applications in different domains

TEXT BOOKS:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, AddisonWesley, 2016
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application,Design”, Morgan Kaufmann, 2003

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	3	3	3	2	-
CO2	3	3	3	3	2	-
CO3	3	3	3	3	2	-
CO4	3	3	3	3	2	-
CO5	3	3	3	3	2	-
AVG	3	3	3	3	2	-

PDS302	3D PRINTING TECHNOLOGIES	L T P C 3 0 0 3

OBJECTIVES:

- The course is designed to impart knowledge and skills related to 3D printing technologies.
- Selection of material and equipment and develop a product using this technique.
- To understand Industry 4.0 environment.
- To understand CAD and Additive manufacturing
- To understand Additive Equipment.

UNIT I 3D PRINTING AND ADDITIVE MANUFACTURING 9

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.

UNIT II CAD AND ADDITIVE MANUFACTURING 9

CAD for Additive Manufacturing-CAD Data formats, Data translation, Data loss, STL format. Additive Manufacturing Techniques - Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.

UNIT III PROCESS 9

Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools

UNIT IV MATERIALS 9

Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT V ADDITIVE MANUFACTURING EQUIPMENT 9

Process Equipment- Design and process parameters-Governing Bonding Mechanism-Commonfaults and troubleshooting - Process Design- Post Processing: Requirement and Techniques- Product Quality.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate .stl file.
- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXTBOOKS:

1. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.2020
2. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”,World Scientific, 2017.

REFERENCE BOOKS:

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series inMaterial Science, 2013.
4. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for RapidPrototyping”, Kulwer Academic Press, 2001.
5. Zhiqiang Fan And Frank Liou, “Numerical Modelling of the Additive Manufacturing (AM)Processes of Titanium Alloy”, InTech, 2012.

CO’s- PO’s MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	3	3	2	-
CO2	3	3	3	3	2	-
CO3	3	3	3	3	2	-
CO4	3	3	3	3	2	-
CO5	3	3	3	3	2	-
AVG	3	3	3	3	2	-

PCP501 **QUANTUM COMPUTING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I QUANTUM BUILDING BLOCKS 9

The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum StateSpaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere

UNIT II QUANTUM STATE TRANSFORMATIONS 9

Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations.

UNIT III QUANTUM ALGORITHMS 9

Computing with Superpositions, Quantum Subroutines, Quantum Fourier Transformations, Shor'sAlgorithm and Generalizations, Grover's Algorithm and Generalizations

UNIT IV ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATION 9

Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graph states and codes, CSS Codes, Stabilizer Codes, Fault Tolerance and Robust Quantum Computing

UNIT V QUANTUM INFORMATION PROCESSING 9

Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Understand the basic principles of quantum computing.
- Gain knowledge of the fundamental differences between conventional computing and quantum computing.
- Understand several basic quantum computing algorithms.
- Understand the classes of problems that can be expected to be solved well by Quantum computers.
- Simulate and analyze the characteristics of Quantum Computing Systems.
- Explore and understand the applications of quantum computing

REFERENCES:

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

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	1	-	1	-	1
CO2	2	1	-	1	1	2
CO3	1	2	-	2	-	1
CO4	2	1	-	1	-	1
CO5	1	-	2	-	-	-
C06	1	1	1	-	-	-
AVG	1.5	1.2	1.5	1.2	1	1.2

PCP502 **NATURAL LANGUAGE PROCESSING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand basics of linguistics, probability and statistics
- To study statistical approaches to NLP and understand sequence labeling
- To outline different parsing techniques associated with NLP
- To explore semantics of words and semantic role labeling of sentences
- To understand discourse analysis, question answering and chatbots

UNIT I INTRODUCTION 9

Natural Language Processing - Components - Basics of Linguistics and Probability and Statistics -Words-Tokenization-Morphology-Finite State Automata

UNIT II STATISTICAL NLP AND SEQUENCE LABELING 9

N-grams and Language models -Smoothing -Text classification- Naïve Bayes classifier - Evaluation - Vector Semantics - TF-IDF - Word2Vec- Evaluating Vector Models - Sequence Labeling - Part of Speech - Part of Speech Tagging -Named Entities -Named Entity Tagging

UNIT III CONTEXTUAL EMBEDDING 9

Constituency -Context Free Grammar -Lexicalized Grammars- CKY Parsing - Earley's algorithm- Evaluating Parsers -Partial Parsing - Dependency Relations- Dependency Parsing - Transition Based - Graph Based

UNIT IV COMPUTATIONAL SEMANTICS 9

Word Senses and WordNet - Word Sense Disambiguation - Semantic Role Labeling - Proposition Bank- FrameNet- Selectional Restrictions - Information Extraction - Template Filling

UNIT V DISCOURSE ANALYSIS AND SPEECH PROCESSING 9

Discourse Coherence - Discourse Structure Parsing - Centering and Entity Based Coherence - Question Answering -Factoid Question Answering - Classical QA Models - Chatbots and Dialoguesystems - Frame-based Dialogue Systems - Dialogue-State Architecture

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Understand basics of linguistics, probability and statistics associated with NLP
- Implement a Part-of-Speech Tagger
- Design and implement a sequence labeling problem for a given domain
- Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP
- Implement a simple chatbot using dialogue system concepts

REFERENCES

1. Daniel Jurafsky and James H.Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition” (Prentice Hall Series in Artificial Intelligence), 2020
2. Jacob Eisenstein. “Natural Language Processing “, MIT Press, 2019
3. Samuel Burns “Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019
4. Christopher Manning, “Foundations of Statistical Natural Language Processing”, MIT Press, 2009.
5. Nitin Indurkhya, Fred J. Damerau, “Handbook of Natural Language Processing”, Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover, 2010
6. Deepti Chopra, Nisheeth Joshi, “Mastering Natural Language Processing with Python”,Packt Publishing Limited, 2016
7. Mohamed Zakaria Kurdi “Natural Language Processing and Computational Linguistics:Speech, Morphology and Syntax (Cognitive Science)”, ISTE Ltd., 2016
8. Atefeh Farzindar,Diana Inkpen, “Natural Language Processing for Social Media (Synthesis Lectures on Human Language Technologies)”, Morgan and Claypool Life Sciences, 2015

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	3	-	3	2	-
CO2	3	-	3	3	-	2
CO3	-	3	-	2	2	-
CO4	-	3	-	2	-	-
CO5	-	-	3	-	2	2
AVG	2.5	3	3	2.5	2	2

PCP503	SOFT COMPUTING	LT P C
		3 0 0 3

OBJECTIVES:

- To learn the key aspects of Soft computing and Neural networks.
- To study the fuzzy logic components.
- To gain insight onto neuro fuzzy modeling and control.
- To know about the components and building block hypothesis of genetic algorithm.
- To gain knowledge in machine learning through neural networks.

UNIT I INTRODUCTION TO SOFT COMPUTING 9

Evolution of Computing - Soft Computing Constituents - From Conventional AI to Computational Intelligence – Machine Learning Basics

UNIT II GENETIC ALGORITHMS 9

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

UNIT III NEURAL NETWORKS 9

Machine Learning using Neural Network, Adaptive Networks - Feed Forward Networks - Supervised Learning Neural Networks - Radial Basis Function Networks - Reinforcement Learning - Unsupervised Learning Neural Networks - Adaptive Resonance Architectures - Advances in Neural Networks.

UNIT IV FUZZY LOGIC 9

Fuzzy Sets - Operations on Fuzzy Sets - Fuzzy Relations - Membership Functions- Fuzzy Rules and Fuzzy Reasoning - Fuzzy Inference Systems - Fuzzy Expert Systems - Fuzzy Decision Making.

UNIT V NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems - Coactive Neuro-Fuzzy Modeling - Classification and Regression Trees - Data Clustering Algorithms - Rule based Structure Identification - Neuro- Fuzzy Control – Case Studies.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Differentiate Conventional AI and Computational Intelligence.
- Discuss on machine learning through neural networks.
- Apply knowledge in developing a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Discover knowledge to develop Genetic Algorithm and Support vector machine based Machine learning system.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hallof India, 2002.
2. KwangH.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall,1996.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, andProgramming Techniques", Addison Wesley, 2003.
5. David E.Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", AddisonWesley, 1989.
6. Mitchell Melanie, "An Introduction to Genetic Algorithm", MIT Press, 1996.
7. S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic Algorithms", Springer, 2008 edition.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	2	2	3	-
CO2	2	1	2	2	3	2
CO3	3	2	1	-	2	2
CO4	3	2	2	-	3	-
CO5	3	1	2	2	3	-
AVG	2.8	1.5	1.8	2	2.8	2