ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.TECH INFORMATION TECHNOLOGY
(SPECIALIZATION IN MULTIMEDIA)
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF INFORMATION SCIENCE AND TECHNOLOGY

VISION OF THE DEPARTMENT:

To educate students with conceptual knowledge and technical skills in the field of Information Technology with moral and ethical values to achieve excellence in academic, industry and research centric environments.

MISSION OF THE DEPARTMENT:

1. To inculcate in students a firm foundation in theory and practice of IT skills coupled with the thought process for disruptive innovation and research methodologies, to keep pace with emerging technologies.
2. To provide a conducive environment for all academic, administrative and interdisciplinary research activities using state-of-the-art technologies.
3. To stimulate the growth of graduates and doctorates, who will enter the workforce as productive IT engineers, researchers and entrepreneurs with necessary soft skills, and continue higher professional education with competence in the global market.
4. To enable seamless collaboration with the IT industry and Government for consultancy and sponsored research.
5. To cater to cross-cultural, multinational and demographic diversity of students.
6. To educate the students on the social, ethical, and moral values needed to make significant contributions to society.

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1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

I. To prepare students to excel in research and to succeed in Information Technology Profession by adapting to the rapid advances in new emerging technologies through rigorous post-graduate education.

II. To provide students with a solid foundation in mathematical, scientific and computing fundamentals required to develop IT solutions to real-world problems of Industries, Businesses and Society.

III. To train students with multimedia computing knowledge and creative thinking so as to comprehend, analyze, design innovative products with immersive user experience.

IV. To inculcate leadership qualities, team work and effective communication skills in students for successful professional growth.

V. To be aware of and practice ethical codes and guidelines, and contribute to sustainable development of society.

2. PROGRAMME OUTCOMES (POs):

After going through the two years of study, our students will exhibit the following:

PO #	Programme Outcome
1	An ability to independently carry out research/investigation and development work to solve practical problems.
2	An ability to write and present a substantial technical report/document.
3	An ability to demonstrate a degree of mastery over Multimedia Technology.
4	An ability to apply multimedia tools and techniques to provide simple, and elegant solutions to complex real-world problems in multidisciplinary domains.
5	An ability to become a leader/entrepreneur/software developer/ media designer and developer in the domain of Multimedia enabled Information Technology.
6	An ability to work individually and in teams with social obligation, ethical and environmental consciousness.

3. PEO / PO Mapping:

Programme Educational Objectives						
	PO1	PO2	PO3	PO4	PO5	PO6
PE01	✓	✓	✓	✓		
PE02	✓	✓	✓	✓		✓
PE03	✓	✓	✓	✓	✓	
PE04		✓			✓	✓
PE05	✓			✓	✓	✓

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Mapping of Course Outcome and Programme Outcome

YEAR	SEMESTER	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR 1	SEM 1	Probability and Statistical Methods						
		Advanced Data Structures and Algorithmics	✓		✓	✓	✓	✓
		Web Technologies	✓	✓	✓	✓	✓	✓
		Principles of Multimedia	✓	✓	✓	✓	✓	✓
		Research Methodology and IPR	✓					✓
		Advanced Data Structures and Algorithms Laboratory	✓		✓	✓	✓	✓
		Web Technologies Laboratory	✓	✓	✓	✓	✓	✓
	SEM 2	Business Data Analytics	✓		✓		✓	✓
		3D Modeling and Rendering	✓		✓	✓	✓	✓
		Multimedia Networks	✓	✓		✓		✓
		Program Elective I						
		Program Elective II						
		Mini Project with Seminar	✓	✓	✓	✓	✓	
YEAR 2	SEM 3	Program Elective III						
		Program Elective IV						
		Program Elective V						
		Dissertation I	✓	✓	✓	✓	✓	✓
	SEM 4	Dissertation II	✓	✓	✓	✓	✓	✓

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I - IV SEMESTER CURRICULA AND SYLLABUS

SEMESTER I

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA5156	Probability and Statistical Methods	FC	3	1	0	4	4
2	IF5151	Advanced Data Structures and Algorithmics	PCC	3	0	0	3	3
3	IF5152	Web Technologies	PCC	3	0	0	3	3
4	MM5101	Principles of Multimedia	PCC	3	0	2	5	4
5	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
7	IF5161	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
8	IF5162	Web Technologies Laboratory	PCC	0	0	4	4	2
			TOTAL	**16**	**1**	**10**	**27**	**20**

* Audit Course is optional

SEMESTER II

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MM5201	3D Modeling and Rendering	PCC	3	0	2	5	4
2.	MM5202	Multimedia Networks	PCC	3	0	2	5	4
3.		Program Elective I	PEC	3	0	0	3	3
4.		Program Elective II	PEC	3	0	2	5	4
5.		Open Elective I	OE	3	0	0	3	3
6.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
7.	MM5211	Mini Project with Seminar	EEC	0	0	2	2	1
8.	IF5261	Data Engineering Laboratory	PCC	0	0	2	2	1
			TOTAL	**17**	**0**	**10**	**27**	**20**

* Audit Course is optional

SEMESTER III

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		Program Elective III	PEC	3	0	2	5	4
2		Program Elective IV	PEC	3	0	2	5	4
3		Program Elective V	PEC	3	0	2	5	4
PRACTICALS								
4	MM5311	Dissertation I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**18**	**27**	**18**

SEMESTER IV

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	MM5411	Dissertation II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 70

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FOUNDATION COURSES (FC)

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	MA5156	Probability and Statistical Methods	FCC	3	1	0	4	4

RESEARCH METHODOLOGY AND IPR COURSE (RMC)

SL. NO	COURSE CODE	COURSE TITLE	CATEG ORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
1.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2

PROGRAM CORE COURSES (PCC)

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF5151	Advanced Data Structures and Algorithmics	PCC	3	0	0	3	3
2.	IF5152	Web Technologies	PCC	3	0	0	3	3
3.	MM5101	Principles of Multimedia	PCC	3	0	2	5	4
4.	IF5161	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
5.	IF5162	Web Technologies Laboratory	PCC	0	0	4	4	2
6.	MM5201	3D Modeling and Rendering	PCC	3	0	2	5	4
7.	MM5202	Multimedia Networks	PCC	3	0	2	5	4
8.	IF5261	Data Engineering Laboratory	PCC	0	0	2	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MM5211	Mini Project with Seminar	EEC	0	0	2	2	1
2.	MM5311	Dissertation I	EEC	0	0	12	12	6
3.	MM5411	Dissertation II	EEC	0	0	24	24	12

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PROGRAM ELECTIVE COURSES (PEC)

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
ELECTIVES I								
1	IF5086	Virtualization	PEC	3	0	0	3	3
2	IF5089	Unix Internals	PEC	3	0	0	3	3
3	IF5082	Next Generation Wireless Networks	PEC	3	0	0	3	3
4	IF5091	Wireless Sensor Networks and Protocols	PEC	3	0	0	3	3
5	IF5084	Software Architecture and Principles	PEC	3	0	0	3	3
6	IF5072	Artificial Intelligence	PEC	3	0	0	3	3
7	IF5071	Advanced Computer Architecture	PEC	3	0	0	3	3
8	MM5001	Reasoning Methods in Computer Science	PEC	3	0	0	3	3
ELECTIVES II								
1	IF5078	Distributed and Cloud Computing	PEC	3	0	2	5	4
2	IF5074	Building Internet of Things	PEC	3	0	2	5	4
3	IF5081	Information Retrieval	PEC	3	0	2	5	4
4	IF5092	Analysis of Social Networks	PEC	3	0	2	5	4
5	IF5077	Digital Image Processing Techniques	PEC	3	0	2	5	4
6	IF5075	Computer Vision	PEC	3	0	2	5	4
7	IF5076	Deep Learning	PEC	3	0	2	5	4
8	IF5080	Human Computer Interaction Techniques	PEC	3	0	2	5	4
9	IF5083	Pattern Recognition	PEC	3	0	2	5	4
10	IF5073	Autonomous Ground Vehicle Systems	PEC	3	0	2	5	4
ELECTIVES III, IV, V								
1	IF5079	GPU Architecture and Programming	PEC	3	0	2	5	4
2	IF5085	Video Processing and Analytics	PEC	3	0	2	5	4
3	MM5073	Multimedia Coding Techniques	PEC	3	0	2	5	4
4	MM5002	Multimedia Information Storage and Retrieval	PEC	3	0	2	5	4

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5	MM5003	Short Film Development	PEC	3	0	2	5	4
6	MM5004	Animation Techniques	PEC	3	0	2	5	4
7	MM5005	Game Programming	PEC	3	0	2	5	4
8	MM5072	Mixed Reality	PEC	3	0	2	5	4
9	IF5087	Visualization Techniques	PEC	3	0	2	5	4
10	MM5071	Advanced Computer Graphics and Animations	PEC	3	0	2	5	4
11	MM5006	Multimedia Based E-Learning	PEC	3	0	2	5	4
12	MM5007	Sound Engineering	PEC	3	0	2	5	4
13	MM5008	Media Security	PEC	3	0	2	5	4
14	MM5009	Multimedia Databases	PEC	3	0	2	5	4

OPEN ELECTIVE COURSES (OEC)

*(out of 6 courses one course must be selected)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	OE5091	Business Data Analytics	OEC	3	0	0	3	3
2.	OE5092	Industrial Safety	OEC	3	0	0	3	3
3.	OE5093	Operations Research	OEC	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	OE5095	Composite Materials	OEC	3	0	0	3	3
6.	OE5096	Waste to Energy	OEC	3	0	0	3	3

AUDIT COURSES (AC)

S. NO.	CODE NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS
			LECTURE	TUTORIAL	PRACTICAL	
1.		Audit courses-I	2	0	0	0
2.		Audit courses-I	2	0	0	0
					Total Credits:	**0**

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AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			Lecture	Tutorial	Practical	
1.	AX5091	English for Research Paper Writing	2	0	0	0
2.	AX5092	Disaster Management	2	0	0	0
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0
4.	AX5094	Value Education	2	0	0	0
5.	AX5095	Constitution of India	2	0	0	0
6.	AX5096	Pedagogy Studies	2	0	0	0
7.	AX5097	Stress Management by Yoga	2	0	0	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0
		Total Credits				**0**

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MA5156 **PROBABILITY AND STATISTICAL METHODS** **L T P C**
3 1 0 4

OBJECTIVES:

I. This course provides a sound and rigorous treatment of the basic principles for a proper understanding of the subject matter and for confidence in applying these principles to practical problem solving
II. This course provides a solid undergraduate foundation in both probability theory and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving problems in the real world
III. To introduce the basic concepts of one dimensional and two dimensional Random Variables
IV. To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis
To enable the students to use the concepts of multivariate normal distribution and principal components analysis

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation – Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES 12

Sampling distributions – Type I and Type II errors – Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 12

Random Vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Use the appropriate and relevant, fundamental and applied mathematical and statistics knowledge and methodologies in solving practical problem.
- Bring together and flexibly apply knowledge to characterize, analyse and solve a wide range of problems.
- Understand the balance between the complexity/accuracy of the mathematical/statistical models used and the timeliness of the delivery of the solution.
- Steeped in research methods and rigor.
- Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

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REFERENCES:

1. Dallas E Johnson , “Applied multivariate methods for data analysis”, Thomson and Duxbury press, Singapore, 1998.
2. Gupta S.C. and Kapoor V.K. “Fundamentals of Mathematical Statistics”, Sultan and Sons, 11th Edition, Reprint, New Delhi, 2019.
3. Jay L. Devore, “Probability and statistics for Engineering and Sciences”, Thomson and Duxbury, 9th Edition, Singapore, Boston, 2016.
4. Krishnaiah K. and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI, New Delhi, 2012.
5. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
6. Richard Johnson. ”Miller & Freund‟s Probability and Statistics for Engineer”, Prentice Hall of India Private Ltd., 8th Edition, New Delhi, 2011.

IF5151 ADVANCED DATA STRUCTURES AND ALGORITHMICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the usage of algorithms in computing.
- To understand and learn the algorithm design techniques.
- To learn and use hierarchical data structures and its operations.
- To learn the usage of graphs and its applications.
- To study about NP Completeness of problems.

UNIT I ALGORITHMS IN COMPUTING 9

Algorithms – Iterative and Recursive Algorithms – Insertion Sort – Analyzing Algorithms – Designing Algorithms – Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions – Recurrences: The Substitution Method – The Recursion – Tree Method – Randomized Algorithms – Quick Sort.

Suggested Activities:

- Flipped classroom on divide & conquer strategy (Merge Sort, Quick Sort).
- External learning – Solving recurrence relations using Master’s method.
- Formulation of recurrence relations for various recursive algorithms (such as Tower of Hanoi, Staircase problem).
- Assignment on finding order of growth for exponent and logarithmic time algorithms.

Suggested Evaluation Methods:

- Assignments on formulation of recurrence relations, Master’s method, finding order of growth for algorithms.
- Quizzes on divide and conquer strategy.

UNIT II ALGORITHM DESIGN TECHNIQUES 8

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence – Greedy Algorithms: An Activity Selection Problem – Elements of the Greedy Strategy – Huffman Codes.

Suggested Activities:

- Flipped classroom on basics of algorithm design strategies.
- External learning – String edit distance and Knapsack problem.
- Assignment on applying suitable algorithm design technique for solving real time problems/scenario such as Checker Board/Sequence Alignment/Puzzle Solving/Data Compression.

- Assignment on analysis of time complexity for memorization algorithms and Huffman Coding.

Suggested Evaluation Methods:

- Assignments on Knapsack problems.
- Quizzes on algorithm design strategies.
- Demonstration for practical learning.

UNIT III HIERARCHICAL DATA STRUCTURES 10

Binary Search Trees: Basics – Querying a Binary Search Tree – Insertion and Deletion – Red-Black Trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion – Definition of B-trees – Basic Operations on B-Trees – Deleting a Key from a B-Tree – Min Max Heaps – Leftist Heaps – Binomial Heaps: Structure – Mergeable-Heap Operations.

Suggested Activities:

- Flipped classroom on AVL trees and binary heap concepts.
- External learning – Fibonacci heap operations.
- Assignment on choosing and apply a suitable tree/heap structure for solving a given real time problem/scenario such as the implementation of trees/heaps/PDF document creation.
- Assignment on analysis of time complexity for B-Trees and Binomial Heaps.

Suggested Evaluation Methods:

- Assignments on binomial heap operations.
- Quizzes on AVL trees, binary heaps, time complexity of trees.
- Demonstration of practical learning.

UNIT IV GRAPH ALGORITHMS 9

Graphs: Representations of Graphs – Topological Sort – Strongly Connected Components – Minimum Spanning Trees: Kruskal and Prim – Single-Source Shortest Paths: The Bellman-Ford Algorithm, Single-Source Shortest Paths in Directed Acyclic Graphs, Dijkstra's Algorithm – All- Pairs Shortest Paths: The Floyd-Warshall Algorithm.

Suggested Activities:

- Flipped classroom on basics of graphs and graph operations.
- External learning – Applications of graphs and DFS.
- Analysis of time complexity for Dijkstra's algorithm and Floyd Warshall algorithm.
- Practical – To choose and apply a suitable graph algorithms for solving a real time problem/scenario such as network routing/shortest path updation in maps/relationship mining in graphs.

Suggested Evaluation Methods:

- Assignments on analysis of time complexity for Dijkstra's algorithm and Floyd Warshall algorithm.
- Quizzes on graph operations.
- Demonstration of practical learning.

UNIT V NP-COMPLETE AND NP –HARD 9

NP-Completeness – Polynomial Time – Polynomial-Time Verification – NP Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems – Clique Problem – The Hamiltonian Cycle Problem – Approximation Algorithms – Vertex Cover Problem.

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Suggested Activities:

- Flipped classroom on basics of approximation algorithms.
- External learning – Subset sum problem.
- Assignments on solving traveling salesman problem using approximation technique.
- Exploration of any two NP-complete problems with proofs.

Suggested Evaluation Methods:

- Assignments on NP-complete problems with proofs, traveling salesman problem using approximation techniques.
- Quizzes on approximation algorithms.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Apply suitable algorithms in real time computing.
2. Apply suitable design strategies to solve problems in an efficient manner.
3. Apply suitable hierarchical data structures to solve practical problems.
4. Design algorithms using graph structures to solve real-life problems.
5. Solve NP Complete problems efficiently.
6. Design data structures and algorithms that are appropriate for real time problems.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice-Hall, 2011.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, 2006.
3. Robert Sedgewick, Kevin Wayne, “Algorithms”, Fourth Edition, Pearson Education. 2011.
4. S. Sridhar, “Design and Analysis of Algorithms”, Second Edition, Oxford University Press, 2014.

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

IF5152 WEB TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To understand the object oriented concepts of Java and learn GUI based application development and network programming.
- To learn client side scripting languages to create dynamic web pages.
- To build dynamic web sites using databases and server side technologies.
- To understand the importance of advanced frameworks.
- To integrate all the features of web technologies for application development.

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UNIT I JAVA FUNDAMENTALS 9

Overview of Java – Object Oriented Concepts: Classes and methods, Inheritance, Polymorphism, Interfaces, packages: JAR files and Annotation – GUI Development – I/O – Files, Streams and Object Serialization – Multithreading – Networking – Generic Collections – Generic Classes and Methods.

Suggested Activities:

- Flipped classroom on basics of Java.
- Learning and implementation of the following topics:
  - Java frame and applet based application development.
  - Java I/O streams for text and binary data operations to read from and write to files.
  - Java based thread implementation using thread priorities.
  - Java networking applications using sockets and datagrams.
  - Java applications using generic collections.

Suggested Evaluation Methods:

- Quiz on Java fundamentals.
- Tutorial – Advanced Java features.

UNIT II WEB AND SCRIPTING 9

Overview of HTML5 – Cascading Style Sheets – Overview of JavaScript – Events Handling –Regular Expressions – HTML DOM, Web Browser BOM, AJAX, JSON – Dynamic Web Pages – Jquery – Overview of Angular JS.

Suggested Activities:

- Learning and implementation of the following topics
  - Developing complex web forms using HTML5 and validating using Javascript.
  - Enhancing website appearance with style sheets.
  - Validating sting data using regular expressions.
  - Traversal of HTML5 document using HTML DOM.
- External learning – Usage of Angular JS in simple web applications.

Suggested Evaluation Methods:

- Quizzes on HTML5 features and Java scripts.
- Presentation on Jquery and Angular JS features.

UNIT III WEB APPLICATION DEVELOPMENT 9

Database Connectivity – JDBC Drivers – Servlets – Servlet API – Servlet Configuration – Running Servlet with Database Connectivity – Basics of JSP – Java Server Faces – MVC Architecture of JSF Apps – JSF Components – Session Tracking – Accessing Databases in Web Apps – Developing Dynamic Data Driven Websites.

Suggested Activities:

- Learning and Implementation of the following topics
  - Develop a database application using JDBC.
  - Develop a servlet program that illustrates the usage of cookies and sessions.
  - Create a shopping cart application and guest book web apps using JSF.
  - Validate user input of an application such as singing contest using JSP.
- Flipped classroom on MVC architecture.
- External learning – Development of dynamic web applications.

Suggested Evaluation Methods:

- Quiz on JDBC.
- Quiz on cookies, JSF and Java Beans.
- Demonstration of web applications developed using servlets, JSP and JSF.

UNIT IV DISTRIBUTED OBJECTS 9

Distributed Objects – RMI Programming Model – Java Beans Component – Java Beans API –XML – Java XML API – XML – RPC – WSDL – SOAP – Overview of Java Web Services – JAX-WS – RESTful Web Services.

Suggested Activities:

- Learning and implementation of the following topics
    - Create XML schema for specifying and validating the structure of an XML document.
    - Retrieve and manipulate XML data programmatically.
- External learning – Creation of an AJAX-enabled version of the feedback form with appropriate fields.
- External learning – Creation of a SOAP and RESTful web services.

Suggested Evaluation Methods:

- Quiz on RMI, XML and web services.
- Demonstration of RMI, XML and web services implementation.

UNIT V ADVANCED FRAMEWORKS 9

Hibernate Architecture – Overview of HQL – O/R Mapping – Working with Hibernate – MVC Architecture – Struts – Understanding Actions – Dependency Injection and Inversion of Control – Spring 3.0 – Dependency Injection – Spring Library – Developing Applications – Case Studies – Current Trends.

Suggested Activities:

Learning and Implementation of the following topics

- Create a simple application using struts.
- Hibernate framework based O/R mapping.
- To create simple applications using Spring framework.

Suggested Evaluation Methods:

- Demonstration of Hibernate, Struts and Spring framework based application.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Have knowledge on Java based implementation of object oriented features.
- Develop dynamic websites using client side technologies.
- Develop dynamic web applications with database connectivity using server side technologies.
- Create distributed applications using RMI and web services.
- Design and develop applications using advanced frameworks.
- Apply client and server side technologies for developing web applications with distributed objects and advanced framework features.

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REFERENCES:

1. "Core and Advanced Java, Black Book", Dreamtech Press, 2018.
2. Paul J. Deitel and Harvey Deitel, "Java How to Program", Eleventh Edition, Pearson Education, 2017.
3. Harvey Deitel, Abbey Deitel, "Internet and World Wide Web, How to Program", Fifth Edition, Pearson Education, 2012.
4. Cay S. Horstmann, "Core Java" Volume I & II, Pearson Education, 2018
5. Marty Hall and Larry Brown, "Core Servlets And Javaserver Pages", Second Edition, Pearson Education, 2008.
6. Uttam K Roy, "Web Technologies", Oxford University Press, 2011.
7. http://nptel.ac.in/courses/106105084/

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

MM5101 PRINCIPLES OF MULTIMEDIA L T P C
3 0 2 4

OBJECTIVES:

- To understand different forms of media in systems.
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To learn about the latest trends and technologies in multimedia.

UNIT I INTRODUCTION 7

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents – Visual Display System.

Suggested Activities:

- Flipped classroom on media Components.
- External learning – Interactive power point presentation.

Suggested Evaluation Methods:

- Tutorial – Handling media components
- Quizzes on different types of data presentation.

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UNIT II ELEMENTS OF MULTIMEDIA 11

Text: Types, Font, Unicode Standard, Text Compression, File Formats – Image: Types, Image Processing, Standards, Specification, Device Independent Color Models, Gamma Correction, File Formats – Video: Video Signal Transmission, Signal Formats, Broadcasting Standards, Digital Video Standards, PC Video, Video File Formats – Audio: Acoustics, Characteristics of Sound – Elements of Audio System: Microphone, Amplifier, Loudspeaker, Audio Mixer, Digital Audio, MIDI – Graphics: Components of Graphics System, Co-ordinate System, Plotter – Introduction to 2D and 3D Graphics – Surface Characteristics and Texture – Illumination Models – Animation: Key Frames and Tweening Techniques – 2D and 3D Animation.

Suggested Activities:

- Flipped classroom on different file formats of various media elements.
- External learning – Adobe after effects, Adobe Media Encoder, Adobe Audition.

Suggested Evaluation Methods:

- Demonstration on after affects animations.
- Quizzes on file formats and color models.

UNIT III MULTIMEDIA SYSTEMS 9

Compression Types and Techniques: CODEC, GIF Coding Standards, JPEG, MPEG – Multimedia Database System – User Interfaces – OS Multimedia Support – Hardware Support – Real Time Protocols – Play Back Architectures – Synchronization – Document Architecture – Hypermedia Concepts: Hypermedia Design – Digital Copyrights.

Suggested Activities:

- Flipped classroom on concepts of multimedia hardware architectures.
- External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:

- Quizzes on multimedia hardware and compression techniques.
- Tutorial – Hypermedia design.

UNIT IV MULTIMEDIA TOOLS 9

Authoring Tools – Features and Types – Card and Page Based Tools – Icon and Object Based Tools – Time Based Tools – Cross Platform Authoring Tools – Editing Tools – Painting and Drawing Tools – 3D Modeling and Animation Tools – Image Editing Tools – Sound Editing Tools – Digital Movie Tools.

Suggested Activities:

- Flipped classroom on multimedia tools.
- External learning – Comparison of various authoring tool.

Suggested Evaluation Methods:

- Tutorial – Audio editing tool.
- Quizzes on animation tool.

UNIT V MULTIMEDIA APPLICATIONDEVELOPMENT 9

Software Life Cycle – ADDIE Model – Conceptualization – Content Collection – Story Board –Script –Authoring Metaphors – Testing – Report Writing – Documentation.

Suggested Activities:

- External learning – Game consoles.
- External learning – VRML scripting languages.

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Suggested Evaluation Methods:

- Demonstration of simple interactive game.
- Tutorial – Simple VRML program.

PRACTICAL EXERCISES: **30**

1. Install tools like Flash, Photoshop, Blender.
2. Design a simple web page with animated web advertisement.
3. Creating visual effects by editing and mixing various media elements using tools like adobe premier pro.
4. Use Adobe after effects for creating lighting effects and shades.
5. Use Adobe audition for sound mixing.
6. Use Adobe media encoder for coding an audio.
7. Use Photoshop to create a button, banner and texture.
8. Use Photoshop to create morphing and animation.
9. Develop a full-fledge multimedia application.
10. Develop a digital story boarding and 3D animation as mini project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Handle the multimedia elements effectively.
2. Articulate the concepts and techniques used in multimedia applications.
3. Develop effective strategies to deliver Quality of Experience in multimedia applications.
4. Design and implement algorithms and techniques applied to multimedia objects.
5. Design and develop multimedia applications following software engineering models.
6. Manage and develop a game as a life-long activity individually or as a team.

REFERENCES:

1. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw-Hill Education, 2017.
2. Tay Vaughan, “Multimedia: Making It Work”, Ninth Edition, McGraw-Hill, 2014.
3. Ralf Steinmetz, Klara Nahrstedt, “Multimedia: Computing, Communications and Applications”, Prentice Hall, 1995.
4. Paul Dietel, Harvey Dietel, Abbey Dietel, “Internet & World Wide Web How to Program”, Fourth Edition, Prentice Hall, 2008.
5. Fred Halsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Pearson Education, 2002.

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

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RM5151 **RESEARCH METHODOLOGY AND IPR** **LT P C**
2 0 0 2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

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

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

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

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

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

TOTAL: 30 PERIODS

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

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REFERENCES:
1. Asimov, “Introduction to Design”, Prentice Hall, 1962.
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners” 2010.

IF5161 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY L T P C
0 0 4 2

OBJECTIVES:
- To learn the design strategies of various algorithms.
- To learn how to analyze the complexities of algorithms.
- To learn and understand the usage of advanced tree structures.
- To familiarize with the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS:
Implement the following programs using C/ Python:
1. Iterative and recursive algorithms and its complexity analysis.
2. Merge sort algorithm analysis using divide and conquer approach.
3. Quick sort algorithm using randomized algorithmic approach.
4. Matrix chain multiplication using dynamic programming approach.
5. Activity selection and Huffman coding using greedy approach.
6. Binary search tree and a Red-Black tree.
7. Basic heaps operations.
8. Binomial heap operations.
9. Representation of graphs and graph traversals
10. A spanning tree for a given graph using Prim’s algorithm.
11. Shortest path of a given graph using Dijkstra’s algorithm and Bellman Ford algorithm.
12. All pair shortest path of a given graph using Floyd Warshall’s algorithm.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
1. Design and implement iterative and recursive algorithms with minimum complexity.
2. Design and develop efficient algorithms for practical problems by adopting suitable algorithm design strategies.
3. Design and implement basic and advanced data structures extensively.
4. Apply suitable hierarchical data structures based on real time problems.
5. Design algorithms using graph structures.
6. Implement real world applications by proper usage of data structures and algorithms.

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

IF5162 **WEB TECHNOLOGIES LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To develop simple Java programs using object orientation concepts.
- To program using files and threads for concurrent operations.
- To design attractive GUI using framework.
- To create more dynamic web pages using CSS, JavaScript and AJAX.
- To develop mobile based web applications in cloud environment.

LIST OF EXPERIMENTS:

1. Simple Java programs using arrays and lists.
2. Object orientation program using inheritance and polymorphism.
3. Simple association using objects (pass & return by reference).
4. Simple GUI application development using applet and SWING.
5. Implement multithread program for concurrent operations.
6. Develop program to set priority and synchronize java threads.
7. Input and Output manipulation on files (Read/Write).
8. Java programs on generic and collections.
9. Client Server network application using java sockets.
10. Dynamic web page creation using Javascript, Jquery and AJAX.
11. Develop servlet and JSF application with JDBC access.
12. Manage sessions in JSP using cookies.
13. Create simple Node Javascript functions for server.
14. Android application for location based service.
15. Develop cloud based web application.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Implement object oriented concepts using Java language
2. Develop GUI application by including I/O streams and threads.
3. Create web pages with proper client-side features
4. Design dynamic web pages with server-side and other technologies
5. Develop simple android based mobile application
6. Deploy web applications in a cloud based environment.

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

MM5201 **3D MODELING AND RENDERING** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the fundamentals of modeling and rendering.
- To know the working principles of objects in three dimensional space.
- To acquire knowledge about the issues in Scene modelling.
- To learn rendering algorithms and application of special effects to the modelled objects.
- To gain skill in designing real time movie and games.

UNIT I MATHEMATICS FOR MODELING **9**

Survey of Computer Graphics – Overview of Graphics System: Video Display Devices, Raster System, Input Devices – Interactive Input Methods and Graphical User Interfaces – Vector Tools for Graphics: Dot Product, Cross Product, Representation of Key Geometric Objects, Intersection of lines and planes, Polygon Intersection – Introduction to OpenGL.

Suggested Activities:

- Flipped classroom on properties of vectors.
- External learning – Simple program in OpenGL.

Suggested Evaluation Methods:

- Tutorial – Problems based on vectors.
- Assignment on the latest input and output devices.

UNIT II GEOMETRIC PRIMITIVES MODELING **9**

Transformation of Objects: 3D Affine Transformation, Geometric Transformation – 2D and 3D Viewing – Modeling Shapes with Polygons Meshes – Curves and Surface Design – Color Models and Color Application – Object Modeling using OpenGL – Introduction to Unity Software.

Suggested Activities:

- Flipped classroom on graphical user Interface.
- External learning – Implementation of colour models and shades in OpenGL.

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Suggested Evaluation Methods:

- Quizzes on interactive graphical user interface.
- Assignments on colour models and small programs in OpenGL.

UNIT III OBJECT MODELING 9

Rendering Faces for Visual Realism – Hidden surface removal – Visual Surface Detection Methods – Illumination Models and Surface Rendering Methods – Computer Animation – Hierarchical Modeling – Human Character Modeling – Applying Emotion for the Characters – Vehicle Modeling – Landscape Modeling.

Suggested Activities:

- Flipped classroom on animation and rendering.
- External learning – Usage of asserts.

Suggested Evaluation Methods:

- Tutorial – Rendering algorithms.
- Assignment on various asserts.

UNIT IV SCRIPTING 9

Physics: Collision Detection, Particles Systems, Rigid Bodies Motion, Deformable Bodies – Artificial Intelligent: Path Finding, Controlled Based Animation, Animation and Modeling: Keyframe, Kinematics, Inverse Kinematics – Rigging – Bones – Adding Speech Movements to Characters – Skinning – Spatial Sorting – Level of Details.

Suggested Activities:

- Flipped classroom on special effects.
- External learning – Unity software.

Suggested Evaluation Methods:

- Quizzes on special effects.
- Tutorial – Basics of movement, force and trajectory.

UNIT V RENDERING AND SPECIAL EFFECTS 9

Developing 2D and 3D Interactive Scene using OpenGL, Unity and Similar Tools – Overview of Gaming Genre, Atmospheric and Render Effects – Ray Tracing and Mental Ray – Advanced Tools in Rendering – Global Illumination – Shade Effects – Sound – Lighting – Video Post Interface – Atmospheric Effects: Fire, Water, Fog – Impact of Graphics and Animation on Film and Gaming Industry.

Suggested Activities:

- Flipped classroom on overview of 3D Maya.
- External learning – VR components: Oculus Rift, VR Headsets, VR Controllers.

Suggested Evaluation Methods:

- Tutorial – Animation coding in Maya.
- Quizzes on VR components.

PRACTICAL EXERCISES: 30

1. Implement an OpenGL program that determines the point of intersection between two lines and line with a plane.
2. Using vertex and color arrays, set up the description for a scene containing at least six two dimensional objects in OpenGL.
3. Implement a OpenGL program that removes the hidden surface of the objects in a scene of five objects that overlaps.

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4. Music and audio editing using Audacity.
5. Creation of interactive presentation and portfolio using 2D animation (tweening, masking, audio effect) using Flash.
6. Video editing using iMovie/FinalCutPro/Adobe Premiere.
7. Creating, modifying, gravity and applying movements to particles.
8. Creating human, birds, animal characters in Unity/Maya.
9. Working with lights, applying different light for the scene.
10. Develop a simple Game using Unity/Maya as mini project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Apply the knowledge related to concepts and techniques used in 3D Modeling.
2. Understand the physics and basic movements of character.
3. Conduct various experiments for effective modern interactive 3D Scene design.
4. Design and implement algorithms and techniques applied to 3D Modeling and Rendering.
5. Apply various tools and software related to three dimensional modelling efficiently to uphold the professional and social obligation.
6. Manage and develop a 3D animation movie and gaming as a life-long activity individually or as a team.

REFERENCES:

1. F. S. Hill Jr., Stephen Kelly, “Computer Graphics Using OpenGL”, Third Edition, Persons Education/PHI Learning, 2007.
2. Donald Hearn, M. Pauline Baker, “Computer Graphics with OpenGL”, Third Edition, Pearson Education, 2012.
3. Andy Beane, “3D Animation Essentials”, John Wiley & Sons, 2012.
4. R. Stuart Ferguson, “Practical Algorithms for 3D Computer Graphics”, Second Edition, CRC Press, 2013.
5. Kelly L. Murdock, “Auto Desk Maya 2016 Basic Guide”, Auto Desk Maya, 2016.

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

MM5202 **MULTIMEDIA NETWORKS** **L T P C**
3 0 2 4

OBJECTIVES:

- To recapitulate the fundamentals of networking and understand the requirements for multimedia communication.
- To learn guaranteed service model.
- To learn communication protocols that is frequently used in IoT ecosystems.
- To explore the support provided for multimedia communication in 3G and 4G networks.
- To study about VoIP and real time multimedia network applications.

UNIT I INTRODUCTION **9**

Switched Networks and Shared media Networks – Circuit Switching, Packet Switching and Virtual Circuits – Flow Control and Congestion Control – TCP/IP reference model – Network Externalities – Service Integration – Elastic and Inelastic Traffic – Playback Applications – Additional Requirements For Inelastic Traffic – Core Networks And Access/Edge Networks.

Suggested Activities:

- Flipped classroom on network externalities and Economies of scale.
- External learning – Inter-continental backbone network and Autonomous Systems model of the Internet.
- Assignments on computing the playout time of packets.

Suggested Evaluation Methods:

- Quiz and discussion on network externalities and economies of scale.
- Assignments on proprietary protocols used in IoT and M2M.
- Assignments on problems related to playout time of multimedia applications.

UNIT II GUARANTEED SERVICE MODEL **9**

Best Effort Service Model and Its Limitations – Qos Metrics – Diffserv and Intserv Networks – Queuing Techniques – WFQ and Its Variants – RED – Qos Aware Routing – Call Admission Control – RSVP – Policing and Traffic Shaping Algorithms – Multicast Routing – IGMP, Protocol Independent Multicast – PIM SM and PIM DM Variants.

Suggested Activities:

- Flipped classroom on IntServ and DiffServ networks.
- External learning – Exploring the ways of using DSCP in IP header.
- Assignments on finish time problems related to WFQ and its variants.

Suggested Evaluation Methods:

- Quiz and discussion on IntServ and DiffServ networks.
- Assignments on configuring a router in such a way that DSCP fielder is exploited to provide QoS.
- Assignments on problems related to the virtual finish and actual finish of packets in WFQ and its variants.

UNIT III MULTIMEDIA TRANSPORT **9**

End To End Solutions – Laissez Faire Approach – Multimedia over TCP – Significance of UDP – Multimedia Streaming – Audio and Video Streaming – Accessing Audio And Video from a Web Server And Media Server – Removing Jitter at the Receiver – Recovering from Packet Loss – Forward Error Correction and Interleaving – Interactive And Non-Interactive Multimedia – Transcoding – RTSP – RTP/RTCP.

Suggested Activities:

- External learning – Exploring various media players available and the ways to customize them.
- Exploring the ways to configure RTP.
- Flipped classroom on RTP and RTCP.

Suggested Evaluation Methods:

- Assignments on media players available and configuring them.
- Configuring RTP and RTSP.
- Quiz and discussion on RTP and RTCP.

UNIT IV MULTIMEDIA OVER WIRELESS NETWORKS 9

Architecture of IP Multimedia Subsystem in 3G Networks – Application, Control and Data Planes in IMS Networks – Session Control, AAA, Real Time Data Transfer and Policy Control Protocols of IMS Networks – Relay Node and Multiple Radio Access Technologies in LTE – Voice Over IP Basics – IMS Volte Architecture – IP Multimedia Service Identity Module, Private Identity, Public Identity (ISIM, IMPI And IMPU) – SIP User Agent (SIP UAC And SIP UAE) – Real Time Polling Service and Extended Real Time Polling Service in IEEE 802.16/Wimax Networks.

Suggested Activities:

- Flipped classroom on IMSVoLTE architecture.
- External learning – Multimedia support in 5G networks.
- Analyzing the protocols of IP media subsystem.

Suggested Evaluation Methods:

- Quiz and discussion on IMSVoLTE architecture.
- Assignments on multimedia support in 5G networks.
- Assignments on analyzing the headers of IP multimedia subsystem.

UNIT V MULTIMEDIA NETWORKED APPLICATIONS 9

H.322 Standard – Protocol Stack And Call Setup – Session Initiation Protocol – Components, Messages And Operation – Supporting Protocols For SIP – Media Gateway Access Protocol, Resource Reservation Protocol, Session Description Protocol – Hardware Standards – Scibus and S.100 – Case Study – Video Conferencing – Military Surveillance – Interactive TV – Video On Demand – Smart Phone.

Suggested Activities:

- Flipped classroom on SCIBus and S.100.
- External learning – Multimedia access networks and edge networks.
- Exploring the ways to configure SIP.

Suggested Evaluation Methods:

- Quiz and discussion on SCIBus and S.100.
- Assignments on multimedia access networks and edge networks.
- Configuring SIP using suitable commands.

PRACTICAL EXERCISES: 30

1. Capturing data, reading data from different types of networks and browsing captured data via GUI using Wireshark (2 hours).
2. Exchanging messages between two programs using TCP sockets (2 hours).
3. Requesting for a response from a server using UDP sockets (2 hours).
4. Maintaining a queue based on WFQ and RED algorithms between a client and a server using TCP/UDP sockets (2 hours).

5. Streaming a video from a server to the client using RTSP using Python PI/JMF (2 hours).
6. Develop a client-server application in which the server extracts the frames from the video and send it to the client (2 hours).
7. Develop a client-server application in which client is able to buffer the video frames and playback the frames without violating end to end delay and jitter (2 hours).
8. Creating RTP header on the server side and interpret the RTP header on the client side using UDP sockets (2 hours).
9. Audio and video streaming simulations in LTE Sim/LTE-Adv (4 hours).
10. Instant messaging and audio video streaming using JAIN SIP API/OSA-PARLAY API (2 hours).
11. Mini project (8 hours).

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Deploy the right multimedia communication models.
2. Apply QoS to multimedia network applications at the network level with efficient scheduling and routing techniques.
3. Apply QoS to multimedia network applications at the end system level with efficient scheduling and routing techniques.
4. Understand IP multimedia subsystem and IP initiatives in cellular networks to support multimedia traffic.
5. Design and implement VoIP based solutions for multimedia transport.
6. Develop the real-time multimedia network applications.

REFERENCES:

1. Mario Marques da Silva, “Multimedia Communications and Networking”, CRC Press, 2012
2. K. R. Rao, Zoron S. Bojkovic, Bojan M. Bakmaz, “Wireless Multimedia Communication Systems: Design, Analysis and Implementation”, CRC Press, 2017
3. Jim Kurose, Keith Ross, “Computer Networking: A Top Down Approach”, Pearson Education, 2017
4. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “Introduction to Multimedia Communications Applications, Middleware, Networking”, John Wiley and Sons, 2009
5. Fred Halsal, “Multimedia Communications: Applications, Protocols and Standards”, Pearson Education, 2002
6. William Stallings, “High speed networks and Internets: Performance and Quality of Service”, Pearson Education, 2002.

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

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IF5261 **DATA ENGINEERING LABORATORY** **L T P C**

0 0 2 1

OBJECTIVES:

- To provide a hands-on experience in R and Weka tool.
- To use the R packages for performing data preprocessing.
- To learn using Weka tool for data preprocessing.
- To familiarize the usage of R commands for visualizing data.
- To write and deploy simple algorithms as Map-Reduce tasks.

LIST OF EXPERIEMNTS:

1. Install standalone R. Install and configure Hadoop. Finally install Rhadoop.
2. Use R tool to explore various commands for descriptive data analytics using bench mark datasets.
3. Explore various variable and row filters in R for cleaning data.
4. Use R commands for probability distributions and probability statistics.
5. Formulate real business problems scenarios to hypothesis and solve using R statistical testing features.
6. Apply various plot features in R on sample data sets and visualize.
7. Write and execute word count, word search and pattern search problems from large text files using Map Reduce programs.
8. Write simple Map Reduce functions for sorting, grouping, joining, projecting, and filtering bench mark data sets.
9. Implement Relational Algebra Operations, Grouping and Aggregation as Map-Reduce tasks.
10. Install Weka tool and explore various data preprocessing options using bench mark data sets.

TOTAL: 30 PERIODS

OUTCOMES:

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

1. Learn to install and use R.
2. Write and execute various data preprocessing experiments in the R platform.
3. Execute data cleaning processes on voluminous data sets.
4. Develop, implement and deploy simple data handling algorithms such as Map Reduce functions.
5. Learn to apply R functions on various applications.
6. Learn to install and use Weka tool.

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

Attested

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IF5086 **VIRTUALIZATION** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the concept of virtualization.
- To understand the various issues in virtualization.
- To familiarize themselves with the types of virtualization.
- To compare and analyze various virtual machines.
- To explore the virtualization tools and products.

UNIT INTRODUCTION TO VIRTUALIZATION 9

System Architectures – Virtual Machine Basics – Process virtual machines – System virtual Machines – Taxonomy of virtual machines – Emulation: Basic Interpretation – Threaded Interpretation – Pre-coded & Direct Interpretation – Binary translation – Full and Para–Virtualization – Types of Hypervisor – Types of Virtualization.

Suggested Activities:

- Quizzes on process virtual machines and system virtual machines.
- Practical – Install Oracle Virtual Box/Vmware Workstation and create a blackboard application [Hint: One VM should act as a master and other VMs acts as a listeners, when any content is written by the master VM, the content should be displayed in all the Listener VMs].

Suggested Evaluation Methods:

- Report submission and evaluation of the working of application in virtual environment.

UNIT II SERVER VIRTUALIZATION 8

Server virtualization: Partitioning techniques – Hardware Virtualization – Virtual Hardware – Types of Server Virtualization – Business cases for Sever Virtualization – Uses of Virtual server Consolidation – Selecting server Virtualization Platform.

Suggested Activities

- Install any one Sever Virtualization Tool (Vmware Esx,Xen,KVM) and run and create two VM and configure one vm as Web Server and another as File Server.

Suggested Evaluation Methods

- Review the Working of Installed Server Virtualization Tools (Access the Service offered by Remote Virtual machine via web browser)

UNIT III NETWORK VIRTUALIZATION 10

Design of Scalable Enterprise Networks – Virtualizing the Campus WAN Design – WAN Architecture – WAN Virtualization – Virtual Enterprise Transport Virtualization–VLANs and Scalability – Theory Network Device Virtualization Layer 2 – VLANs Layer 3 VRF Instances Layer 2 – VFIs Virtual Firewall Contexts Network Device Virtualization – Datapath Virtualization Layer 2: 802.1q –Trunking Generic Routing Encapsulation –IPSec L2TPv3 Label Switched Paths – Control–Plane Virtualization–Routing Protocols– VRF – Aware Routing Multi–Topology Routing.

Suggested Activities:

- Create and configure a VLAN using Cisco packet tracer.
- Connect the Created VLANs using router in Cisco packet tracer.

Suggested Evaluation Methods:

- Demo – Inter VLAN Communication.

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UNIT IV STORAGE VIRTUALIZATION 8

Hardware Devices – SCSI– Speaking SCSI– Using SCSI buses – Fiber Channel – Fiber Channel Cables –Fiber Channel Hardware Devices – Iscsi Architecture – Securing Iscsi SAN Backup & Recovery Techniques – RAID – Classic Storage Model – SNIA Shared Storage Model Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – Performing Backups – Virtual tape libraries.

Suggested Activities:

- Setup Iscsi in Linux Machine.

Suggested Evaluation Methods:

- Created storage luns should be accessed from target/remote system.

UNIT V APPLYING VIRTUALIZATION 9

Comparison of Virtualization Technologies:Guest, host os,hypervisor,emulation,kernel level,shared kernel – Enterprise Solution:VmwareServer,Esxi, Citrix XenServer,Microsoft virtual PC,Microsoft Hyper–V,Virtual box – Server Virtualization:configuring Server with server virtualization,adjusting & tuning virtual servers.VM backup & migration – Desktop Virtualization:terminal services,hosted desktop,web based solutions,localized virtualized desktop – Network & storage virtualization:VPN,VLAN,SAN & VSAN,NAS.

Suggested Activities:

- Mini project – Must use any virtualization Concept.

Suggested Evaluation Methods:

- Demonstration of the mini project.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Create a virtual machine and to extend it to a virtual network.
2. Discuss on various virtual machine.
3. Compile all types of virtualization techniques and utilize them in design of virtual machines.
4. Apply the concepts of virtualization in network and storage.
5. Explore the various virtualization tools.
6. Be able to use cisco packet tracer to simulate network virtualization.

REFERENCES:

1. William von Hagen, “Professional Xen Virtualization”, Wrox Publications, January, 2008.
2. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, Apress 2005.
3. Kumar Reddy, Victor Moreno, “Network virtualization”, Cisco Press, July, 2006.
4. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
5. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: Vmware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

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

IF5089 **UNIX INTERNALS** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn about the design of the Unix operating system.
- To become familiar with the various data structures used.
- To learn the various low-level algorithms used in Unix.
- To understand the various Unix system calls.
- To explore the process and memory management concepts.

UNIT I OVERVIEW **9**

General Overview of the System – System Structure – User Perspective – Operating System Services – Assumptions about Hardware – Introduction to the Kernel Architecture of the UNIX Operating System – Introduction to System Concept – The Buffer Cache – Buffer Headers – Structure of the Buffer Pool – Scenarios for Retrieval of a Buffer – Reading and Writing Disk Blocks – Advantages and Disadvantages of the Buffer Cache.

Suggested Activities:

- External learning – Usage of disk blocks and buffer cache.
- Assignment on system calls related to various UNIX commands.

Suggested Evaluation Methods:

- Quizzes on services of OS.
- Quizzes on advantages and disadvantages of buffer cache.

UNIT II FILE SUBSYSTEM **9**

Internal Representation of Files: Inodes – Structure of a Regular File – Directories – Conversion of a Path Name to an Inode – Super Block – Inode Assignment to a New File – Allocation of Disk Blocks.

Suggested Activities:

- Quizzes on inode.
- Practical – Implement superblock structure to handle the allocation and releasing of inode.

Suggested Evaluation Methods:

- Demonstration of the practical implementation.
- Assignment on disk block allocation.

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UNIT III SYSTEM CALLS FOR THE FILE SYSTEM 9

Open – Read – Write – File and Record Locking – Adjusting the Position of File I/O – lseek – close – File Creation – Creation of Special Files – Changing Directory – Root – Owner – Mode – stat and fstat – Pipes – Dup – Mounting and Unmounting File Systems – Link – Unlink.

Suggested Activities:

- Practical – Implement the following UNIX commands using System calls in C Program: cat and mv
- Practical – Write a C program to determine the size of a file using the lseek command. Once you found out the size, calculate the number of blocks assigned for the file.
- Practical – Write two simple programs pipe reader.c and pipe writer.c that use a named pipe to communicate. The pipe reader program will set up a named pipe using mkfifo(), open it read only, and read strings from it until it isualiz the string exit. The writer will open the named pipe file, read strings from the user and write them to the named pipe. When the user enters exit, the program will write the string to the pipe and then exit.

Suggested Evaluation Methods:

- Demonstration of the practical implementations and quizzes on the implementations.

UNIT IV PROCESSES 10

Process States and Transitions – Layout of System Memory – The Context of a Process – Saving the Context of a Process – Manipulation of the Process Address Space – Process Control –process Creation – Signals – Process Termination – Awaiting Process Termination – Invoking other programs – User Id of a Process – Changing the size of a Process – Shell – System Boot and the INIT Process.

Suggested Activities:

- Practical – Write a program in C that creates a child process, waits for the termination of the child and lists its PID, together with the state in which the process was terminated (in decimal and hexadecimal)
- Practical – In a C program, print the address of the variable and enter into a long loop (say using while (1)). Start three to four processes of the same program and observe the printed address values. Show how two processes which are members of the relationship parent child are concurrent from execution point of view, initially the child is copy of the parent, but every process has its own data.

Suggested Evaluation Methods:

- Demonstration of the practical implementations and quizzes on the implementations.

UNIT V MEMORY MANAGEMENT AND I/O 8

Memory Management Policies – Swapping – Demand Paging – The I/O Subsystem: Driver Interface – Disk Drivers – Terminal Drivers.

Suggested Activities:

- Practical – Implement memory management Policies (Group Activity)
- Practical – Modify the functionality of basic commands in xv6 system (Group Activity)

Suggested Evaluation Methods:

- Demonstration of the mini project.

Attested

TOTAL: 45 PERIODS

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OUTCOMES:

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

1. Understand UNIX architecture and describe the component of operating system
2. Explain how they interact with computer hardware.
3. Deeper understanding of system calls in Unix operating system.
4. Apply the concepts of operating systems design to practical problems.
5. Design and implement the subsystems of an operating system.
6. Critically analyze different data structures and algorithms used in the building of a kernel.

REFERENCES:

1. Maurice J. Bach, “The Design of the Unix Operating System”, First Edition, Pearson Education, 1999.
2. B. Goodheart, J. Cox, “The Magic Garden Explained”, Prentice Hall of India,1986.
3. S. J. Leffler, M. K. Mckusick, M. J. Karels, J. S. Quarterman, “The Design and Implementation of the 4.3 BSD Unix Operating System”, Addison Wesley, 1998.
4. Robert Love, “Linux Kernel Development”, Third Edition, Addison Wesley, 2010.

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

IF5082 NEXT GENERATION WIRELESS NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- To learn the fundamentals of 5G internet.
- To understand the concept of small cells in 5G mobile networks.
- To learn the mobile clouds in 5G network context.
- To understand the role of cognitive radios in 5G networks.
- To learn the security issues in 5G networks.

UNIT I PERVASIVE CONNECTED WORLD AND 5G INTERNET 9

Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – Ten Pillars of 5G – Internet of Things and Context Awareness – Networking Reconfiguration and Virtualization Support – Mobility – Quality of Service Control – Emerging Approach for Resource Over-provisioning.

Attested

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Suggested Activities:

- Flipped classroom on Ten Pillars of 5G.
- Assignment on millimeter wave mobile communication.
- External learning – 5G in global level.

Suggested Evaluation Methods:

- Viva Voce on assignment topic.
- Group discussion on different generations of telecommunication networks.
- Quiz on spectrum allocation strategies for 5G.

UNIT II SMALL CELLS FOR 5G MOBILE NETWORKS 9

Introduction to Small Cells – Capacity Limits and Achievable Gains with Densification – Mobile Data Demand – Demand vs. Capacity – Small Cell Challenges.

Suggested Activities:

- Flipped classroom on types of small cells.
- Assignments on issues in fem to cells.
- External learning – Small cell challenges.

Suggested Evaluation Methods:

- Viva Voce on assignment topic.
- Quizzes on the drawbacks of dense deployment of wifi systems.

UNIT III COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS 9

Introduction – Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding, Cooperative ARQ MAC Protocols – PHY Layer Impact on MAC Protocol Analysis: Impact of Fast Fading and Shadowing on Packet Reception for QoS Guarantee, Impact of Shadowing Spatial Correlation– Study: NCCARQ, PHY Layer Impact.

Suggested Activities:

- Flipped classroom on network coding.
- External learning – Cooperative MAC protocols.
- Assignment on packet exchange in PRCSMA.

Suggested Evaluation Methods:

- Viva voce on assignment topic.
- Quiz on NCCARQ operation under realistic channel conditions.
- Practical – Assessing the performance of NC-aided MAC protocols in event-driven C++ simulator.

UNIT IV MOBILE CLOUDS AND COGNITIVE RADIO 9

Introduction – The Mobile Cloud – Mobile Cloud Enablers – Network Coding – Overview of Cognitive Radio Technology in 5G Wireless –Spectrum Optimization using Cognitive Radio – Relevant Spectrum Optimization Literature in 5G – Cognitive Radio and Carrier Aggregation – Energy Efficient Cognitive Radio Technology.

Suggested Activities:

- External learning – Network coding.
- Assignment on spectrum optimization using cognitive radio.
- External learning – Key Requirements and Challenges for 5G Cognitive Terminals.
- Assignment on component of a cognitive radio terminal.

Suggested Evaluation Methods:

- Viva voce on assignment topics.
- Quiz on carrier aggregation.

Attested

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UNIT V SECURITY &SELF ORGANISING NETWORKS 9

Overview of Potential 5G Communications System Architecture – Security Issues and Challenges in 5G Communications Systems – Self Organising Networks: Introduction, Self Organising Networks in UMTS and LTE, The Need for Self Organising Networks in 5G, Evolution towards Small Cell Dominant HetNets.

Suggested Activities:

- External learning – 5G communications system architecture.
- Flipped classroom on security issues and challenges in communication systems.
- Assignment on centralised 5G mobile botnet.

Suggested Evaluation Methods:

- Viva voce on assignment topics.
- Quiz on D-SON and C-SON architectures.
- Group discussion on attacks on 4G Access Network.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Compare the 5G network with older generations of networks.
2. Identify suitable small cells for different applications in 5G networks.
3. Simulate 5G network scenarios.
4. Connect applications to mobile cloud.
5. Design applications with 5Gnetwork support.
6. Analyze the security risks in 5G networks.

REFERENCES:

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.
2. Yin Zhang, Min Chen, “Cloud Based 5G Wireless Networks”, SpringerBriefs in Computer Science, Springer, 2016.
3. Athanasios G. Kanatas, Konstantina S. Nikita, Panagiotis Takis Mathiopoulos, “New Directions in Wireless Communications Systems: From Mobile to 5G”, CRC Press, 2017.

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

IF5091 WIRELESS SENSOR NETWORKS AND PROTOCOLS L T P C
3 0 0 3

OBJECTIVES:

- To learn about the physical layer and MAC layer of WSNs.
- To understand the data centric computing to be followed in WSNs.
- To study about the routing protocols followed in WSNs.
- To study about data aggregation and in–network processing.
- To explore various motes, sensor network operating systems, databases and development platforms.

UNIT I FUNDAMENTALS OF WSN 9

Wireless Adhoc Networks – Distributed Sensing – Sensors and Transducers – Types of Sensors – Accuracy, Resolution and Hysteresis – Architecture of a Sensor Node and WSN – Sensor Network Design Considerations – Energy Efficient Design Principles for WSNs – Applications of WSNs.

Suggested Activities:

- External learning – Exploring various sensors, the corresponding actuators, various motes and their configuration (sensors supported, microcontroller and the clock speed, Flash, RAM, Battery capacity, RF transceivers and data rate supported).
- Flipped classroom on accuracy, hysteresis and resolution of sensors.
- Exploring energy required for transmission, receiving and channel sensing.

Suggested Evaluation Methods:

- Assignments on various types of sensors, actuators and motes.
- Quiz and discussion on accuracy, hysteresis and resolution of sensors.
- Assignments on problem solving related to energy consumption in WSNs.

UNIT II MAC LAYER OF WSN AND ZIGBEE STANDARD 9

Energy issues in Transceiver Design and Channel Access – PHY Frame Structure – Roles of Nodes – End device, Router and Coordinator – Full Function Device and Reduced Function Device – Star, Mesh and Tree topology – Medium Access Control – Duty cycle S–MAC protocol – IEEE 802.15.4 standard and ZigBee.

Suggested Activities:

- External learning – A study of Wireless HART, 6LoWPAN and ISA 100.11a standards.
- Flipped classroom on different roles of nodes in WSNs and different types of ZigBee devices.
- Analyzing duty cycle and sleep cycle of S–MAC protocol.

Suggested Evaluation Methods:

- Assignments on various standards available for WSNs.
- Quiz and discussion on roles of nodes and different types of ZigBee devices.
- Assignments on solving problems related to duty cycle of S–MAC protocol.

UNIT III DATA CENTRIC COMPUTING IN WSN 9

Data Gathering and Dissemination–Broadcasting and Geocasting from Sink – Data Aggregation – LMST based Aggregation – Power Efficient Data gathering and Aggregation (PEDAP) – In–Network Processing – Aggregate Queries – Routing Challenges and Strategies in WSNs – SPIN, Directed Diffusion, Rumour Routing, Energy Aware Routing, Gradient based Routing.

Attested

Suggested Activities:

- Flipped classroom on data centric computing and information centric networks.
- Assignments on analyzing the generation and consumption of energy with non-conventional energy sources.
- External learning – Sensor network platforms and tools and sensor network databases.

Suggested Evaluation Methods:

- Quiz and discussion on data-centric computing and Information-centric networks.
- Assignments on solving problems regarding generation and consumption of energy sources.
- Assignments on sensor network platforms, tools and sensor network databases.

UNIT IV SYNCHRONIZATION, LOCALIZATION AND TRACKING IN WSNs 9

Sensor Management – Topology Control Protocols and Sensing Mode Selection Protocols – Time Synchronization – Localization and Positioning – Ranging techniques – Range based localization algorithms – Location services – Scene analysis, GPS and RFID.

Suggested Activities:

- External learning – Exploring tracking of objects using ultrasonic sensors and camera nodes.
- Exploring the idea of smart cities using Object Tracking Sensor Networks (OTSN).
- Flipped classroom on scene analysis, GPS, RFID and location based services.

Suggested Evaluation Methods:

- Assignments on tracking of objects using ultrasonic sensors and camera nodes.
- Practical – Designing WSNs to locate and track moving objects using ultrasonic sensors or camera nodes for smart cities.
- Quiz and discussion on scene analysis, GPS, RFID and location based services.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Network Hardware – Berkeley Motes – Arduino IDE – Node Level Software Platforms – Tiny OS – Imperative Language – nesC – Simulators – ns–3, Contiki OS and COOJA IDE, TOSSIM – State Centric Programming – PIECES – A State Centric Framework – Google for Physical World – Role of WSN in IoT.

Suggested Activities:

- Explore various network simulators available to carry out experiments in WSNs and various WSN testbeds: WISBED, SensLAB, MoteLAB, CitySense and Sensei
- Flipped classroom on Contiki OS and COOJA IDE
- Practical – Developing Arduino sketches and WSN simulation in ns-3.

Evaluation Methods:

- Assignments on various WSN simulators and WSN testbeds
- Quiz and discussion on Contiki OS and COOJA IDE
- Writing Arduino sketches for socially relevant projects and creating a sensor network topology in ns–2.35 with Mannasim patch or in ns–3

TOTAL: 45 PERIODS

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OUTCOMES:

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

1. Understand different types of sensors, their actuators and the architecture of motes.
2. Design the topology of WSNs using different types of ZigBee devices and understanding their roles.
3. Understand apply data centric computing in wireless sensor networks.
4. Apply appropriate localization techniques for different scenarios.
5. Manage sensor networks by synchronizing the time, locating and tracking objects.
6. Carry out experiments in simulators and real sensors.

REFERENCES:

1. Mohammed A. Matin, "Wireless Sensor Networks: Technology and Protocols", InTech, 2012
2. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
3. Robert Faludi, "Building Wireless Sensor Networks", O'Reilly Media, 2011.
4. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufmann, 2004
5. Bob Tucker, "Wireless Sensor Networks: Signals and Communication Technology", NY Research Press, 2015

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

IF5084 SOFTWARE ARCHITECTURE AND PRINCIPLES L T P C
3 0 0 3

OBJECTIVES:

- To study the basics of software architecture and drivers.
- To be exposed to architectural styles and views.
- To study the need for software architectural standards.
- To be familiar with architectural patterns.
- To understand the basics of software architecture documentation and tools.

UNIT I INTRODUCTION 9

Introduction to Software Architecture – Importance of Software Architecture – Standard Definitions – Architectural Drivers – Architectural Structures and Views – Architectural Patterns – Software Processes and Architecture Business Cycle.

Suggested Activities:

- Study of the problem in a detailed fashion.
- Identifying the underlying software architecture.

Suggested Evaluation Methods:

- Case studies evaluation – Keyword in Context; Mobile robotics; Cruise control.

UNIT II ARCHITECTURAL REQUIREMENTS 9

Quality attributes – Quality Attribute Requirements – Introduction to Tactics – Availability Tactics – Modifiability tactics – Performance Tactics – Security Tactics – Testability Tactics – Usability Tactics – Relationship of Tactics to Architectural Patterns.

Suggested Activities:

- Draw a mind map of quality attributes.
- Identify the quality attributes of a given system.

Suggested Evaluation Methods:

- Evaluating the mind map for Railway Reservation System.
- Quality Attributes for food management system.

UNIT III ARCHITECTURAL PATTERNS 9

Introduction – Pipes and Filters – Blackboard – Data Flow Styles – Call-Return Styles – Shared Information Styles – Event Styles.

Suggested Activities:

- Case studies for styles like Data flow systems, Call-and-return systems, Virtual machines, Independent components, Data-centered systems (repositories) etc.
- Match appropriate software architectures to applications.

Suggested Evaluation Methods:

- Evaluate various style of Architectural pattern for a given system.
- Assignment on various styles of different architecture.

UNIT IV ARCHITECTURAL VIEWS 9

Introduction – Standard Definitions for Views – Structures and Views – Representing Views– View of RUP, Siemens 4 Views, SEI's Perspectives and Views – Reference Models and Reference Architectures – Architectural Structures and Views.

Suggested Activities:

- Study of need for organizational standards.
- Case studies for understanding the choice of architectural views.

Suggested Evaluation Methods:

- Exploring the various views for cruise control system, mobile robot system, etc.
- Assignment for identifying the choice of views for a keyword in context system.

UNIT V DOCUMENTATION AND TOOLS 9

Creating a Skeletal System – Uses of Architectural Documentation – Documentation Across Views – Software Tools for Architecture Design – Excel as an Architecture Tool – Exploiting Style in Architectural Design – Quality-Driven Software Architecture Design.

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Suggested Activities:

- Documentation for Keyword in Context; Mobile robotics; Cruise control.
- In class discussion for identifying tools that match the current style in software architecture design.

Suggested Evaluation Methods:

- Documentation of Software architecture systems like internet information systems, automotive systems, scenario-based architectural analysis etc...
- Exploring tools lik**e** Open Model Sphere etc

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Explain influence of software architecture on business and technical activities.
2. Identify key architectural structures.
3. Use styles and views to specify architecture.
4. Design document for a given architecture.
5. Able to match appropriate software architectures to applications.
6. Develop standard process and to follow standard practices.

REFERENCES:

1. Len Bass, Paul Clements, Rick Kazman, “Software Architectures Principles and Practices”, Second Edition, Addison-Wesley, 2003.
2. Anthony J. Lattanze, “Architecting Software Intensive System. A Practitioner’s Guide”, Auerbach Publications, 2010.
3. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, Judith Stafford, “Documenting Software Architectures. Views and Beyond”, Second Edition, Addison-Wesley, 2010.
4. Mary Shaw and David Garlan, “Software Architecture: Perspectives on an Emerging Discipline”, Prentice Hall, 1996.

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

IF5072 **ARTIFICIAL INTELLIGENCE** **L T P C**
3 0 0 3

OBJECTIVES:

- To know the underlying structure behind intelligence mathematically.
- To know the logical implications in computational intelligence.
- To know the automated learning techniques.
- To study the techniques of Knowledge Representation.
- To explore Artificial Intelligence techniques in real–time scenarios.

UNIT I INTELLIGENT AGENTS AND KNOWLEDGE REPRESENTATION 9

Agents and Environments – Good Behavior: The concepts of Rationality – The Nature of Environments – The Structure of Agents – Knowledge Representation – Object Oriented Approach – Semantic Nets – Frames – Semantic Web – Ontology.

Suggested Activities:

- Flipped classroom on intelligent agents, means o knowledge representation
- Assignment on exercise questions on PEAS formulation from the text-book.
- Examples of knowledge representation through different methods and reasoning.
- Practical – Ontology creation using Protégé.

Suggested Evaluation Methods:

- Tutorial on intelligent agents and PEAS formulation.
- Assignments on semantic nets, frames.
- Quizzes on agents.
- Practical – Programming exercises on object oriented structure, semantic nets and frames.

UNIT II SEARCH TECHNIQUES 9

Problem Solving by Search – Uninformed Search – Searching with Costs – Informed State Space Search – Heuristic Search: – Problem Reduction Search – Game Search – Constraint Satisfaction Problems.

Suggested Activities:

- Flipped classroom on uninformed search and searching with costs.
- In-class activity – Solve puzzles with uninformed and informed searches.
- Practical – Implementation of search through Python/ Other languages.

Suggested Evaluation Methods:

- Tutorial – Different types of searches.
- Assignments on uninformed and informed searches.
- Quizzes on heuristic methods.
- Practical – Programming exercises on different search strategies.

UNIT III REASONING WITH LOWER ORDER LOGICS 9

Logical Agent – Proposition Logic – Syntax and Semantics – Theorem Proving – Model Checking – Inference in First Order Logic.

Suggested Activities:

- Reasoning methods through puzzles and real life scenarios.
- Implementation: Inference through prolog/ python.

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Suggested Evaluation Methods:

- Tutorial – Inference methods.
- Assignments on theorem proving and resolution.
- Quizzes on basics of logic – syntax and semantics.
- Practical – Programming exercises for theorem proving.

UNIT IV ARTIFICIAL INTELLIGENCE PLANNING 9

Classical Planning – Partial Order Planning – Graph Plan and SAT Plan – Hierarchical Planning – Planning and Acting in Nondeterministic Domains – Multiagent Planning.

Suggested Activities:

- Flipped classroom on planning methods.
- Assignments on derivation of plan through partial order plan, graph plan and hierarchical plan.

Suggested Evaluation Methods:

- Tutorial – Different planning methods.
- Assignments on graph plan, SAT plan.
- Quizzes on planning in non-deterministic domains.
- Practical – Programming exercises on planning with PDDL/PDL/Python.

UNIT V LEARNING TECHNIQUES 9

Logical Formulation of Learning – Knowledge in Learning – Explanation–Based Learning – Learning using Relevance Information – Inductive Logic Programming – Statistical Learning – Learning with Complete Data – Learning with Hidden Data – Applications.

Suggested Activities:

- Flipped classroom on theoretical study of learning methods
- Assignment on solving problem in statistical learning
- Practical – Programming exercises using Python/ other programming languages.

Suggested Evaluation Methods:

- Tutorial – Learning methods.
- Assignments on statistical methods in learning.
- Quizzes on learning methods.
- Practical – Programming exercises on Statistical learning.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand the search techniques.
2. Apply the search techniques to real–time problems.
3. Apply the reasoning techniques to real world problems.
4. Understand the representation of knowledge.
5. Understand the learning techniques.
6. Apply AI techniques in developing real world applications.

REFERENCES:

1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Third Edition, Pearson Education, 2015.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill, 2008.
3. Dheepak Khermani, “A First Course in Artificial Intelligence”, McGraw-Hill, 2013.

Attested

4. NPTEL Artificial Intelligence Course by Prof. Dasgupta – http://nptel.ac.in/courses/106105079/2
5. Sebastian Thrun, Peter Norvig, Udacity: Introduction to Artificial Intelligence, https://in.udacity.com/course/intro–to–artificial–intelligence—cs271

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

IF5071 ADVANCED COMPUTER ARCHITECTURE L T P C
3 0 0 3

OBJECTIVES:

- To evaluate different computer systems based on performance metrics.
- To explore parallelism in instruction and processor functional block.
- To understand the fundamentals of Graphics processing unit.
- To compare different approaches of memory interfacing in multiprocessor.
- To understand and analyze interconnection in multicore.

UNIT I INSTRUCTION LEVEL PARALLELISM 11

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and Its Exploitation – Concepts and Challenges – Overcoming Data Hazards with Dynamic Scheduling – Dynamic Branch Prediction – Speculation – Multiple Issue Processors – Case Studies.

Suggested Activities:

- Flipped classroom on classes of processor.
- External learning – Static (compiler) scheduling for instruction execution.
- Survey on multi core and draw a mind map on trends of multicore processor.
- Tutorial – Measuring processor performance.

Suggested Evaluation Methods:

- Quizzes on out of order scheduling.
- Group discussion on how to reduce CPI lesser than 1.

UNIT II THREAD–LEVEL PARALLELISM 8

Multi–threading – Multiprocessors – Centralized and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization Issues – Models of Memory Consistency.

Suggested Activities:

- Flipped classroom on Flynn taxonomy.
- External learning – True and false sharing.
- Survey on memory consistency protocol.

Suggested Evaluation Methods:

- Quizzes on memory consistency.
- Group discussion on memory models.

UNIT III SIMD AND GPU ARCHITECTURES 8

SIMD Extensions for Multimedia – Graphics Processing Units – GPU Computational Structures – GPU Instruction Set Architecture – GPU Memory Structures – Case Study.

Suggested Activities:

- Flipped class on evolution of GPU.
- External learning – Vector architecture.
- Survey on multi core and draw a mind map on trends of multicore.

Suggested Evaluation Methods:

- Quizzes on multicore and GPU.
- Group discussion on GPU vs. Vector architecture.

UNIT IV MEMORY HIERARCHY DESIGN 9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Name Mapping Implementations – Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

Suggested Activities:

- Flipped classroom on memory hierarchy in Intel i7 and ARM Cortex.
- Practical – Implement a simple functional model for memory mapping in cache using C/C++.
- Study hit/miss rates for various access patterns. Experiment with different replacement policies.

Suggested Evaluation Methods:

- Mock test for problems on memory mapping.
- Quizzes on memory management in ARM and Intel processor.

UNIT V INTERCONNECT AND STORAGE 9

Interconnection Networks – Buses, Crossbar and Multi–Stage Switches – Multi–Core Processor Architectures – Case Study. Warehouse– Scale Computers – Programming Models and Workloads – Storage Architectures – Physical Infrastructure – Case Study.

Suggested Activities:

- Flipped classroom on static and dynamic interconnection.
- Practical – Implement a simple map reduce program for counting a word.
- Case study on ware house scale computers

Suggested Evaluation Methods:

- Mock test for problems on types of interconnection.
- Quizzes on large scale computer programming.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students should be able to:

1. Compare and evaluate the performance of various architectures.
2. Design a coherent and consistent memory system for multiprocessor.
3. Analyze the requirements of large systems to select and build the right infrastructure
4. Design and analyze memory and interconnection system for processor.
5. Distinguish and model multiprocessor architecture styles.
6. Point out the hazards present in a pipeline and suggest remedies

REFERENCES:

1. John L. Hennessey, David A. Patterson, “Computer Architecture – A Quantitative Approach”, Morgan Kaufmann/Elsevier, Fifth Edition, 2012.
2. Richard Y. Kain, “Advanced Computer Architecture – A Systems Design Approach”, PHI, 2011.
3. Hwang Kai, A. Ramachandran, R. Purushothaman, “Advanced Computer Architecture: Parallelism, Scalability, Programmability” McGraw-Hill, 1993.

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

MM5001 REASONING METHODS IN COMPUTER SCIENCE L T P C
3 0 0 3

OBJECTIVES:

- To know the mathematical background of Logic.
- To learn the basics of Lower Order Logic.
- To study the background of Higher Order Logic.
- To explore the real world applications with Lower Order Logic.
- To explore the real world applications with Higher Order Logic.

UNIT I PROPOSITION LOGIC 9

Introduction to Logic – Foundation in mathematics – Natural Deduction – Formal language Syntax and Semantics – Normal Forms – Applications in AI.

Suggested Activities:

- Flipped classroom on natural deduction.
- In-class activity – Solving puzzles through proposition logic.
- Practical – Programming exercises for SAT solver.

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Suggested Evaluation Methods

- Quiz on formal proof methods.
- Assignment problems on natural deduction and SAT Solvers.
- Programming exercises on resolution and SAT Solvers.

UNIT II PREDICATE LOGIC 9

Syntax and semantics – Natural Deduction rules – Expressiveness –Micromodels of software – Inference mechanisms in AI.

Suggested Activities:

- Flipped classroom on micromodels of software.
- In-class activity – Problem solving exercise on natural deduction rules.

Suggested Evaluation Methods:

- Quiz on reasoning methods.
- Assignment problems on inference mechanisms in AI.

UNIT III MODAL LOGIC 9

Higher order logic – Modal logic syntax – Semantics – Accessibility relation – Types of modal logic – Natural deduction.

Suggested Activities:

- Flipped classroom on types of modal logic.
- In-class activity – Entailment through Kripke semantics.

Suggested Evaluation Methods

- Quiz on different accessibility relations.
- Assignment problems based on Kripke structures.

UNIT IV TEMPORAL LOGIC 9

Linear Temporal Logic – Syntax – Semantics – Model Checking – Computational Tree Logic – Syntax – Semantics – Application in Operating Systems and Distributed systems.

Suggested Activities:

- Flipped classroom on applications.
- In-class activity – Solving problems with model checking.

Suggested Evaluation Methods:

- Quiz on Model Logic with types, temporal logic syntax and semantics.
- Assignment problems on semantics.
- Programming assignment on Model Checking.

UNIT V EPISTEMIC LOGIC 9

Logic of knowledge – Syntax – Semantics – Natural Deduction – Multi–agent reasoning – Applications in Distributed systems.

Suggested Activities:

- Flipped classroom on multi-agent reasoning.
- In-class activity – Solving puzzles like Muddy Children and Three Wise Men puzzle.

Suggested Evaluation Methods:

- Quiz on Reasoning methods using Muddy Children and Three Wise Men puzzle.
- Assignment problems on Deduction and other reasoning methods.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand the mathematical underpinnings of Logic
2. Apply Proposition Logic to Computer Science domains
3. Understand the reasoning process of Predicate Logic
4. Understand the advantages of Higher Order Logic over Lower Order Logic
5. Apply Temporal Logic to Distributed Systems
6. Design Multiagent systems using Epistemic Logic

REFERENCES:

1. Michael Huth, Mark Ryan, "Logic in Computer Science: Modeling and Reasoning about Systems", Second Edition, Cambridge University Press, 2005.
2. Johan van Benthem, Hans van Ditmarsch, Jan van Eijck, Jan Jaspars, "Logic in Action", Open Course and ebook, 2016. http://www.logicinaction.org/.
3. Mordechai Ben-Ari, "Mathematical Logic for Computer Science", Third Edition, Springer, 2012.
4. Michael Fisher, "An Introduction to Practical Formal Methods using Temporal Logic", John Wiley, 2011.

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

IF5078 DISTRIBUTED AND CLOUD COMPUTING L T P C
3 0 2 4

OBJECTIVES:

- To learn distributed communication.
- To understand distributed resource management.
- To study the basics of cloud computing.
- To study about virtualization and cloud resource management.
- Be able to install and use current cloud technologies.

UNIT I INTRODUCTION TO DISTRIBUTED SYSTEM AND COMMUNICATION 8

Introduction to Distributed Systems – Characteristics – Issues in Distributed Systems – Distributed Architectural Models – Communication Primitives – Remote Procedure Call – Physical Clock Synchronization – Logical Clocks, Vector Clocks and Casual Ordering – Multicast Ordering.

Suggested Activities:

- Practical – Implement clock synchronization in distributed system using Lamport's algorithm.
- Practical – Create and distribute a Torrent file to share a file in LAN environment.

Suggested Evaluation Methods:

- Demonstration and assessment of the working of the implemented algorithm.

UNIT II DISTRIBUTED RESOURCE MANAGEMENT 10

Distributed Mutual Exclusion Algorithm – Distributed Deadlock Detection Algorithms– Election Algorithm – Distributed File System – Design Issues – Distributed Shared Memory – Global States and Snapshot – Check Point and Recovery – Two Phase Protocol – Non Blocking Commit Protocol.

Suggested Activities:

- Practical – Implement Election Algorithm.
- Practical – Implement any one deadlock detection Algorithm.

Suggested Evaluation Methods:

- Demonstration and assessment of the working of the implemented algorithm.

UNIT III CLOUD COMPUTING, ARCHITECTURE MODELS AND SERVICES 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning – NIST Cloud Computing Reference Architecture– Architectural Design Challenges – Deployment Models: Public, Private and Hybrid Clouds – Service Models: IaaS – PaaS – SaaS – Benefits of Cloud Computing.

Suggested Activities:

- Practical – Use Google Collaboration Tools: Create Google Docs, Sheets, and Slides and share it with others.
- Practical – Explore public cloud services including Amazon, Google, Sales force, and Digital Ocean etc.

Suggested Evaluation Methods:

- Quizzes on different service models and deployment models.
- Report submission – Comparison of various services provided by different Cloud Service Provider (Configuration of VM, Cost, Network Bandwidth etc).

UNIT IV CLOUD ENABLING TECHNOLOGIES 10

Service Oriented Architecture – SOAP – RESTful Web Services – Basics of Virtualization – Types of Virtualization –Full and Para Virtualization– Implementation Levels of Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization – Server Virtualization –Network and Storage Virtualization – Containers.

Suggested Activities:

- Create a simple web service using Python Flask /Java /any language [Web Service: Client-server model should be implemented using socket/http].
- Install Oracle Virtual Box/Vmware Workstation and Create a blackboard application[Hint: One VM should act as a master and other VMs acts as a listeners, when any content is written by the master VM, the content should be displayed in all the Listener VMs].

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Suggested Evaluation Methods:

- Review of the Web Service Implementation: Proper Connection should be established between the client and server to make use of the service offered by the Server.
- Assessment of the workings of installed Virtualization Tools.
- Review the workings of application in virtual environment [Implemented using basic echo and chat concepts].

UNIT V CLOUD MANAGEMENT, SECURITY AND COMPUTING PLATFORMS 8

Resource Provisioning – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Virtual Machine Security – Application and Data Security Cloud Storage – HDFS – Map Reduce – Google App Engine(GAE) – Programming Environment for GAE – Architecture of GFS – Cloud Software Environments – Openstack, Heroku, Docker, Case Studies: Amazon EC2, AWS, Microsoft Azure, Google Compute Engine.

Suggested Activities:

- Practical – Use security tools like ACUNETIX, ETTERCAP to scan web applications on the cloud, cloud networks for finding vulnerabilities, verifying leakage of information to an unauthorized third party.
- Practical – Install and configure OpenStack all– in– one using Devstack/Packstack and Launch VMs in OpenStack through dashboard:

Suggested Evaluation Methods:

- Report Submission – A detailed report describing vulnerabilities along with the suitable action that can be taken to remedy the loopholes.
- Evaluation of the practical: OpenStack Dashboard should be accessed though web browser and the working of the instances must be verified by logging in to it/pinging the instance.

PRACTICAL EXECISES: 30

1. Connect a minimum of 3 nodes and implement a group chat amongst them.
2. Implement any one of the message ordering algorithms on the previously implemented system.
3. Implement an election algorithm to elect a co– ordinator for the system.
4. Perform clock synchronization on the system, with the co– ordinator node's time as reference.Create a VM image which has a C compiler along with an operating system and do the following experiments
    a. Fibonacci Series b. File Operations
5. Install Virtualbox with different flavours of linux or windows OS on top of windows7 or 8
6. Install Google App Engine/Heroku and run a run a simple webapp using python/java.
7. Install and run Openstack using Packstack/Devstack
8. Create two VMs in Openstack and exchange data.
9. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim.
10. Install hadoop and manipulate a large dataset and run on Hadoop.

TOTAL: 75 PERIODS

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OUTCOMES:

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

1. Appreciate distributed communication, distributed resource management.
2. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
3. Learn the key and enabling technologies that help in the development of cloud.
4. Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
5. Explain the core issues of cloud computing such as resource management and security.
6. Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

REFERENCES:

1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems – Principles and Paradigms", Second Edition, Pearson Education, 2006.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann, 2012.
3. Barrie Sosinky, "Cloud Computing bible", Wiley, 2010.
4. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", John Wiley, 2011.
5. Mukesh Singhal, "Advanced Concepts in Operating Systems", McGraw-Hill Series in Computer Science, 1994.
6. John W. Rittinghouse, James F. Ransome, "Cloud Computing: Implementation Management, and Security", CRC Press, 2010.

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

IF5074 **BUILDING INTERNET OF THINGS** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.
- To learn communication protocols that is frequently used in IoT ecosystems.
- To explore the ways of processing enormous amount of data generated in IoT based systems.
- To understand the role of cloud computing in IoT and to become familiar with various cloud offerings.

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UNIT I ENABLING TECHNOLOGIES AND REFERENCE MODELS 9

Sensors and Actuators – Centralized Sensing vs Distributed Sensing – Making Physical Objects as Smart Objects – Enabling Technologies – Wireless Sensor Networks, Cloud Computing and Data Analytics – IoTVs M2M – Possible IoT Reference Models – Domain Specific IoTs – Levels of IoT Based Systems.

Suggested Activities:

- Flipped classroom on enabling technologies.
- External learning – Exploring proprietary protocols used in IoT and M2M.
- Analyzing the required level of design for different IoT based ecosystems.

Suggested Evaluation Methods:

- Quiz and discussion on enabling technologies (WSN, Cloud and Big Data).
- Assignments on proprietary protocols used in IoT and M2M.
- Deciding the level and designing the IoT framework for case studies.

UNIT II DESIGN OF END DEVICES 9

Microprocessors vs. Microcontrollers – Open Source Movement in Hardware – Engineering vs Prototyping – Software Development Lifecycle for Embedded Systems – Arduino IDE – Programming And Developing Sketches – Arduino Rest APIs – Raspberry Pi – Interfaces – Python Packages of Interests for IoT

Suggested Activities:

- Flipped classroom on open source movement in hardware and SDLC for embedded systems.
- Explore the variants of Arduino Boards, Atmel Microcontrollers, Cypress Pioneer and NXP Freedom.
- Learning to write Arduino Sketches and Python Programs.

Suggested Evaluation Methods:

- Quiz and discussion on open source movement in hardware and SDLC for embedded systems.
- Assignments on Arduino boards, Atmel Microcontrollers, Cypress Pioneer and NXP Freedom.
- Practical – Developing Arduino Scripts and Python Programs.

UNIT III IoT PROTOCOLS 9

MAC Layer Protocols – IEEE 802.15.4 – G And E Variants of IEEE 802.15.4 – IEEE 802.11ah – IEEE 1901.2a – LoRaWAN – 6LoWPAN – From 6LoWPAN to 6Lo – NBIoT – REST Based Protocols – SCADA, CoAP and MQTT

Suggested Activities:

- External learning – Explore various software tools that support Coap and MQTT.
- Flipped classroom on role of Ipv6 in designing IoT based systems.
- Analyze Cisco Reference Model and IBM Reference Models.

Suggested Evaluation Methods:

- Assignments on software tools that support Coap and MQTT.
- Quiz and discussion on role of Ipv6 inIoT based systems.
- Assignments on the IoT policy of Meity (Government of India).

UNIT IV DATA ANALYTICS 9

Structured vs. Unstructured Data – Data in Motion vs. Transit – Machine Learning Overview – Big Data Tools and Technologies – Hadoop – Map Reduce Programming Model, Job Execution and Work Flow, Cluster Setup – Lambda Architecture – Flexible Netflow Architecture – Providing Multiservice in IoT using FNF Components.

Suggested Activities:

- External learning – Exploring popular machine learning algorithms (both supervised and unsupervised).
- Flipped classroom on MapReduce programming.
- Learning dataflow programming using open source software library.

Suggested Evaluation Methods:

- Assignments on supervised, unsupervised and reinforcement algorithms.
- Quiz and discussion on MapReduce programming.
- Practicing data flow programming languages using libraries like Tensorflow/CNTK/Theanoetc.

UNIT V CLOUD OFFERINGS 9

Cloud Storage Models and Communication API – WAMP AutoBahn – Xively Cloud – Python Web Application Framework – Django–IBM Watson – AWS for IoT – Case Studies – Smart Home, Smart Cities, Smart Agriculture and Weather Monitoring Systems.

Suggested Activities:

- Flipped classroom on cloud models and type of clouds.
- External learning – Django framework.

Suggested Evaluation Methods:

- Quiz and discussion on cloud models and types of clouds.
- Developing web apps for IoT ecosystems using Django framework.

PRACTICAL EXERCISE: 30

1. Develop a BLINK sketch in Arduino.
2. Develop an Arduino sketch that repeats an LED to glow brightly, decrease the brightness, switches off the LED, increases the brightness and LED glows with maximum intensity (a sketch for fading).
3. Develop an Arduino sketch that takes sensor readings for five seconds during the startup, and tracks the highest and lowest values it gets. These sensor readings during the first five seconds of the sketch execution define the minimum and maximum of expected values for the readings taken during the loop (a sketch for calibrating a sensor).
4. Develop an Arduino sketch that reads the value of a variable resistor as an analog input and changes blink rate of the LED.
5. Develop an Arduino sketch to use a piezo element to detect the vibration.
6. Develop a Python program to control an LED using Rapberry Pi.
7. Develop a Python program to interface an LED with a switch using Rapberry Pi.
8. Implement a map reduce program that produces a weather data set.
9. Implement an application that stores big data in Hbase/Mongo DB using Hadoop/R.
10. Use Google Collaboration Tools: Create Google Docs, Sheets, and Slides and share it with others.
11. Mini project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Understand the enabling technologies and reference models of IoT.
2. Design portable IoT devices using Arduino IDE/ Raspberry Pi with Python.
3. Apply appropriate protocols in various parts of IoTbased systems.
4. Understand Big Data tools and technologies and apply them in IoT based systems.
5. Design and deploy IoT based systems and connect them to cloud offerings.
6. Design IoT systems for various real time applications.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A Hands-On Approach”, Universities Press, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.
3. David Hanes, Gonzalo Salguerio, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for Internet of Things”, Cisco Press, 2017.
4. Perry Lea, “Internet of Things for Architects”, PACKT, 2018.

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

IF5081 **INFORMATION RETRIEVAL** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the basics of Information Retrieval with pertinence to modelling, Query operations and indexing.
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of Information Retrieval giving emphasis to Multimedia IR and Web Search.
- To understand the concepts of digital libraries.
- To learn the procedure for recommendation system.

UNIT I INTRODUCTION 9

Introduction – Goals And History of IR – The Impact of the Web on IR – The Role of Artificial Intelligence (AI) in IR – Basic IR Models Boolean and Vector Space Retrieval Models – Ranked Retrieval – Text Similarity Metrics – TF-IDF (term frequency/inverse document frequency) Weighting – Cosine Similarity.

Suggested Activities:

- Install Lucene, LingPipe, and Gate.

Suggested Evaluation Methods:

- Group discussion on applications of vector space model.

UNIT II PREPROCESSING 9

Basic Tokenizing – Indexing and Implementation of Vector Space Retrieval – Simple Tokenizing – Stop Word Removal and Stemming – Inverted Indices – Efficient Processing with Sparse Vectors – Query Operations and Languages – Relevance Feedback – Query Expansion – Query Languages.

Suggested Activities:

- Construct manually a frequency table for the collection of documents after removing stop words.
- Index the frequency table using Latent semantic indexing techniques.

Suggested Evaluation Methods:

- Apply query document information and isuali manually the performance of the retrieval.

UNIT III METRICS 9

Experimental Evaluation of IR Performance Metrics Recall, Precision and F Measure – Evaluations on Benchmark Text Collections – Text Representation – Word Statistics – Zipf's law – Porter Stemmer – Morphology – Index Term Selection using Thesauri –Metadata and Markup Languages – Web Search Engines – Spidering – Meta Crawlers – Directed Spidering – Link Analysis Shopping Agents.

Suggested Activities:

- Assignments on problems on precision and recall like the following:
- An IR system returns 8 relevant documents and 10 non-relevant documents. There are a total of 20 relevant documents in the collection. What is the precision of the system on this search and what is its recall?

Suggested Evaluation Methods:

- Group discussion on metrics.

UNIT IV CATEGORIZATION AND CLUSTERING 9

Text Categorization and Clustering – Categorization Algorithms – Naive Bayes – Decision Trees and Nearest Neighbour – Clustering Algorithms – Agglomerative Clustering – K Means – Expectation Maximization (EM) – Applications to Information Filtering – Organization and Relevance Feedback.

Suggested Activities:

- Categorize documents by topic using classifiers and build groups of self-organized documents using clustering algorithms.

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Suggested Evaluation Methods:

- Analyze the algorithm by changing the input set.

UNIT V EXTRACTION AND INTEGRATION 9

Recommender Systems – Collaborative Filtering – Content Based Recommendation of Documents and Products – Information Extraction and Integration – Extracting Data from Text – XML – Semantic Web – Collecting and Integrating Specialized Information on the Web.

Suggested Activities:

- External learning – Survey on recommendation process that takes place in various online shopping portals.

Suggested Evaluation Methods:

- Group discussion on recommendation process in a real time scenario.

PRACTICAL EXERCISES: 30

Implement the following exercises using python libraries.

1. Construct a vector space model for the collection of text documents and also compute the similarity between them. (4 hrs)
2. Perform the preprocessing on any text document collection. (4 hrs)
3. Classification and clustering approach on standard text database and also compute performance measures Precision, Recall and F- measure (4 hrs)
4. Construct a search engine index with an optional backend database to manage large document collections. (4 hrs)
5. Parse XML text and compute topic specific page rank. (4 hrs)
6. Mini project. (10 hrs)

TOTAL: 75PERIODS

OUTCOMES:

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

1. Build an Information Retrieval system using the available tools.
2. Identify and design the various components of an Information Retrieval system.
3. Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
4. Analyze the Web content structure.
5. Analyze the approaches used for recommendation systems.
6. Design an efficient search engine.

REFERENCES:

1. Christopher D. Manning, Prabhakar Raghavan, HinrichSchütze, ”Introduction to Information Retrieval” , Cambridge University Press, 2008.
2. F. Ricci, L. Rokach, B. Shapira, P. B. Kantor, “Recommender Systems Handbook”, Springer, 2011.
3. Peter Brusilovsky, “The Adaptive Web Methods and Strategies of Web Personalization”, Springer, 2007.
4. Manu Konchady, “Building Search Applications: Lucene, LingPipe, and Gate”, Mustru Publishing 2008.

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

IF5092 **ANALYSIS OF SOCIAL NETWORKS** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behavior in social web and related communities.
- To learn visualization of social networks.
- To understand the importance of security and privacy in social networks.

UNIT I INTRODUCTION TO SOCIAL NETWORKS **9**

Social Network Analysis: Definition and Features – The Development of Social Network Analysis – Representation of Social Networks: Graph and Matrix Representations – Graph Concepts in Network Analysis – Ties, Degree, Density, Path, Length, Geodesic, Eccentricity, Between – Ness, Centrality, Clique – Overview of Electronic Discussion Networks, Blogs and Online Communities.

Suggested Activities:

- Given a social graph derive the various graph metrics.
- Group discussion on pros and cons of various online discussion forums.
- Convert a graph into equivalent matrix representation.

Suggested Evaluation Methods:

- Assignment on graph metrics.
- Report submission on features of online social forums.
- Quizzes on graph and matrix representations.

Attested

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UNIT II ONTOLOGY FOR SOCIAL NETWORK ANALYSIS 9

RDFS – Plus – Using RDFS – SKOS – Managing vocabularies with RDFS–Plus – Introduction to Ontology– OWL–Web Ontology Language– Basic OWL– Bibliographic Ontology (BIBO) – FOAF Good Relations– CIDOC's Conceptual Reference Model (CRM) – Digital Public Library (DPLA) – Counting and Sets in OWL – Ontologies on the Web–Putting it all Together – Ontology Mapping –Good and Bad Modeling Practices – Expert Modeling in OWL The Future Of The Semantic Web – RDF Parser/Serializer– RDF Store – Querying the Semantic Web– SPARQL–Query Language for RDF–Advanced Features of SPARQL – RDF and Inference.

Suggested Activities:

- Group activity – Defining concepts and relations for sample scenarios using benchmark ontology.
- Practical – Developing ontology using tools.
- Assignment on inferring the entities involved from a sample RDF schema.

Suggested Evaluation Methods:

- Report submission on benchmark ontology.
- Quizzes and assignments on RDF/FOAF and other related vocabulary.

UNIT III SOCIAL MEDIA MINING AND SEARCH 9

Discovering Mobile Social Networks by Semantic Technologies – Online Identities and Social Networking – Concept Discovery and Categorization for Video Searching – Discovering Communities in Social Networks – Recommender Systems.

Suggested Activities:

- Group discussion on the pros and cons of communities in social networks.
- Charting the metrics for evaluating real time online communities.

Suggested Evaluation Methods:

- Group assignment on evaluating real time social network communities.
- Assignment on scenario based comparative analysis of community discovery.
- Open book quizzes on Recommender Systems for specific social networking scenarios.

UNIT IV SOCIAL NETWORK INFRASTRUCTURES AND COMMUNITIES 9

Detecting and Discovering Communities in Social Network: Evaluating Communities – Methods for Community Detection – Applications of Community Mining Algorithms – Ethical Practices in Social Network Mining-Understanding and Predicting Human Behavior for Social Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities-Inferential Methods in Social Network Analysis.

Suggested Activities:

- User interaction data collection from real time social network applications.
- Comparison of behavior models in social networks using sample data.

Suggested Evaluation Methods:

- Tutorial – Scenarios to identify suitable web accessibility testing.
- Group projects – Use open source data collection tools and predict user behavior.

UNIT V PRIVACY IN SOCIAL NETWORKS AND VISUALIZATION 9

Introduction to Security and Privacy in Online Social Networks – Key Player Problem – Intrusion Detection on Social Networks – Security Requirements for Social Networks – Visualizing Online Social Networks – Novel Visualizations and Interactions for Social Networks Exploration.

Suggested Activities:

- Case studies on applications of social network analysis.
- In-class activities – Network visualization using benchmark data and network visualization tools.

Suggested Evaluation Methods:

- Assignments on chart work for modeling social networks using node-edge diagrams.
- Mini project on applications of social network analysis.

PRACTICAL EXERCISES: 30

1. Download and install open source social network analysis tools like UCINET, Net Miner, Smart Network Analyzer, Pajek, Gephi and explore the visualization and analytical features of that tool using sample real world data.
2. Construct any graph representing a real life social network scenario, feed the same as a matrix input to any tool and explore the graph theoretical metrics of the graph and note down your observations and inferences on those values.
3. Download any RDF schema on tourism and explore various tags in the schema. To isualize, open them using a Word Editor. Highlight the subject, predicate and object in each file. If necessary use the RDF validator service by W3C to obtain the triplets.
4. Download and install any open source RDF/Ontology editing tool like protégé, Onto Studio, etc. Try the following in that tool: (i) Load existing RDF schema and visualize and (ii) Add, modify and delete RDF
5. Do the following using W3C RDF Validator: (i) Enter a URI or paste an RDF/XML document and parse the RDF and (ii) Visualize the RDF/XML as Triples and/or Graph.
6. Download any benchmark FOAF ontology/RDF and study the various FOAF classes used in that RDF/Ontology.
7. Download and install Gephi tool and explore importing graph file formats from (i) Spreadsheet import wizard, (ii) Database import. Also use the statistics and metrics framework in Gephi to calculate the following: Betweenness Centrality, Closeness, Diameter, Clustering Coefficient, Page Rank.
8. Load different social network data into Gephi tool and perform community detection using the features available and also compute the shortest path.
9. Explore various forced layout and random forest algorithms in Gephi tool to create a network layout. Compare the outputs of various layouts algorithms.
10. Study of various bibliometric RDFs and visualization of citation networks.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Convert a social network data into its equivalent graph data and derive social graph metrics.
2. Develop social blogs with necessary tags.
3. Design and develop ontology for various domains.
4. Predict human behavior in social web and related communities using community prediction and mining algorithms.
5. Design and develop trust models for social networks.
6. Visualize social network data and quantify its structural properties.

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REFERENCES:

1. Peter Mika, “Social Networks and the Semantic Web”, Springer 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 2010.
3. Guandong Xu ,Yanchun Zhang, Lin Li, “Web Mining and Social Networking – Techniques and Applications”, Springer, 2011.
4. Dion Goh, Schubert Foo, “Social Information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively”, IGI Global Snippet, 2008.
5. Max Chevalier, Christine Julien, Chantal Soulé-Dupuy, “Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling”, IGI Global Snippet, 2009.
6. John G. Breslin, Alexander Passant, Stefan Decker, “The Social Semantic Web”, Springer, 2009.

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

IF5077 DIGITAL IMAGE PROCESSING TECHNIQUES L T P C
3 0 2 4

OBJECTIVES:

- To learn about the basic concepts of Digital Image Processing and various Image Transforms.
- To familiarize the student with the Image Enhancement Techniques.
- To expose the student to a broad range of Image Processing Techniques and their Applications.
- To appreciate the use of current technologies those are specific to Image Processing Systems.
- To expose the students to real-world applications of Image Processing.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction–Applications of Image Processing – Steps in Image Processing Applications – Digital Imaging System – Sampling and Quantization – Pixel Connectivity – Distance Measures – Colour Fundamentals and Models – File Formats, Image Operations.

Suggested Activities:

- Discussion on Image Processing applications.
- External learning – Open Source Tools like Octave/SciLab/OpenCV.
- External learning – Matlab/Octave Toolboxes.
- Installation of OpenCV/SciLab.
- Numerical Problems in Pixel connectivity and Distance measures.

Suggested Evaluation Methods:

- Tutorial problems in image operations, image connectivity and distance measures.
- Assignment on sampling, quantization and image operations.
- Quizzes on image types.

UNIT II IMAGE ENHANCEMENT 9

Image Transforms: Fast Fourier Transform and Discrete Fourier Transform – Image Enhancement in Spatial and Frequency Domain – Grey level Transformations–Histogram Processing – Spatial Filtering – Smoothing and Sharpening – Filtering in Frequency Domain.

Suggested Activities:

- Discussion of Mathematical Transforms.
- Numerical problem solving using Fourier Transform.
- Numerical problem solving in Image Enhancement.
- External learning – Image Noise and its types.

Suggested Evaluation Methods:

- Tutorial – Image transforms.
- Assignments on histogram specification, histogram equalization and spatial filters.
- Quizzes on noise modeling.

UNIT III IMAGE RESTORATION AND MULTI-RESOLUTION ANALYSIS 9

MultiResolution Analysis: Image Pyramids – Multi Resolution Expansion – Wavelet Transforms–Image Restoration–Image Degradation Model–Noise Modelling – Blur – Order Statistic Filters–Image restoration Algorithms.

Suggested Activities:

- Discussion on Image Arte facts and Blur.
- Discussion of Role of Wavelet Transforms in Filter and Analysis.
- Numerical problem solving in Wavelet Transforms.
- External learning – Image restoration algorithms.

Suggested Evaluation Methods:

- Tutorial – Wavelet transforms.
- Assignment problems on order statistics and multi-resolution expansions.
- Quizzes on wavelet transforms.

UNIT IV IMAGESEGMENTATIONANDFEATUREEXTRACTION 9

Image Segmentation – Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region based Segmentation –Image Features and Extraction–Image Features– Types of Features–Feature Extraction–SIFT, SURF and Texture–Feature Reduction Algorithms.

Suggested Activities:

- Flipped classroom on importance of segmentation.
- External learning – Feature selection and reduction.
- External learning – Image salient features.
- Assignment on numerical problems in texture computation.

Suggested Evaluation Methods:

- Tutorial – Image segmentation and edge detection.
- Assignment problems on feature extraction and reduction.
- Quizzes on feature selection and extraction.

UNIT V IMAGE PROCESSING APPLICATIONS 9

Image Classifiers – Supervised Learning – Support Vector Machines, Image Clustering – Unsupervised Learning – Hierarchical and Partition Based Clustering Algorithms – EM Algorithm – Case Studies in Biometrics – Iris, Fingerprint and Face Recognition – Case Studies on Image Security – Steganography and Digital Watermarking – Case Studies on Medical Imaging and Remote Sensing.

Suggested Activities:

- Discussion on machine learning in image processing.
- Discussion on image classifiers.
- External learning – Study of visual effects, image processing in security, forensic applications.

Suggested Evaluation Methods:

- Tutorial – Image classifier and clustering.
- Assignment problems on support vector machines and EM algorithm.
- Quizzes on image processing applications.

PRACTICAL EXERCISES:

1. Implementation of Reading and Writing of Images in Matlab and OpenCV/Octave/SciLab.
2. Implementation of simple spatial filters like Low Pass Filters and High Pass Filters in Matlab/OpenCV.
3. Implementation of Histogram Techniques in Matlab/Octave/OpenCV.
4. Implementation of noise modelling in Matlab/Octave/SciLab.
5. Implementation of Wavelet Transforms and Deconvolution Algorithms in Matlab/Octave.
6. Implementation of SIFT, SURF in Matlab/Octave/SciLab.
7. Implementation of PCA in Matlab/Octave.
8. Implementation of Image Classifier using SVM in Matlab/Octave.
9. Implementation of Image Clustering algorithms in Matlab/Octave.
10. Implementation of Feature extraction Fingerprint using Matlab/Octave.

TOTAL: 75PERIODS

OUTCOMES:

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

1. Implement basic Image Processing Operations.
2. Apply and develop new techniques in the areas of Image Enhancement and Restoration.
3. Understand the Image segmentation algorithms.
4. Extract features from Images.
5. Apply classifier and Clustering algorithms for Image classification and Clustering.
6. Design and develop an image processing application that uses different concepts of Image Processing.

REFERENCES:

1. Rafael Gonzalez, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018.
2. S. Sridhar, “Digital Image Processing”, Second Edition, Oxford University Press, 2016.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”, Second Edition, Thompson Learning, 2007.
4. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, 2011.

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

IF5075 **COMPUTER VISION** **L T P C**
3 0 2 4

OBJECTIVES:

- To provide knowledge about computer vision algorithms.
- To understand the basic concepts of camera calibration, stereoscopic imaging and higher level image processing operations.
- To familiarize the student with the image processing facilities in Matlab and its equivalent open source tools like OpenCV.
- To appreciate the use of compute vision in Industrial applications and to understand the role of computer vision.
- To understand and implement Object detection and Object tracking Algorithms.

UNIT I FUNDAMENTALS OF VISION **9**

Image Formation and Representation–Intensity and Range Images – Camera models – Camera parameters – Light and colour – Image Noise – Image Filtering (spatial domain) – Mask based filtering – Image Smoothing –Sharpening.

Suggested Activities:

- Installation of OpenCV.
- Numerical Problems on Filtering, Masking, Smoothing and sharpening.

Suggested Evaluation Methods:

- Quizzes on various camera models and its effect.
- Practical – Programming assignments on types of filters for different applications.

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UNIT II IMAGE SEGMENTATION and CAMERA CALLIBRATION 9

Point and Line Detection – Hough Transform and Shape detection – Edge Detection – Corner Detection – Harris Detector- Stereopsis – Correspondence Problem –RANSAC and Alignment –Epipolar Geometry.

Suggested Activities

- Flipped classroom on importance of segmentation.
- External learning – Various camera calibration methods.

Suggested Evaluation Methods

- Quizzes on various segmentation methods.
- Practical – Programming assignments on edge and shape detection methods .

UNIT III FEATURE DETECTION AND TRACKING 9

Image Features – Textures – Deformable Contours – Features Reduction – Principal Component analysis – Feature Descriptors – SIFT and SURF– Motion field of rigid objects – Notation of Optical flow – Estimation Motion Field – Horn and Schunck Algorithm – Lucas and Kanade Algorithm.

Suggested Activities

- Flipped classroom on various feature reduction methods.
- External learning – Optical flow algorithms.

Suggested Evaluation Methods

- Quizzes on various feature detection methods.
- Practical – Programming assignments on object tracking algorithms.

UNIT IV SHAPE FROM CUESAND OBJECT DETECTION 9

Shape from Shading and shape from Texture Model based Vision – Smooth Surfaces and their Outlines–Aspect Graphs and Range Data – Localization – Classification and Evaluation – AdaBoost – Random Decision Forests – Pedestrian Detection.

Suggested Activities

- Flipped classroom on pedestrian detection methods.
- Assignments on numerical problems on Shading and Texture Model based Vision.
- Assignments on numerical problems on AdaBoost and Random Decision Forests.

Suggested Evaluation Methods

- Quizzes on methods to identify the shape of an object in an image.
- Practical – Programming assignments on algorithms and methods used for identification of objects.

UNIT V COMPUTER VISION APPLICATION 9

Emotion Recognition – Real Time Object Detection – Gesture Recognition – Face Detection.

Suggested Activities

- External learning – Exploring advancement in computer vision.
- Discussion on Emotion Recognition methods.

Suggested Evaluation Methods

- Quizzes on various real time computer vision application.
- Group discussion on methods to solve the real world problems in computer vision applications.

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PRACTICAL EXERCISE: **30**

1. Implementation of Noise removal algorithms using OpenCV.
2. Implementation of Object detection based on Edge detection algorithms on any application using OpenCV.
3. Implementation of Perspective projection of the lane borders using OpenCV.
4. Implementations of Feature Extraction of an object using SIFT in OpenCV.
5. Implementation of Feature Extraction of an object using SURF in OpenCV.
6. Implementation of Emotion Recognitionin OpenCV.
7. Implementation of Gesture Recognitionin OpenCV.
8. Implementation of Face Detection in OpenCV.
9. Implementation of Object detection using AdaBoost in OpenCV

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Implement basic computer vision algorithms.
2. Familiar with the use of MATLAB and OpenCV environment.
3. Apply and develop various object detection methods.
4. Design and implement industrial applications that incorporate different concepts of Image Processing.
5. Analyze different Object detection algorithms used in Computer Vision.
6. Understand the proper use of shape and Shape related cue features for Computer Vision Applications.

REFERENCES:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer International, 2011.
2. Reinhard Klette, “Concise Computer Vision: An Introduction into Theory and Algorithms”, Springer, 2014.
3. E. R. Davies, “Computer and Machine Vision”, Fourth Edition, Elsevier, 2012.

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

IF5076 **DEEP LEARNING** **L T P C**
3 0 2 4

OBJECTIVES:

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

UNIT I BASICS OF NEURAL NETWORKS 9

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

Suggested Activities:

- Discussion of role of Neural Networks.
- External learning – Boltzmann Machine and Perceptron.
- Practical – Installation of TensorFlow and Keras.

Suggested Evaluation Methods:

- Tutorial – Perceptron.
- Assignment problems on backpropagation networks.
- Quizzes on Neural Networks.

UNIT II INTRODUCTION TO DEEP LEARNING 9

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

Suggested Activities:

- Discussion of role of Gradient Descent in Deep Learning.
- External learning – Feature extraction and feature learning.
- Survey of Deep Learning Development Frameworks.
- Discussion of Gradient Descent Problem.

Suggested Evaluation Methods

- Tutorial – Gradient descent in deep learning.
- Assignment problems in optimization.
- Quizzes on deep learning regularization and optimization.

UNIT III CONVOLUTIONAL NEURAL NETWORKS 9

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

Suggested Activities:

- Discussion of role of Convolutional Networks in Machine Learning.
- External learning – Concept of convolution and need for Pooling.

Suggested Evaluation Methods:

- Tutorial – Image classification and recurrent nets.
- Assignment problems in image classification performances.
- Quizzes on Convolutional Neural Networks.

UNIT IV MORE DEEP LEARNING ARCHITECTURES 9

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

Suggested Activities:

- Discussion of role of Deep Learning architectures.
- External learning – Compression of features using Autoencoders.

Suggested Evaluation Methods:

- Tutorial – LSTM and Autoencoders.
- Assignment problems in deep generative models, Deep Belief Networks.
- Quizzes on deep learning architectures.

UNIT V APPLICATIONS OF DEEP LEARNING 9

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

Suggested Activities:

- Discussion of role of Deep Learning in Image and NLP applications.
- External learning – NLP concepts.

Suggested Evaluation Methods:

- Tutorial – Image segmentation.
- Assignment problems in parsing and sentiment analysis.
- Quizzes on deep learning architectures.

PRACTICAL EXERCISES:

1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras.
8. Implement a SimpleLSTM using TensorFlow/Keras.
9. Implement an Opinion Mining in Recurrent Neural network.
10. Implement an Object Detection using CNN.
11. Mini Project

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Understand the role of Deep learning in Machine Learning Applications.
2. To get familiar with the use of TensorFlow/Keras in Deep Learning Applications.
3. To design and implement Deep Learning Applications.
4. Critically Analyse Different Deep Learning Models in Image Related Projects.
5. To design and implement Convolutional Neural Networks.
6. To know about applications of Deep Learning in NLP and Image Processing.

Attested

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REFERENCES:

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

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

IF5080 HUMAN COMPUTER INTERACTION TECHNIQUES L T P C
3 0 2 4

OBJECTIVES:

- To learn the principles and fundamentals of HCI.
- To understand components of interfaces and screens, including windows, menus and controls.
- To understand user interface design principles, and apply them to designing an interface.
- To learn user interface designs through usability inspection and user models.
- To understand the rationale and guidelines for an effective interface design methodology.

UNIT I DESIGN PROCESS 9

Humans – Information Process – Computer – Information Process – Differences and Similarities between them – Need for Interaction – Framework and HCI – Models – Ergonomics – Style – Context – Paradigms – Designing of Interactive systems – Design rules: Golden Rules and Heuristics- Usability – Paradigm Shift – Interaction Design Basics – Design Process – Scenarios – Users need –Complexity of Design – Design Alternatives and Selection.

Suggested Activities:

- Flipped classroom on knowledge on the HCI design process.
- External learning – Exploration of various human computer interfaces.

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Suggested Evaluation Methods:

- Tutorials – HCI design process.
- Assignment on comparison of various interfaces.

UNIT II DESIGN AND EVALUATION OF INTERACTIVE SYSTEMS 9

Software Process – Usability Engineering – Issue Based Information Systems – Iterative Design Practices – Design Rules – Maximum Usability – Principles – Standards and Guidelines – Design Patterns – Programming Tools – Windowing Systems – Interaction Tool Kit – Interaction Devices – Layouts – Fragments – Widgets – Views – Adapters – Interaction styles – Direct Manipulation and Virtual Environments – Menu Selection – Form Fill – Dialog Boxes – Command and Natural Languages – User Interface Management System – Prototype Development– Evaluation Techniques – Evaluation Design – Evaluating Implementations – Observational Methods- Evaluation Strategies.

Suggested Activities:

- Flipped classroom on designing a good User Interface system based on design rules.
- External learning – Techniques related to evaluation of HCI design.

Suggested Evaluation Methods:

- Tutorial – Usage of design rules to create interfaces.
- Assignment on applying evaluation techniques on different user interfaces.

UNIT III COMMUNICATION MODELS 9

Universal Design Principles – Multimodal Systems – User Support – Presentation and Implementation Issues – Types – Requirements – Approaches – Task Models – Task Analysis and Design – Face to Face Communication – Conversation – Text Based Communication – Group Working.

Suggested Activities:

- Flipped classroom on basic knowledge of various models used in HCI design.
- External learning – Design and implementation of various models used in HCI design.

Suggested Evaluation Methods:

- Tutorial – Task models.
- Assignment on dialog models and task models.

UNIT IV EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS OF HCI 9

Basic Design Structure – Single Independent Variable – Multiple Independent Variable – Factorial Design – Split-plot Design – Random Errors – Experimental Procedure – Statistical Analysis – T tests – Analysis of Variance Test – Regression – Chi-Square Test – Survey – Probabilistic Sampling – Non-probabilistic Sampling – Developing Survey Questions.

Suggested Activities:

- Flipped classroom on basic concepts of probability and statistics.
- External learning – Practical problems related to hypothesis testing.

Suggested Evaluation Methods:

- Tutorial – Statistical testing related to UI evaluation parameters.
- Assignment on problems on hypothesis testing for UI parameters.

UNIT V DIALOGUE AND CURRENT TRENDS 9

Dialogue Notations and Design – Dialogue Need – Dialogue Design Notations – Graphical – Textual – Representing Dialogue – Formal Descriptions – Dialogue Analysis – System Models – Interaction Models – Relationship with Dialogue – Formalisms – Formal Notations – Interstitial Behavior – Virtual Reality – Devices for Virtual Reality and 3D Interaction – Modeling Rich Interaction – Status Event Analysis – Properties – Rich Contexts – Sensor-Based systems – Groupware – Applications – Ubiquitous Computing – Applications – HCI for Smart Environment – HCI for Scientific Applications, Medical Applications – HCI for Assistive Technology.

Suggested Activities:

- Flipped classroom on basic concepts of dialogue notations and design.
- External learning – Study of how Virtual Reality interface are used in various real time applications.

Suggested Evaluation Methods:

- Tutorial – Recent trends in human computer interface systems.
- Assignment on dialogue notation representation for various interfaces.

PRACTICAL EXERCISES: 30

1. Study of UI Development Tools like scratch, React, Adobe XD, Flash, Wix, Bootstrap and Angular js.
2. Study of user interfaces of common applications like Facebook, UberEats, Twitter, IRCTC, Anna university Sems, Amazon etc. Prepare a comparative Design document.
3. Design and development of simple user interface for an E-commerce website.
4. Design and development of the user interface of a university Web portal.
5. Design and development of movie ticket booking interface for Physically Challenged people. Prepare design document for the following interfaces which should include the design process, design methodology and the design rules used in the development of the UI application. The document should also justify the chosen methodology for the given application. Using an evaluation technique, evaluate the way in which user experiences with your proposed design would be satisfiable to the end user.
6. Implementation of Mixed Reality based visual interface for dialogue based systems.
7. Implementation of user interfaces for video streaming application which caters to the need of older people.
8. Design and development of mobile application interfaces for chat bots.
9. Design and development of novel user interfaces for any wearable device.
10. Design and develop an interface for geographical information system.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Interpret the contributions of human factors and technical constraints on human-computer interaction.
2. Evaluate the role of current HCI theories in the design of software.
3. Design and develop interfaces related to real applications.
4. Apply exploratory and experimental research methods in HCI.
5. Familiarize with principles and guidelines of user centered interface design process, evaluation methodologies and tools to analyze the interfaces.
6. Implement human computer interfaces for different applications using various tools and technologies.

Attested

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REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Prentice Hall, 2004.
2. Preece, J., Sharp, H., Rogers, Y. “Interaction Design: Beyond Human-Computer Interaction”, Fourth Edition, John Wiley, 2015.
3. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, “Research Methods in Human-Computer Interaction”, Wiley, 2010.
4. Ben Shneiderman, Catherine Plaisant, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Fifth Edition, Reading, Addison Wesley, 2009.
5. Jeff Johnson, “Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules”, Morgan Kauffman, 2010.

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

IF5083 **PATTERN RECOGNITION** **L T P C**
3 0 2 4

OBJECTIVES:

- To provide basic knowledge about the fundamentals of pattern recognition and its application.
- To understand about unsupervised algorithms suitable for pattern classification.
- To familiarize with the feature selection algorithms and method of implementing them in applications.
- To learn about the basis of algorithm used for training and testing the dataset.
- To learn basic fuzzy system and neural network architectures, for applications in pattern recognition, image processing, and computer vision**.**

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern Recognition – Discriminant Functions – Supervised Learning – Parametric Estimation – Maximum Likelihood Estimation – Bayes Theorem – Bayesian Belief Network–Naive Bayesian Classifier.

Suggested Activities:

- Discussion on pattern recognition application like image classification .
- Installation of Matlab.
- Assignment on numerical problem solving on Naive Bayesian classifier.

Suggested Evaluation Methods:

- Quizzes on importance of classifier in recognizing various patterns.
- Practical – Programming assignments on implementation of Bayes theorem.

Attested

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UNIT II CLUSTERING 9

Clustering Concept – Hierarchical Clustering Procedures – Partitional Clustering – Clustering of Large Data Sets – EM Algorithm – Grid Based Clustering– Density Based Clustering.

Suggested Activities:

- Assignments on numerical problem solving using hierarchical Clustering in Matlab.
- Assignments on numerical problem solving using EM Algorithm in Matlab.

Suggested Evaluation Methods:

- Quizzes on various clustering methods in pattern recognition.
- Practical – Programming assignments on the working of clustering algorithms on various applications.

UNIT III FEATURE EXTRACTION AND SELECTION 9

Entropy Minimization – Karhunenloeve Transformation – Feature Selection through Functions Approximation – Binary Feature Selection – K-NN.

Suggested Activities:

- Assignment on numerical problem solving using K-NN algorithm.
- Assignment on numerical problem solving using Decision Tree algorithm.

Suggested Evaluation Methods:

- Quizzes on various feature selection methods.
- Practical – Programming assignments on various feature extraction algorithms for various applications.

UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE 9

State Machines – Hidden Markov Models: Maximum Likelihood for the HMM, Forward-Backward Algorithm, Sum and Product Algorithm for the HMM, Scaling Factors, Viterbi Algorithm, Extensions of the Hidden Markov Model – Support Vector Machines: Maximum Margin Classifiers, Relevance Vector Machines.

Suggested Activities:

- Assignments on numerical problem solving using HMM algorithm in Matlab.
- Assignments on numerical problem solving using SVM classifier in Matlab.

Suggested Evaluation Methods:

- Quizzes on various Markov models.
- Practical – Programming assignments on working of SVM and HMM over real world application.

UNIT V RECENT ADVANCES 9

Fuzzy Classification: Fuzzy Set Theory, Fuzzy and Crisp Classification, Fuzzy Clustering, Fuzzy Pattern Recognition– Introduction to Neural Networks: Elementary Neural Network for Pattern Recognition, Hebbnet, Perceptron, ADALINE, and Back Propagation.

Suggested Activities:

- Numerical problem solving on simple neuron in Matlab.
- Numerical problem solving on custom neural networks in Matlab.

Suggested Evaluation Methods:

- Quizzes on various fuzzy classification methods.
- Practical – Programming assignments on neural network for pattern recognition applications.

PRACTICAL EXERCISE: **30**

1. Implementation of Image classification using Hebbnet method inMatlab.
2. Implementation of Image classification using Perceptron method in Matlab.
3. Implementation of Fuzzy pattern recognition in Matlab/OpenCV.
4. Implementation of Feature extraction using KL transform Matlab/OpenCV.
5. Implementation of Clustering using partitional based clustering in Matlab/OpenCV.
6. Implementation of Clustering using density based clustering in Matlab/OpenCV.
7. Implementation of Classification using SVM in Matlab/OpenCV.
8. Implementation of Classification using HMM in Matlab/OpenCV.
9. Implementation of Classification using Bayes in Matlab/OpenCV.
10. Implementation of Neural Network methods using OpenCV.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Implement basic pattern classifier algorithms.
2. Have knowledge about the working principle of unsupervised algorithm
3. Have knowledge about functionality of classifiers
4. Perceive the recent advancement in pattern recognition
5. Apply SVM and HMM algorithms for real time applications.
6. Implement advanced methodologies over image processing applications.

REFERENCES:

1. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
2. M. Narasimha Murthy, V. Susheela Devi, “Pattern Recognition”, Springer, 2011.
3. Andrew Webb, “Statistical Pattern Recognition”, Arnold Publishers, 1999.
4. R. O. Duda, P. E. Hart, D. G. Stork, “Pattern Classification”, John Wiley, 2001.
5. S. Rajasekaran, G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice Hall, 2010.

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

IF5073 **AUTONOMOUS GROUND VEHICLE SYSTEMS** **L T P C**
3 0 2 4

OBJECTIVES:

- To learn the fundamentals of autonomous driving.
- To study the different ways of sensing internal states of Autonomous Ground Vehicles (AGVs).
- To learn the environment perception for autonomous driving.
- To explore the navigation techniques of AGVs.
- To learn the fundamentals of vehicle control systems and connected vehicles.

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UNIT I INTRODUCTION TO AUTONOMOUS DRIVING 9

Autonomous Driving Technologies Overview – Autonomous Driving Algorithms – Autonomous Driving Client System – Autonomous Driving Cloud Platform – Components of autonomy – Difference between Unmanned and Autonomous Vehicles – Introduction to Unmanned Aerial Vehicles (UAVs).

Suggested Activities:

- Flipped classroom on autonomous driving system architecture.
- External learning – Building blocks of typical Unmanned Aerial Vehicles.
- Flipped classroom onrobot operating system.
- External learning – Applications of autonomous vehicles (aerial, under water, ground vehicles).
- Assignment on the design requirement specifications of autonomous vehicles (aerial, under water, ground vehicles).

Suggested Evaluation Methods:

- Viva voce on assignment topics.
- Quizzes on Advanced Driver Assistance Systems (ADAS).
- Group Discussion on Google's self-driving car.

UNIT II SENSORS FOR AUTONOMOUS GROUND VEHICLES 9

Sensor Characteristics – Vehicle Internal State Sensing: OEM Vehicle Sensors, GPS, Inertial Measurements, Magnetometer – External World Sensing: RADAR, Lidar, Image Processing Sensors.

Suggested Activities:

- Flipped Classroom on sensor characteristics.
- External learning – Working principle of IMU/GPS/RADAR sensors.
- External learning – Exploring Velodyne Lidar sensor dataset in Veloview software.

Suggested Evaluation Methods:

- Practical-Experiments on interfacing IMU sensor to Raspberry Pi board and recording the acceleration of a dummy vehicle.
- Practical-Experiments on interfacing Lidar/RADAR sensor to Raspberry Pi board and recording the distances to the nearby objects.
- Practical-Experiments on interfacing camera to Raspberry Pi board and capturing images/videos.

UNIT III ENVIRONMENT PERCEPTION AND MODELING 9

Road Recognition: Basic Mean Shift Algorithm, Mean Shift Clustering, Mean Shift Segmentation, Mean Shift Tracking, Road Recognition Algorithm –Vehicle Detection and Tracking: Generating ROIs, Multi Resolution Vehicle Hypothesis, Vehicle Validation using Gabor Features and SVM, Boosted Gabor Features –Multiple Sensor Based Multiple Object Tracking.

Suggested Activities:

- Flipped classroom onBasic Mean Shift Algorithm.
- External learning – Lane detection algorithm.
- Flipped classroom onvehicle tracking.

Suggested Evaluation Methods:

- Practical – Implementation of Mean Shift Clustering / Mean Shift Segmentation Algorithm.
- Practical – Experiments onstationary obstacle detection algorithm using Lidar sensor.

UNIT IV NAVIGATION FUNDAMENTALS 9

Introduction – Navigation: GNSS Overview, GPS, GLONASS, Galileo, Compass – Inertial Navigation Overview: Inertial Sensor Technology – GNSS/INS Integration Overview – Case Studyon Kalman Filtering.

Suggested Activities:

- Flipped classroom on GPS orbits/GPS Signals.
- External learning – Indian Regional Navigation Satellite System (IRNSS).
- Assignment onthe working principles of Google Map.

Suggested Evaluation Methods:

- Quizzes on GNSS signal structure.
- Viva Voce on assignment topics.
- Practical – Simulation of Waypoint Navigation Algorithm.

UNIT V VEHICLE CONTROL AND CONNECTED VEHICLE 9

Vehicle Control: Cruise Control, Antilock Brake Systems, Steering Control and Lane Following, Parking – Connected Vehicles: Vehicle to Vehicle Communication, Vehicle to Infrastructure Communication.

Suggested Activities:

- Flipped classroom on cruise control.
- External learning – Study on proportional integral derivative (PID) control.
- Assignment – Communication protocols for connected vehicles.

Suggested Evaluation Methods:

- Viva Voce on assignment topic.
- Practical – Experiment on simple velocity control.
- Practical – Experiment on simple longitudinal motion control.

PRACTICAL EXERCISES: 30

1. Write a python program to read Lidar sensor data and write it in a text file.
2. Write an Arduino sketch to operate DC motors through motor driver.
3. Write a python program on Raspberry Pi board to control the movement of pan-tilt platform with 5v dc motors.
4. Write a python program to read the IMU sensor values through I2C bus in Raspberry Pi board.
5. Develop an Arduino application to drive a simple rover with four wheels in a random path.
6. Write a python program to send the location of a rover with GPS to Firebase real-time database.
7. Develop a Lidar sensor assisted application to implement 2D collision cone based obstacle avoidance for rovers.
8. Develop an application using python program to control the pan-tilt motion of a camera and to take pictures/videos in the field of view of the camera.
9. Develop a convolutional neural network model to detect cars in videos.
10. Develop a convolutional neural network model to detect road lanes in videos.
11. Mini Project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Identify the requirements and design challenges of AGVs.
2. Select suitable sensors to sense the internal state and external world of AGVs.
3. Implement lane detection, road detection & vehicle detection algorithms.
4. Simulate/implement ground vehicle navigation algorithms.
5. Simulate/implement ground vehicle control systems.
6. Design communication protocols for connected vehicles.

TEXT BOOKS:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems", Morgan & Claypool, 2018.
2. UmitOzguner, TankutAcarman, Keith Redmill, "Autonomous Ground Vehicles", Artech House, 2011.

REFERENCES:

1. Hong Cheng, "Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation", Springer, 2011.
2. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, "Global Navigation Satellite Systems, Inertial Navigation, and Integration", Third Edition, John Wiley & Sons, 2013.

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

IF5079 GPU ARCHITECTURE AND PROGRAMMING L T P C
3 0 2 4

OBJECTIVES:

- To understand the basics of GPU architectures.
- To write programs for massively parallel processors using CUDA/OpenCL.
- To understand the issues in mapping algorithms for GPUs.
- To understand different GPU programming models.
- To analyze performance of algorithms on GPUs.

UNIT I GPU ARCHITECTURE 12

Evolution of GPU Architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

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Suggested Activities:

- Survey the machines in the laboratory and identify the configuration of the GPUs in them.
- Download the CUDA toolkit and setup the CUDA environment.
- Write simple CUDA code and vary the parameters to understand the concept of threads, blocks and grids.

Suggested Evaluation Methods:

- Check the configuration.
- Demonstrate the CUDA setup by running simple and sample programs.

UNIT II CUDA PROGRAMMING 8

CUDA basics - Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

Suggested Activities:

- Code walkthrough of sample CUDA programs.
- Run sample CUDA programs with different memory options.

Suggested Evaluation Methods:

- Check the trace of the CUDA programs.
- Check the output corresponding to different memory options.

UNIT III PROGRAMMING ISSUES 8

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

Suggested Activities:

- Code walkthrough of sample CUDA programs with synchronization within thread blocks and across thread blocks.
- Write CUDA programs with and without pitched memory and compare.

Suggested Evaluation Method:

- Quizzes on the understanding of synchronization options.

UNIT IV OPENCL BASICS 8

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

Suggested Activities:

- Code walkthrough of sample OpenCL programs.
- Run sample OpenCL programs with different memory options.

Suggested Evaluation Methods:

- Check the trace of the OpenCL programs.
- Check the output corresponding to different memory options.

UNIT V ALGORITHMS ON GPU 9

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

Suggested Activities:

- Analyse programs in CUDA/OpenCL to perform graph traversal, tree traversal.
- Study sample programs for matrix multiplication and analyse their performance.

Suggested Evaluation Methods:

- Check the output of the CUDA programs.
- Check Performance chart.

PRACTICAL EXERCISE: **30**

1. Implement matrix multiplication using CUDA. Experiment with different matrix sizes and kernel launch options and compare the performance. (2 labs)
2. Implement vector reduction using CUDA, and check output with CUDA profiler.
3. Implement matrix multiplication with tiling and shared memory.
4. Implement various performance tuning techniques for matrix multiplication.
5. Implement matrix multiplication using OpenCL.
6. Implement vector reduction using OpenCL.
7. Implement graph traversal using CUDA
8. Implement image processing algorithms using CUDA
9. Experiment with advanced features such as dynamic parallelism
10. Mini project: Choose an application and implement using GPU and do performance analysis.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Describe GPU Architecture.
2. Write programs using CUDA, identify issues and debug them.
3. Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication.
4. Write simple programs using OpenCL.
5. Given a problem, identify efficient parallel programming patterns to solve it.
6. Compare different GPU programming paradigms.

REFERENCES:

1. Shane Cook, “CUDA Programming: A Developer’s Guide to Parallel Computing with GPUs”, Morgan Kaufmann, 2013.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous Computing with OpenCL 2.0”, Morgan Kauffman, 2015.
3. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors – A Hands-on Approach”, Third Edition, Morgan Kaufmann, 2016.
4. Nicholas Wilt, “CUDA Handbook: A Comprehensive Guide to GPU Programming”, Addison Wesley, 2013.
5. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General Purpose GPU Programming”, Addison Wesley, 2011.
6. http://www.nvidia.com/object/cuda_home_new.html
7. http://www.openCL.org

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

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IF5085 VIDEO PROCESSING AND ANALYTICS L T P C
3 0 2 4

OBJECTIVES:

- To have a better knowledge about videos representation and its formats
- To know the fundamental concepts of data science and analytics
- To enrich students with video processing for analytics
- To understand the data analytics for processing video content
- To expose the student to emerging trends in video analytics

UNIT I VIDEO FUNDAMENTALS 9

Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog-to Digital Conversion – Color Representation and Chroma Sub Sampling – Video Sampling Rate and Standards Conversion – Digital Video Formats –Video Features – Colour, Shape and Textural Features.

Suggested Activities

- In class activity – Numerical problems related to sampling and standards conversion.
- Flipped classroom – Discussion on video features.

Suggested Evaluation Methods

- Online quiz on video features.
- Assignments on sampling and standards conversion.

UNIT II MOTION ESTIMATION AND VIDEO SEGMENTATION 9

Fundamentals of Motion Estimation – Optical Flow – 2D and 3D Motion Estimation – Block Based Point Correspondences – Gradient Based Intensity Matching – Feature Matching – Frequency Domain Motion Estimation – Video Segmentation.

Suggested Activities

- In-class activity – Numerical problems related to motion estimation.
- External learning – Survey on optical flow techniques.

Suggested Evaluation Methods

- Online quiz on optical flow techniques.
- Assignments on numerical problems in motion estimation.

UNIT III FUNDAMENTAL DATA ANALYSIS 9

Exploratory Data Analysis – Collection of Data – Graphical Presentation of Data – Classification of Data – Storage and Retrieval of Data – Big Data – Challenges of Conventional Systems – Web Data – Evolution of Analytic Scalability – Analytic Processes and Tools – Analysis vs. Reporting.

Suggested Activities

- In class activity – Graphical presentation of data for visualization.
- External learning – Survey on Modern Data Analytic Tools.

Suggested Evaluation Methods

- Quiz on modern data analytic tools.
- Assignments on data visualization.

UNIT IV MINING DATA STREAMS AND VIDEO ANALYTICS 9

Introduction To Streams Concepts – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Analytic Processes and Tools – Video shot boundary detection – Model Based Annotation and Video Mining – Video Database – Video Categorization – Video Query Categorization.

Suggested Activities

- Flipped classroom on discussion on automatic video trailer generation.
- External learning – Survey on analytic processes and tools.

Suggested Evaluation Methods

- Quiz on video trailer generation.
- Assignments on analytic processes and tools.

UNIT V EMERGING TRENDS **9**

Affective Video Content Analysis – Parsing a Video Into Semantic Segments – Video Indexing and Abstraction for Retrievals – Automatic Video Trailer Generation – Video In painting – Forensic Video Analysis.

Suggested Activities

- External learning – Survey on Affective Video Content Analysis.
- Flipped classroom on discussion on forensic video analysis.

Suggested Evaluation Methods

- Online quiz on forensic video analysis.
- Assignments on affective video content analysis.

PRACTICAL EXERCISES: **30**

1. Choose appropriate features for video segmentation for given sample video.
2. Compute two dimension motion estimation using block based match technique.
3. Calculate the motion estimation based on Frequency domain.
4. Compare the video features extracted from a given video dataset using graphical representation.
5. Compute the number of distinct elements found in the given sample data stream.
6. Detect shot boundary for given sample video.
7. Parse the given sample video for indexing and faster retrieval.
8. Generate an automatic video trailer for given sample video.
9. Design simple application using video in painting technique.
10. Mini project for video categorization based on content analysis.

TOTAL: 75 PERIODS

OUTCOMES:

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

- Discuss video processing fundamentals
- Analyze video features for segmentation purpose
- Derive numeric problems related to motion estimation
- Process video streams for analytics purpose
- Parse and index video segments
- Design applications for video analytics in current trend

REFERENCES:

1. Roy, A., Dixit, R., Naskar, R., Chakraborty, R.S., “Digital Image Forensics: Theory and Implementation”, Springer, 2018.
2. Paul Kinley, “Data Analytics for Beginners: Basic Guide to Master Data Analytics”, CreateSpace Independent Publishing Platform, 2016.
3. Henrique C. M. Andrade, Bugra Gedik, Deepak S. Turaga, “Fundamentals of Stream Processing: Application Design, Systems, and Analytics”, Cambridge University Press, 2014.
4. A. Murat Tekalp, “Digital Video Processing” Second Edition, Prentice Hall, 2015.
5. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications“, Wiley, 2014.
6. Oges Marques, “Practical Image and Video Processing Using MATLAB”, Wiley-IEEE Press, 2011.

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

MM5073 MULTIMEDIA CODING TECHNIQUES L T P C
3 0 2 4

OBJECTIVES:

- To enrich student learning in fundamentals of multimedia coding and standards.
- To train the students to acquire knowledge in text coding.
- To acquire knowledge behind theory of image and video coding & decoding with standards.
- To learn principles of audio coding and standards.
- To get comprehensive learning in multimedia standard content description and formats.

UNIT I LOSSLESS AND LOSSY CODING 9

Components of Multimedia – Basics of Information Theory – Entropy – Lossless Compression – Text Compression – Run Length Coding – Variable Length Coding – Shannon Fano Coding – Huffman and Adaptive Huffman Coding – Dictionary Based Coding – Arithmetic Coding – Lossy Compression Algorithms – Rate Distortion Theory – Quantization – Transform Coding – Wavelet Based Coding.

Suggested Activities:

- Flipped classroom on text coding concepts.
- Practical – Implement basic text coding and decoding algorithm using Python.
- Case study of WinZip, RAR.

Suggested Evaluation Methods:

- Estimate complexity and coding efficiency of a given algorithm.
- Assignment on numerical problem solving in coding theory.
- Assignment on numerical problems in coding theory.

UNIT II IMAGE PROCESSING AND CODING 9

Image Formation – CIE Chromaticity Diagram – Color Models: RGB, CMY, LMS, HSV, HSL – Color Balancing – Gamma Correction – Image Coding and Decoding Standards: JPEG, JPEG-2000, JPEG-LS, GIF, PNG, TIFF, EXIF, BMP.

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Suggested Activities:

- Flipped classroom on different image coding techniques.
- Practical – Demonstration of EXIF format for given camera.
- Practical – Implementing effects quantization, color change.
- Analyze effects of change in RGB components in a digital color image.
- Case study of Google's WebP image format.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Assignment on image file formats.
- Quizzes on colour models.

UNIT III VIDEO PROCESSING AND CODING 9

Video Color Transform: YUV, YIQ, YcbCr – Chroma Subsampling – Standard Digital Video Formats – CIF – QCIF – HDTV – UHDTV – Resolutions – 4K, 8K, 16K – Video Compression Based on Motion Compensation – Search for Motion Vectors – H.261 – H.264 – Motion Compensation in MPEG – MPEG–1, MPEG–2 – MPEG–4.

Suggested Activities:

- Flipped classroom on concepts of video coding standards.
- Assignment on calculation of file size in different resolution and standards.
- Assignment on complexity estimation of different motion vector search methods.
- Assignment on measurement of video quality using tools.
- Practical – Implementation of effects quantization, Chroma sub-sampling etc.
- Case study of Google's WebM video format.
- Mini project on processing of coded video.

Suggested Evaluation Methods:

- Evaluation of the practical implementation.
- Evaluation of the mini project.
- Quizzes on MPEG standards.

UNIT IV AUDIO PROCESSING AND CODING 9

Digitization of Audio: PCM, ADPCM – Waveform Audio File Format – Synthetic Sounds – Musical Instrument Digital Interface – Vocoders – MPEG Audio – MP3 – Advance Audio Coding – High-Efficiency Advanced Audio Coding – MPEG4 – Home Theatre Systems.

Suggested Activities:

- Flipped classroom on audio coding standards.
- External learning – Dolby, DTS systems in Cinema theatres.
- Assignment on numerical problems on digital audio.
- Practical – Implementation of surround sound.
- Case study of a multi-channel home theatre system.

Suggested Evaluation Methods:

- Assignment on numerical problems on digital audio.
- Real-time demonstration of surround sound.
- Quizzes on Surround audio.

UNIT V MULTIMEDIA CONTENT DESCRIPTION AND FRAMEWORK 9

Hypermedia Coding – Multimedia and Hypermedia Expert Group – Multimedia Content Description Interface – MPEG-7 – Multimedia Framework – MPEG-21 – High Efficiency Coding and Media Delivery in Heterogeneous Environments – MPEG-H – Dynamic Adaptive Streaming over HTTP – MPEG-DASH.

Suggested Activities:

- Designing the structure and user interface.
- Case study of media coding used by YouTube, Netflix.
- External learning – Media streaming for TV.

Suggested Evaluation Methods:

- Responsive web design using hypermedia.
- Demonstration of media streaming through internet.
- Quizzes on multimedia frameworks.

PRACTICAL EXERCISES: 30

1. Implement Shannon Fano, Huffman, and adaptive Huffman coding techniques.
2. Develop and implement Dictionary based coding and decoding methods.
3. Implement Arithmetic coding and decoding algorithms.
4. Develop and implement transform coding with DCT / Wavelet based algorithm.
5. Implement color balancing and Gamma correction methods.
6. Implement different modules of JPEG algorithms.
7. Implement color processing in video.
8. Implement different modules of MPEG–1 / H.261 standards.
9. Develop tool for editing MIDI musical files.
10. Implement different modules of MP–3, AAC standards.
11. Create multimedia contents with standard multimedia content description interface and frameworks.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Articulate the concepts and techniques used in multimedia basics and standard coding techniques.
2. Develop competence in implementing text coding.
3. Design and implement algorithms for image and video coding.
4. Choose and analyze suitable audio coding for a given multimedia application.
5. Design and develop multimedia projects with standard content formats and frameworks.

REFERENCES:

1. Mark S. Drew, Zee Nian Li, “Fundamentals of multimedia”, Prentice Hall, 2014.
2. Ralf Steinmetz, Klara Nahrstedt, “Multimedia Computing, Communications and Applications”, Innovative Technology Series, Prentice Hall, 1995.
3. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh, Richard L. Baker, “Digital Compression for Multimedia: Principles and Standards”, Elsevier, 2006.
4. Ranjan Parekh, “Principles of Multimedia”, McGraw-Hill, Second Edition, 2017.
5. Fred Halsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Pearson Education, 2002.

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

MM5002 MULTIMEDIA INFORMATION STORAGE AND RETRIEVAL L T P C
3 0 2 4

OBJECTIVES:

- To introduce the basics of multimedia information storage technology, techniques for analysis, representation and retrieval that is commonly used in industry.
- To compare and contrast information retrieval models and internal mechanisms such as Boolean, Probability, and Vector Space Models.
- To outline the structure of queries and media elements.
- To use of machine learning methods on multimedia collections.
- To critically evaluate Multimedia retrieval system effectiveness and improvement techniques.

UNIT I STORAGE AND PRESENTATION OF MULTIMEDIA 9

Introduction – Media Types – Media Understanding – Description of Audio, Visual Spectral and Video – Storage Networks, Storage Medium – Multidimensional Data Structures: K-D Trees – Point Quadtrees – The MX-Quadtree – Rtrees – Comparison of Different Data Structures.

Suggested Activities:

- Install openCV and learn the functions which are used for Image retrieval.

Suggested Evaluation Methods:

- Quiz on applications of data structure

UNIT II TEXT AND MUSIC RETRIEVAL 9

Text Information Retrieval: Information Retrieval System – Catalog and Indexing – Automatic Indexing – Term Clustering – User Search Techniques – Information Visualization – Fundamentals – Instantaneous Features – Intensity – Tonal Analysis – Musical Genre, Similarity and Mood.

Attested

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Suggested Activities:

- Compute the tf-idf weights for the terms car, auto, insurance, best for each document, using the idf values from Figure.

	Doc1	Doc2	Doc3
Car	27	4	24
Auto	3	33	0
Insurance	0	33	29
Best	14	0	17

- Consider the query best car insurance on a fictitious collection with N=1,000,000 documents where the document frequencies of auto, best, car and insurance are respectively 5000, 50000, 10000 and 1000. Compute the cosine similarities between the query vector and each document vector in the collection.

Suggested Evaluation Methods:

- Discussion on applying various tf-idf variant and similarity measurements and comparing the results.

UNIT III IMAGE RETRIEVAL 9

Content-Based Image Retrieval – Techniques – Feature Extraction – Integration – Similarity –Feature in Indexing – Interactive Retrieval – MPEG-7 Standard.

Suggested Activities:

- Assignment on numerical problems on feature extraction techniques.

Suggested Evaluation Methods:

- Tutorial – MPEG-7 standards.
- Tutorial on the problem of choosing the features to be extracted for a large image collection.

UNIT IV VIDEO RETRIEVAL 9

Content Based Video Retrieval – Video Parsing – Video Abstraction and Summarization – Video Content Representation, Indexing and Retrieval – Video Browsing Schemes – Example of Video Retrieval Systems.

Suggested Activities:

- External learning – Survey on colour-based tracking and optical flow.
- Practical – Learn any open source database software for database operations.

Suggested Evaluation Methods:

- Demonstration and quiz on the practical exercise and the EL component.

UNIT V RETRIEVAL METRICS AND TRENDS 9

Average Recall and Average Precision – Harmonic Mean – Evaluation of a Search Engine – Relevance Issue – Kappa Measure – Quality Versus Quantity, Possible Factors Which Influence Outcome of a Search – Grandfield Experimental Study – Introduction To Parallel IR – Distributed IR – Trends and Research Issue.

Suggested Activities:

- External learning – Survey on image and video retrieval processing in a search engine such as Google, Yahoo and Bing.

Suggested Evaluation Methods:

- Group discussion and quiz on EL component.
- Assignment on various metric calculations.

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PRACTICAL EXERCISES: **30**

Implement the following exercises using OpenCV:

1. Develop a system to compute that representation for each of the images in a database and to change images between different colour spaces, transformations, about Contours (4 hr)
2. Develop a system to search for an object in an image using Template Matching and segment images and extractions of foreground (4 hr)
3. Implement to do the pre-processing for any document and construct a vector space model for the collection of text documents and also compute the similarity between them. (4 hr)
4. Develop a system to compute spatial-temporal motion trajectory for a video dataset. (4 hr)
5. Develop a system to compute any two Feature extraction techniques and dimension reduction procedure. (4 hr)

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Learn the basics of multimedia information storage technology, techniques for analysis, representation and retrieval.
2. Compare and contrast information retrieval models and internal mechanisms such as Boolean, Probability, and Vector Space Models.
3. Outline the structure of queries and media elements.
4. Implement the process by exploring the open source tool for Image retrieval and video retrieval.
5. Recognize the feasibility of applying machine learning for a particular problem.
6. Critically evaluate Multimedia retrieval system effectiveness and improvement techniques.

REFERENCES:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, “Introduction to Information Retrieval” , Cambridge University Press, 2008.
2. Philip K. C. Tse, “Multimedia Information Storage and Retrieval: Techniques and Technologies”, IGI Publishing, 2002.
3. Oge Marques, Borko Furht, “Content-Based Image And Video Retrieval”, Springer, 2002.
4. V.S. Subrahmanian, “Principles of Multimedia Database Systems”, Morgan Kaufmann, 1998.
5. Stefan Rüger, “Multimedia Information Retrieval”, Morgan and Claypool Publishers, 2009.

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

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MM5003	SHORT FILM DEVELOPMENT	L T P C 3 0 2 4

OBJECTIVES:

- To understand the fundamentals of Short film Making.
- To know the working principles camera.
- To acquire knowledge about the editing software.
- To train the student as a member or leader in diverse teams of short film development.
- To inculcate aesthetic sense involved in creativity and transform creative ideas into short film.

UNIT I INTRODUCTION TO SHORT FILM 9

Introduction – Different Types of Short Film – Documentary and Non Fiction Film – Animated Short Films – Challenges in Developing Short Films – Creative Approaches.

Suggested Activities:

- Blended Learning – Displaying Different types short films.
- Flipped classroom on issues in short film production.
- External learning – Practical problems related to interacting with people related public issues.

Suggested Evaluation Methods:

- Assignment on different types of short film.
- Tutorial – Various issues related to short films production.
- Assignment on different interviews style.

UNIT II PREPRODUCTION 9

Developing and Researching Short Film Project – Considering and Selecting an Idea – Developing Questions – Research Techniques- Writing a Concept and Treatment - Shooting Script – Hiring Crew – Crew Position and Responsibilities – Producing and Budgeting – Visual Scope and Visual Evidence – Permission – Funding – Proposals – Attracting Funding – Ethics in Short Film Making.

Suggested Activities:

- Blended learning – People interest towards short films.
- Flipped classroom on discussion on selection of crew members based on their talents.
- External learning – Survey on funding agencies and legal details regarding short films productions.

Suggested Evaluation Methods:

- Assignment on preparing survey question to known people interest towards short film.
- Tutorial – Crew and their responsibilities.
- Assignment on project proposal preparation.

UNIT III PRODUCTION 9

Research Leading up to the Shoot – Production Team, Production –Camera Equipment and Shooting Procedure – Lighting Location Sound – Interviewing – Directing Participants – Working Together – Team Work – Scheduling – Problems and Issues.

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Suggested Activities:

- Blended learning – Research regarding the locations and pervious stories.
- Flipped classroom on different types of cameras.

Suggested Evaluation Methods:

- Quizzes on research and scheduling the locations.
- Assignment on the usage of cameras in shooting procedures.

UNIT IV POST PRODUCTION 9

Designing a Structure – Working with Editor – Visual Effects – Transition – Adding Sound Effects and Music – Special Effect Dubbing – Rerecording – Narration – Voiceover — Titles –Graphics – Color Exposure and Color Correction – Credits and Acknowledgements.

Suggested Activities:

- Flipped classroom on various visual and color effects.
- External learning – Interaction with media peoples.

Suggested Evaluation Methods:

- Tutorial – Color theory.
- Assignment on recording and editing.

UNIT V SCREENING 9

Impact of Short Film on the Society – Various Media Techniques used in Short Film Production – Identifying Important Current Social Issues for Short Film – Exploring Background Research Current Social Issues – Making Short Film for Television and Theatrical Release – Non Fiction Presentation – Production of an individually or Group Authored Short Film Based on Historical – Corporate – Institutional – Current Social Issues.

Suggested Activities:

- External learning – Survey on current public issue.
- Flipped classroom on discussion on innovative short film production.

Suggested Evaluation Methods:

- Quizzes on public issues.
- Tutorial – Various new techniques in short film production.

PRACTICAL EXERCISES: 30

1. Power point presentation on Current public issues topics.
2. Song mixing using Adobe Audition.
3. Creating new sound effects and voice over for the short film using Adobe Audition.
4. Creating graphics for titles using Adobe illustrator.
5. Implementing various transition animation using Unity.
6. Editing short film using Adobe Premier Pro.
7. Creating Lighting effects using Adobe Light Room.
8. Working on color correction and color exposure using Photoshop.
9. Preparing shooting script and Editing Script.
10. Develop a short film based on current public issues as mini project.

TOTAL: 75 PERIODS

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OUTCOMES:

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

1. Apply the knowledge of concepts and techniques used in short film development.
2. Understand the social issues and projecting them effectively through short film.
3. Conduct various experiments for effective short film.
4. Design and implement various techniques in to short film that brings impact on the society.
5. Apply various tools and software for lighting and sound to uphold the professional and social obligation.
6. Manage and Develop a short film as a life-long activity as a team.

REFERENCES:

1. Clifford Thurlow, “Making Short Films – The Complete Guide from Script to Screen” , Berg Publishers, 2008
2. James R. Matin, “Create Documentary Films, telling Techniques Videos and Multimedia: A Comprehensive Guide to Using Documentary Storytelling Techniques for Film Video, The internet and Digital Media Nonfiction project”, Real Deal Press, 2010.
3. Michael Rabiger, “Directing the Documentary”, Focal Press, 2004.
4. Daniel Faltesek, “Selling Social Media The Political Economy of Social Networking”, Bloomsbury Academic, 2018.

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

MM5004 ANIMATION TECHNIQUES L T P C
3 0 2 4

OBJECTIVES:

- To understand the fundamentals of animation.
- To know the working principles of animation tools.
- To acquire knowledge about the issues in 2D and 3D animation.
- To train the student as a member or leader in diverse teams of animation.
- To gain skill in designing real time animation movie.

UNIT I INTRODUCTION TO ANIMATION 9

Basics of 2D and 3D Graphics – Introduction to Animation – Kinematics – Inverse Kinematics – Different Types of Animation – Designing Elements – Styles and Formats – Properties of Multimedia System.

Suggested Activities:

- Flipped classroom on properties of multimedia systems design elements
- External learning – Graphics display devices and input devices

Suggested Evaluation Methods:

- Quizzes based on designing elements.
- Assignment on latest input and output devices.

UNIT II PERSPECTIVE IN ANIMATION 9

Perspective Blocks and Boxes – Vanishing Point in Horizon – Outside Horizon and Indoors – Scale Diagrams in Perspective – Different View Points – Importance of Eye Level – Curves and Cylinders in Perspective – Perspective in 1 point, 2 point,3 point, Multiple Points – Shapes in Perspective with Light and Shade – Foreshortening.

Suggested Activities:

- Flipped classroom on discussion on projection.
- External learning – Camera mechanism.

Suggested Evaluation Methods:

- Tutorials – Viewing port and camera positing.
- Assignment on camera working and principles.

UNIT III ANIMATION PRINCIPLE 9

Drawing for Animation – Sequential Movement Drawing – Caricaturing the Action – Thumbnails – Motion Studies – Drawing for Motion – Basic Principles in Animation – Squash and Stretch – Anticipation – Staging – Straight Ahead – Pose to Pose – Follow Through – Overlapping Action – Slow In and Slow Out – Arcs – Secondary Action – Timing – Exaggeration – Solid Drawing – Appeal – Mass and Weight – Character Acting – Volume – Line of Action – Path of Action – Walk Cycles – Animal and Human.

Suggested Activities:

- Flipped classroom on drawing gestures, facial expressions and pose to pose sketching.
- External learning – Sketching from acting, sketching from live models.

Suggested Evaluation Methods:

- Tutorial – Drawing body movements and facial expression.
- Assignments on sketching various animal movements.

UNIT IV ANIMATION PRESENTATION 9

Timing for Inanimate Objects – Rotating Objects – Timing a Slow Action – Timing a Fast Action—Single Frames or Double Frames – Special Effects: Flames, Smoke, Water, Rain, Snow, Explosions – Repeat Movements of Inanimate Objects – Accentuating a Movement – Strobing – Basic Expressions – Lip Movement – Key Animation – Clean Up – Character Design – Different Characters – Change of Expression.

Suggested Activities:

- Flipped classroom on different special effects
- Discussion on slow and fast actions and movements of the objects

Suggested Evaluation Methods:

- Tutorial – Environmental and surrounding Effects
- Assignments on physical nature of the objects

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UNIT V ADVANCES IN ANIMATION 9

Dynamic Web Pages – Publishing in Internet – User interactions Using Multimedia Systems, Advanced Animations Tools and Applications – Dialogues in Animation – As a Part of Acting – Phrasing – Picture and Sound Sync – Accents – Attitude – Secret – Animation with Sound Track – Dialogue and Voice Over.

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Suggested Activities:

- Flipped classroom on designing web pages.
- External learning – Sound editing tools.

Suggested Evaluation Methods

- Tutorial – Creating web pages.
- Assignment on different sound effects and background music.

PRACTICAL EXERCISES:

1. Simple 2D text animation using Flash.
2. Implementing morphing, Tweening using Flash.
3. Implementation Animation with control buttons using Flash.
4. Creating interactive slide shows Adobe Illustrator.
5. Adding back ground music and voice over to animation sequence using Adobe Audition.
6. Editing the animation sequence and adding transitions using Adobe Premier Pro.
7. Story Board writing.
8. Animation calibration using Adobe after Effects.
9. Designing human, animal, object and background environment using Unity.
10. Creating a simple animation movie using Maya as mini project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Apply the knowledge of concepts and techniques used in Animation.
2. Understood the physics and basic movements of character.
3. Conduct various experiment for effective modern interactive Animation.
4. Design and implement algorithms and techniques applied to Animation.
5. Apply various tools and software like OpenGL, Unity, 3D Maya efficiently to uphold the professional and social obligation.
6. Manage and develop a cost effective animation movie and Gaming as a life-long activity individually or as a team.

REFERENCES:

1. Donald Hearn, M. Paulline Baker, “Computer Graphics”, Prentice-Hall, 2001.
2. Peter Shirley, “Fundamentals of Computer Graphics”, AK Peters, 2002.
3. Steven Heller, Karen Pomeroy “Design Literacy: Understanding Graphic Design”, Allworth Press, 1997.
4. Mark Gaimbruno, “3D Graphics and Animation”, Second Edition, New Riders, 2002.
5. Micheal O’Rourke, “Principles of 3D Computer Animation: Modelling, Rendering and Animation with 3D Computer Graphics”, W. W. Norton, 1998.
6. Rogers David, “Animation: Master – A Complete Guide (Graphics Series)”, Charles River Media, 2006.
7. Tom Bancroft, “Creating Characters with Personality: For Film, TV, Animation, Video Games and Graphics Novels”, Watson-Guptill Publications, 2006.

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

MM5005 **GAME PROGRAMMING** **L T P C**
3 0 2 4

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 game engine.
- To survey the gaming development environment and toolkits.
- To learn and develop simple games using Pygame environment.

UNIT I 3D GRAPHICS FOR GAME PROGRAMMING 9

Game – Definition – Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Colour Models – Illumination and Shader Models – Animation – Controller Based Animation.

Suggested Activities:

- Discussion about computer and video games origin and history.
- Discussion of graphics objects, open source language for game development like Pygame and Processing.py – a Language for creative arts.
- External learning – Algorithms in translation, scaling, zooming and rotation of 3D objects.
- Practical – Installation of Pygame and Pygame Zero and Implementation of colour models and shading models in Python.

Suggested Evaluation Methods:

- Tutorial – 2D and 3D transformations.
- Practical – Programming exercises in animations.
- Assignments on image projections and colour models.
- Quizzes on 2D and 3D Game Object transforms.

UNITII GAMEDESIGNPRINCIPLES 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.

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Suggested Activities:

- Flipped classroom on animation.
- Practical – Creation of game script.
- External learning – Problems on game level design.
- Assignment on preparation of game level design document, detailed document.

Suggested Evaluation Methods:

- Tutorial – Script writing.
- Assignments on game proposal writing.
- Quizzes on game design document.

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.

Suggested Activities:

- Flipped classroom on rendering.
- External learning – Problems on rendering and animation.
- Practical – Implementation of simple animations in Pygame and Processing.py

Suggested Evaluation Methods:

- Tutorial – Collision detection.
- Assignments on game AI and path finding.
- Quizzes on rendering.

UNIT IV OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 9

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity – Single player and Multi-Player games.

Suggested Activities:

- Flipped classroom on gaming environments.
- External learning – Problems on Installation of Unity and scripts.
- Practical – Pygame routines for character rendering, transformations and sound processing.

Suggested Evaluation Methods:

- Tutorial – Mobile gaming.
- Assignment on game logic.
- Quizzes of all topics related to Unity and Pygame.

UNITV GAME DEVELOPMENT USING PYGAME 9

Developing 2D and 3D 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 arcade Games – Puzzle Games.

Suggested Activities:

- External learning – Writing Unity scripts and assets.
- Practical – Implementation of simple games.

Suggested Evaluation Methods:

- Tutorial problems in 2D and 3D graphics Programming.
- Practical – Programming problems like asset creation.
- Quizzes on game development in Pygame.

PRACTICAL EXERCISES: **30**

1. Implement a small avatar in Pygame/Unity.
2. Implement a canvas and colour models in Pygame/Unity.
3. Implement a Lighting and Shade model in Pygame/Unity.
4. Write a Proposal document for a Game.
5. Write a Game Level design document and detailed document.
6. Implementation of simple animations in Pygame/Unity.
7. Implement Pygame routines for Character rendering and transformations.
8. Implement routines for creation and playing of Sounds in Pygame.
9. Implement a simple game logic.
10. Implement a simple Tile gameusing Pygame/Unity.
11. Mini Project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Have knowledge on the concepts of 2D and 3D graphics.
2. Know about Games and its genres with its origin and history.
3. Design game design documents.
4. Understand the implementation of gaming engines.
5. Survey gaming environments and frameworks.
6. Implement a simple game in Pygame.

REFERENCES:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley, 2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress, 2007.
3. Paul Craven, “Python Arcade games”, Apress Publishers, 2016.
4. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press, 2006.
5. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.

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

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MM5072 **MIXED REALITY** **L T P C**
3 0 2 4

OBJECTIVES:

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

UNIT I INTRODUCTION 9

Introduction to Virtual Reality and Mixed Reality – Definition – Introduction to Trajectories and Hybrid 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 –Performance Parameters – 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.

Suggested Activities:

- Flipped classroom on uses of MR applications.
- Videos – Experience the virtual reality effect.
- Assignment on comparison of VR with traditional multimedia applications.

Suggested Evaluation Methods:

- Tutorial – Applications of MR.
- Quizzes on the displayed video and the special effects.

UNIT II MR COMPUTING ARCHITECTURE 9

Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering – PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – SGI Infinite Reality Architecture – Distributed VR Architectures – Multi-pipeline Synchronization – Collocated Rendering Pipelines – Distributed Virtual Environments-MR architecture.

Suggested Activities:

- Flipped classroom on basic graphics pipeline.
- External learning – Different types of Graphics architectures and workstations.
- Practical – GPU programming.

Suggested Evaluation Methods:

- Tutorial – Graphics pipelines.
- Brainstorming session on GPU architecture.
- Quizzes on graphical architectures.
- Demonstration on GPU related simple modeling and rendering programs.

UNIT III MR MODELING 9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – 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.

Suggested Activities:

- Flipped classroom on modeling three dimensional objects.
- External learning – Collision detection algorithms.
- Practical – Creating three dimensional models.

Suggested Evaluation Methods:

- Tutorial – Three dimensional modeling techniques.
- Brainstorming session on collision detection algorithms.
- Demonstration of three dimensional scene creation.

UNIT IV PROGRAMMING AND APPLICATIONS 9

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D – GHOST – People Shop – 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 – MR in Business – MR in Entertainment – MR in Education.

Suggested Activities:

- External learning – Different types of programming toolkits and Learn different types of available VR applications.
- Practical – Create VR scenes using any toolkit and develop applications.

Suggested Evaluation Methods:

- Tutorial – VR tool comparison.
- Brainstorming session on tools and technologies used in VR.
- Demonstration of the created VR applications.

UNIT V MIXED REALITY TECHNOLOGIES 9

Synchronizing Time – Tangible & Ubiquitous – Vision Based Tracking – Sensing Technologies – Seamful Design – Assembling Interaction – Trajectories Through Mixed Reality Performance – Mobile Interface Design – Wearable Computing – Games.

Suggested Activities:

- External learning – Different types of sensing and tracking devices for creating mixed reality environments.
- Practical – Create MR scenes using any toolkit and develop applications.

Suggested Evaluation Methods:

- Tutorial – Mobile Interface Design.
- Brainstorming session on wearable computing devices and games design.
- Demonstration and evaluation of the developed MR application.

PRACTICAL EXERCISES:

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection methods by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.

Approved

8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop MR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Understand the basic concepts of Mixed reality
2. Understand the tools and technologies related to Mixed Reality
3. Know the working principle of Mixed reality related Sensor devices
4. Develop the Virtual Reality applications in different domains
5. Design of various models using modeling techniques
6. Expose the concept of Virtual Reality and Mixed reality Programming with toolkits.

REFERENCES:

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

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

IF5087 **VISUALIZATION TECHNIQUES** **L T P C**
3 0 2 4

OBJECTIVES:

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

UNIT I INTRODUCTION 9

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

Suggested Activities:

- Blended Learning - Displaying Different types visualization images.
- Flipped classroom on task of representing information.
- External learning - Problems related to acquiring data.

Suggested Evaluation Methods:

- Tutorial - Different data visualizing images.
- Assignment on different data acquiring methods.
- Quizzes on issues and solutions in different visualization applications.

UNIT II DATA REPRESENTATION 9

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

Suggested Activities:

- Blended learning - Human Visual and Auditory System.
- Flipped classroom on color formats.
- External learning - Survey on different human computer interaction and types of user interface.

Suggested Evaluation Methods:

- Assignment on human visual and auditory system.
- Quizzes on various color format.
- Assignment on human computer interaction user interface.

UNIT III DATA PRESENTATION 9

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

Suggested Activities:

- Blended learning - Drawing Charts for display.
- Flipped classroom on various presentation techniques.
- External learning - Different font and font styles, symbols and Gesture representation.

Suggested Evaluation Methods:

- Assignment on chart preparation.
- Tutorial - Various presentation techniques.
- Assignment on gesture presentation.

UNIT IV INTERACTION AND DESIGN 9

Norman's Action Cycle – Interacting with Visualization – Interaction for Information Visualization – Interaction for Navigation – Interaction with Models – Interacting with Visualization – Interactive 3D Illustrations with Images and Text – Personal View – Attitude – user perspective – Convergence – Sketching – Evaluation.

Attested

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Suggested Activities:

- Flipped classroom on various interacting Techniques.
- External learning - Interaction facilities and high level support for animation design.

Suggested Evaluation Methods:

- Tutorial - Interaction models.
- Assignment on animation design.

UNIT V CURRENT TRENDS 9

Design – Virtual Reality: Interactive Medical Application – Tactile Maps for visually challenged People – Animation Design for Simulation – Integrating Spatial and Nonspatial Data – Innovating the Interaction – Small Interactive Calendars – Selecting One from Many – Web Browsing Through a Key Hole – Communication Analysis – Archival Galaxies.

Suggested Activities:

- Flipped classroom on implementation of virtual reality environment.
- Mini project for designing and implementing a innovative interfaces.

Suggested Evaluation Methods:

- Demonstration of the mini project.
- Tutorial - Virtual reality application.

PRACTICAL EXERCISES: 30

1. Creating Interoperable Web Visualization Components using Candela tool.
2. Implementing Line and Stacked charts with Labels and Notes using Data wrapper tool.
3. Creating Interactive Charts using Google Chart tool.
4. Use Myheatmap tool to View Geographic Data Interactively.
5. Visualizing TSV, CSV, DSV data using Rawgraph.
6. Working with animation using Chartist.js tool.
7. Visualizing Image data using Matlab.
8. Visualizing Complex Historical Data using Palladio tool.
9. Creating Mobile Friendly Interactive Maps using Leaflet tool.
10. Implementing a Real Time Application using VTK tool as mini project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Apply mathematics and basic science knowledge for designing information visualizing System.
2. Collect data ethically and solve engineering problem in visualizing the information.
3. Implement algorithms and techniques for interactive information visualization.
4. Conduct experiments by applying various modern visualization tool and solve the space layout problem.
5. Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams.
6. Develop a cost effective and a scale able information visualization system.

REFERENCES:

1. Robert Spence, “Information Visualization: An Introduction”, Third Edition, Pearson Education, 2014.
2. Colin Ware, “Information Visualization Perception for Design”, Third Edition, Morgan Kaufmann, 2012.
3. Robert Spence, “Information Visualization Design for Interaction”, Second Edition, Pearson Education, 2006.

4. Benjamin B. Bederson, Ben shneiderman, “The Craft of Information Visualization”, Morgan Kaufmann, 2003.
5. Thomas Strothotte, “Computational Visualization: Graphics, Abstraction and Interactivity”, Springer, 1998.
6. Matthew O. Ward, George Grinstein, Daniel Keim, “Interactive Data Visualization: Foundation, Techniques and Applications”, Second Edition, A.K.Peters/CRC Press, 2015.
7. Joerg Osarek, “Virtual Reality Analytics”, Gordon’s Arcade, 2016.

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

MM5071 ADVANCED COMPUTER GRAPHICS AND ANIMATIONS L T P C
3 0 2 4

OBJECTIVES:

- To understand the basics of geometry processing.
- To understand the fundamentals of pipelined rasterization rendering of meshed objects and curved surfaces.
- To understand and work with advanced rendering methods such as radiosity.
- To design programs for advanced animation methods.
- To become proficient in graphics programming using OpenGL.

UNIT I FUNDAMENTALS 9

Basics - Scope and Applications – Graphics Standards – Display Systems – Image Formation – Graphics Systems – 2D and 3D Coordinate Systems – Vectors – Matrices and Basic Vector/Matrix Operations – Line Drawing – Object Representation – Anti-Aliasing.

Suggested Activities:

- Practical - Basic application to be implemented for vectors and matrices.
- Practical - Apply various implementations of the graphics algorithms and analyze.
- Practical - Execute some shader application and fix the warnings and errors.

Suggested Evaluation Methods:

- Quiz to check the understanding of the graphics concepts (like graphics hardware, displays and standards).
- Assessing the understanding of various basic graphics algorithms through programming assessment by using vectors and matrices.

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UNIT II TRANSFORMATIONS 9

2D and 3D Geometric Transformations: Translation, Rotation, Scaling, Affine – Hierarchical Modelling & viewing – The Camera Transformation – Perspective – Orthographic and Stereographic Views.

Suggested Activities:

- Flipped classroom on rasterization.
- Practical - Execute any shader application and set viewports, windows, draw polylines and explore the keyboard and mouse interaction routines.
- Familiarize with transformations and hierarchical in OpenGL using a matrix stack.

Suggested Evaluation Methods:

- Quizzes on rasterization schemes.
- Assessing the understanding of the basic elements available in the OpenGL environment through the programming structs.
- Demonstration on transformations hierarchies using matrix stack.

UNIT III FRACTALS 9

Fractals and Self Similarity – Peano Curves – Creating Image by Iterated Functions – Mandelbrot Sets – Julia Sets – Random Fractals – Intersecting Rays with Other Primitives – Reflections and Transparency – Boolean Operations on Objects and its Applications.

Suggested Activities:

- Flipped classroom on various algorithms used to generate the fractals.
- Practical - Generation of fractals using Python and Numpy
- Practical - Run any shader application and set viewports, windows, fractal rendering and explore the keyboard and mouse interaction routines.

Suggested Evaluation Methods:

- Quiz on Fractals.
- Demonstration the generation of fractals using Python and Numpy.
- Assessing the understanding of generation of fractals by changing the various parameters in the OpenGL environment through the programming structs.

UNIT IV ADVANCED GRAPHICS 9

Hidden Surface Removal– Parametric Curves and Surfaces– Global Illumination – Ray Casting –Monte Carlo Algorithm – Texture Synthesis – Bump Mapping – Environmental Mapping –Advanced Lighting and Shading – Shadows –Volumetric Rendering.

Suggested Activities:

- Flipped classroom on Texture Synthesis and photo realistic rendering
- Run the shader application and add the texture and shadow.
- Analyze few more shaders - Toon/Cell, Cook-Torrance, Oren-Nayar, Gradient.

Suggested Evaluation Methods:

- Quiz on advanced graphics techniques (like texture synthesis and photo realistic rendering).
- Demonstration of shader application exploring texture and shadow features.
- Discussion on bi-directional reflectance distribution function after analyzing the various shader models.

UNIT V ANIMATION 9

Overview of Animation Techniques – Key framing, Computer Animation – Motion Capture and Editing–Forward/Inverse Kinematics– 3D Computer Animation for Applications Such as Games and Virtual Environments – Character Animation Techniques Such as Synthesizing their Body Movements – Facial Expressions and Skin Movements – Behaviors in Crowded Scenes.

Suggested Activities:

- Exploration of various animation techniques and tools (Self Study).
- Carry out small projects like Design of small animation movies using any tools with good aesthetic sense.

Suggested Evaluation Methods:

- Discussion on various animation techniques and tools.
- Projects may be evaluated base on the theme, design, creativity, tools and aesthetic sense.

PRACTICAL EXERCISE: 30

1. Introduction to Programming in OpenGL.
2. Write a program to draw the following points: (0.0,0.0), (20.0,0.0), (20.0,20.0), (0.0,20.0) and (10.0,25.0). For this purpose, use the GL_POINTS primitive.
3. Re-write the previous program in order to draw a house. The house consists of two figures: a square and a triangle. The first four points given above define the square, while the last three points define the triangle. For this purpose, use the GL_QUADS and GL_TRIANGLES primitives.
4. Write a program to color to primitives like cube, triangle and perform 2D rotation using OpenGL.
5. Modify the above program extending the 2D rotation to 3D with a simple 3D Orthographic Projection.
6. Write a program to roll a wheel on a horizontal line using OpenGL.
7. Draw the Koch snowflake (or some other variation of the Koch curve) using python.
8. Create a rotating cube with lighting using OpenGL.
9. Create a scene consisting of multiple spheres and cubes, apply a different texture to each object, and give a bumpy-looking appearance to each surface using normal mapping.
10. Create 10 seconds Walking animation with a rigged character using any animation tool.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Prepare for the emerging field of digital modelling and fabrication based on the competence gained.
2. Understand and apply 3d graphics algorithms related to transformations, illumination, texturing, etc. With the aid of software libraries.
3. Develop interactive applications using 3d graphics
4. Investigate and apply software libraries for 3d graphics and related software needs.
5. Understand the issues relevant to computer animation.
6. Describe and synthesise character animation techniques, including motion, changing their facial expressions and crowd behaviour.

REFERENCES:

1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, “Computer Graphics with Open GL”, Fourth Edition, Prentice Hall, 2011.
2. Foley van Dam, Feiner Hughes, “Computer Graphics Principles and Practice”, Third Edition, Addison Wesley, 2014.
3. Alan Watt, Mark Watt, “Advanced Animation and Rendering Techniques: Theory and Practice”, Addison Wesley, 1992.
4. Rick Parent, “Computer Animation – Algorithms and Techniques”, Third Edition, Morgan Kaufman, 2012.
5. Edward Angel, Dave Shreiner, “Interactive Computer Graphics: A Top-Down Approach with OpenGL”, Sixth Edition, Addison Wesley, 2012.

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

MM5006 MULTIMEDIA BASED E-LEARNING L T P C
3 0 2 4

OBJECTIVES:

- To learn the various multimedia E-learning approaches and Components.
- To understand the key elements of Design Thinking.
- To explore the models for multimedia E-learning E-learning courseware development.
- To learn about Multimedia E-learning Authoring tools.
- To know about Evaluation and management of Multimedia E-learning solutions.

UNIT I INTRODUCTION 9

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

Suggested Activities:

- External learning - E-learning approaches and components.
- Discussion on design thinking.

Suggested Evaluation Methods:

- Assignment on E-learning approaches and components.
- Quiz on design thinking.

Attested

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UNIT II DESIGNING MULTIMEDIA E-LEARNING CONTENT/COURSE 9

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

Suggested Activities:

- Discussion forum - design models.
- External learning - E-learning instructional methods.

Suggested Evaluation Methods:

- Assignment on design models of multimedia E-learning.
- Quiz on E-Learning instructional methods.

UNIT III CREATING INTERACTIVE CONTENT 9

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

Suggested Activities:

- Discussion forum on creation of multimedia story boards.
- External learning on types of authoring tools.

Suggested Evaluation Methods:

- Assignment on multimedia story boards creation.
- Quiz on authoring tools.

UNIT IV LEARNING PLATFORMS 9

Types of Learning Platforms – Proprietary vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS solutions – Functional Areas of LMS.

Suggested Activities:

- Discussion on LMS categories for multimedia E-learning.
- External learning - Functional areas E-learning.

Suggested Evaluation Methods:

- Assignment on proprietary and open source LMS.
- Quiz on LMS solutions.

UNIT V COURSE DELIVERY AND EVALUTION 9

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

Suggested Activities:

- Discussion on planning and documentation.
- External learning - Evaluation and delivery methods.

Suggested Evaluation Methods:

- Assignment on planning and documentation.
- Quiz on evaluation and delivery methods.

Attested

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PRACTICAL EXERCISES: **30**

1. Creation of Users and Schedule users Vs Courses in Moodle.
2. Preparation and Organization of Multimedia Course Contents in Moodle.
3. Aligning the course objectives, Assessments and evaluation methods of Courseware
4. inMoodle.
5. Courseware Content generation with various Multimedia instructional formats.
6. Adding communication tools in Moodle for effective collaboration.
7. Creation of instructor led courses in Moodle.
8. Creation of self-Learning courses in Moodle.
9. Implementation of various Evaluation strategies of Courseware in Moodle .
10. Implementation of various delivery strategies in Moodle.
11. Assessing the Quality of Multimedia Courseware in Moodle.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Distinguish the phases of activities in models of Multimedia E-learning
2. Identify appropriate Multimedia instructional methods and delivery strategies
3. Choose appropriate Multimedia E-learning Authoring tools
4. Create interactive Multimedia E-Learning courseware
5. Evaluate the Multimedia E-learning courseware
6. Manage the E-learning courseware

REFERENCE BOOKS:

1. Clark, R. C., Mayer, R. E, "eLearning and the Science of Instruction", Third edition, 2011.
2. Means, B., Toyama, Y., Murphy, R, "Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies", 2010.
3. Crews, T. B., Sheth, S. N., Horne, T. M, "Understanding the Learning Personalities of Successful Online Students. Educause Review", 2014.
4. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", 2017.
5. Madhuri Dubey, "Effective E-learning Design, Development and Delivery", University Press 2011.

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

Attested

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MM5007 **SOUND ENGINEERING** **L T P C**
3 0 2 4

OBJECTIVES:

- To make students aware of the basic principles of sound.
- To learn about sound production and hearing.
- To learn about designing sound techniques.
- To know about Studio environment.
- To know about Surround Sound.

UNIT I PRINCIPLES OF SOUND 9

Sound production – Characteristics of Sound – Compression & Rarefaction – Velocity, Amplitude and Phase – Loudness – Microphones – Types of Microphones – Microphone Selection and Use.

Suggested Activities:

- Flipped classroom on human speech production and voice box of human.
- External learning - Physical & psychological properties of sound, microphones and its types.
- Assignment on numerical problems in computing sound parameters.

Suggested Evaluation Methods:

- Tutorial - Sound characteristics.
- Assignments on computation of phase, amplitude and loudness of sound.
- Quizzes on sound properties.

UNIT II LISTENING SOUND 9

Human Ear – Frequency and Human Hearing – Timbre and Sound Envelope – Analytical & Critical Listening – Dynamic Range – Acoustics & Psycho Acoustics of Sound – Binaural Hearing – Mono & Stereo effects – Direct & Reflected Sound – Reverberation and Echo Effect.

Suggested Activities:

- Flipped classroom on human auditory mechanisms, stereo sound.
- External learning - Binaural and stereo recording techniques, sound effects.
- Assignment on numerical problems in stereo signals.

Suggested Evaluation Methods:

- Tutorial - Sound acoustics.
- Assignments on mono and stereo sound.
- Quizzes on human auditory mechanisms.

UNIT III DESIGNING SOUND 9

The Roles and Responsibilities of a Sound Designer – Elements of Sound – Perception of Various Sounds – Designing of Sound – Functions of Sound with Respect to Dialogue – Sound Aesthetics – Music Instruments – Music Production.

Suggested Activities:

- Flipped classroom on perception of sound.
- External learning - MIDI formats, music synthesis.
- Assignment on numerical problems in music signals processing.

Suggested Evaluation Methods:

- Tutorial - Audio perception.
- Assignments on sound design.
- Quizzes on music processing.

UNIT IV STUDIO MANAGEMENT 9

Studio and Live Mixing Speech – Studio Management: Equipment Management – Transmission & Reception – Studio Operations – Studio Layout & Design – The Sound Control Room – The Sound Recording Room – Station Management.

Suggested Activities:

- Flipped classroom on sound mixing
- External learning - Studio instruments, studio layout and design

Suggested Evaluation Methods:

- Quizzes on studio equipment.
- Quizzes on studio management.

UNIT V SURROUND SOUND 9

Principles of Loudspeaker – Types of Loudspeakers – Stereo, Two–Channel Signal Formats and Microphone techniques, Binaural Recording and Dummy Head Techniques, Surround Sound – Three Channel Stereo, Four Channel Surround, 5.1 Channel Surround, and Other Multichannel Configurations. Surround Sound Systems, Matrix Surround Sound Systems, Dolby Digital, DTS, and Ambisonics.

Suggested Activities:

- Flipped classroom on loudspeakers and its types.
- External learning - Survey of cinematic sound systems, layout and design of home theater.

Suggested Evaluation Methods

- Quizzes on types of loudspeakers and microphones.
- Quizzes on surround sound.

PRACTICAL EXERCISES: 30

1. Installation of Audacity and Matlab Audio Toolbox.
2. Record Live audio with Audacity/Matlab.
3. Extract sound features using Matlab.
4. Implement programs for computer playback of audio using Audacity.
5. Convert tapes and records into digital recordings or CDs using Audacity/Matlab.
6. Edit WAV, AIFF, FLAC, MP2, MP3 in Audacity.
7. Use Files of AC3, M4A/M4R (AAC), WMA and other formats supported using optional libraries of Audacity/Matlab.
8. Implement Cut, copy, splice operations using Audacity.
9. Mix Sounds using Audacity.
10. Implement sound effects including change the speed or pitch of a recording in Audacity.

TOTAL: 75 PERIODS

Attested

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OUTCOMES:

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

1. Have knowledge about basics of sound.
2. Know about the auditory mechanisms.
3. Know about studio management.
4. Compose a music using tools.
5. Know about studio equipments and design.
6. Know about surround sound.

REFERENCES:

1. David Miles Huber, Robert E. Runstein, “Modern Recording Techniques”, Eighth Edition, Focal Press, 2013.
2. Francis Rumsay, Tim McCormik, “Sound and Recording”, Sixth Edition, Focal press, 2009.

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

MM5008 **MEDIA SECURITY** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the cryptanalysis on standard algorithms meant for confidentiality, integrity and authenticity.
- To know about the Digital rights management.
- To know about the concepts of Digital Watermarking techniques.
- To understand the concept of Steganography
- To learn the privacy preserving techniques on Multimedia data.

UNIT I CRYPTANALYSIS AND DIGITAL RIGHTS MANAGEMENT 9

Cryptanalysis Techniques – Encryption Evaluation metrics – Histogram Deviation – orthogonal Frequency Division Multiplexing – OFDM Model – OFDM Limitations – Introduction to DRM – DRM Products –DRM Laws

Suggested Activities:

- External learning - cryptanalysis for algorithms such as AES, RSA.
- Analysis for DRM products.

Suggested Evaluation Methods:

- Group discussion on linear and differential cryptanalysis of cryptographic algorithms.
- Tutorial on DRM products.

Attested

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UNIT II DIGITAL WATERMARKING BASICS 9

Introduction – Basics Models of Watermarking – Basic Message Coding – Error Correction coding – Mutual Information and Channel Capacity – Designing a Good Digital Watermark – Information Theoretical Analysis of Digital Watermarking.

Suggested Activities:

- Problems on Error Correction Coding.
- Designing a good watermark.

Suggested Evaluation Methods:

- Assignment on ECC.
- Tutorial on DRM products.

UNIT III DIGITAL WATERMARKING SCHEMES AND PROTOCOLS 9

Spread Spectrum Watermarking – Block DCT-domain Watermarking – Watermarking with Side Information – Dirty-paper Coding – Quantization Watermarking – buyer Seller Watermarking Protocol – Media Specific Digital Watermarking : Image WM , Video WM , Audio WM– Watermarking for CG-Models: Watermarking for Binary Images and 3D Contents – Data Hiding Through Watermarking Techniques.

Suggested Activities:

- Implementation of buyer seller watermarking protocol.
- Analyzing the performance of different media specific WM and WM for CG models.

Suggested Evaluation Methods:

- Tutorial - Media specific watermarking techniques.
- Group discussion on the performance evaluation of watermarking techniques.

UNIT IV STEGANOGRAPHY AND STEGANALYSIS 9

Steganographic Communication – Notation and Terminology – Information –Theoretic Foundations of Steganography – Cachin's Definition of Steganographic Security – Statistics Preserving Steganography – Model-Based Steganography – Masking Embedding as Natural Processing – Minimizing the Embedding Impact – Matrix Embedding –Nonshared Selection Rule – Steganalysis Algorithms: LSB Embedding and the Histogram Attack – Sample Pairs Analysis.

Suggested Activities:

- An application development using Steganography.

Suggested Evaluation Methods:

- Project.

UNIT V MULTIMEDIA ENCRYPTION 9

Multimedia Processing in the Encryption Domain – Information Processing – Data Sanitization – Finger Printing – Digital Forensics: Intrusive and Non- Intrusive –Forgeries Detection– Privacy Preserving – Surveillance.

Suggested Activities:

- Case study on forensic data.
- Case study on forgery detection.

Suggested Evaluation Methods:

- Group discussion on case studies.

PRACTICAL EXERCISE: **30**

1. Implementation of Error Correction Coding.
2. Developing a cryptanalytic tool for simple ciphers
3. Implementation of Image Watermarking
4. Implementation of Video Watermarking
5. Implementation of Audio Watermarking
6. Implementation of Watermarking for Binary Images
7. Implementation of Watermarking for Binary Images
8. Implementation of Watermarking for 3D contents
9. Implementation of Steganographic Image and retreiving the hidden image from the input image.
10. Install any steganographic tool and forensic tool and explore the same. Make use of the tools to develop an application of your choice.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

1. Analyze the security algorithms required by any computing system.
2. Identify the security challenges and issues that may arise in any system.
3. Implement the concepts of steganography, digital watermarking techniques, etc.
4. Design secure applications using steganography and water marking schemes
5. Apply concepts on digital rights management while developing secure systems
6. Design any secure system by preserving the privacy.

REFERENCES

1. Frank Shih, “Digital Watermarking and Steganography: Fundamentals and Techniques”, CRC Press, 2014.
2. Fathi E. Abd El-Samie, HossamEldin H. Ahmed, Ibrahim F. Elashry, Mai H. Shahieen, Osama S. Faragallah, El-Sayed M. El-Rabaie, Saleh A. Alshebeili , “Image Encryption: A Communication Perspective”, CRC Press, 2013.
3. Douglas R. Stinson, “Cryptography Theory And Practice”, Third Edition, Chapman & Hall/CRC, 2006
4. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, 2006.
5. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich and TonKalker, “Digital Watermarking and Steganography”, Second Edition, Elsevier, 2007.

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

MM5009 **MULTIMEDIA DATABASES** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand about the database storage, retrieval of multimedia elements.
- To familiarize about the database indexing methods and different multidimensional data structures.
- To learn about text database and image database storage and retrieval.
- To understand design and architecture of a Multimedia Database.
- To understand about Audio and Video Storage.

UNIT I DATABASE INDEXING METHODS 9

Hashing – B-trees – Secondary Key Access Methods – Inverted Files – Point Access Methods (PAMs) –Spatial Access Methods (SAMs) – Space Filling Curves – Transformation to Higher–D Points – Multidimensional Data Structures – K-D Trees – Point Quadtrees– The MX–Quadtree– R-Trees.

Suggested Activities

- Flipped classroom on traditional databases.
- External learning - Comparison of different data structures and its usage.
- Practical - Application development using multi dimensional data structures.

Suggested Evaluation Methods

- Assignments on hashing mechanisms
- Tutorials - Indexing and access methods.
- Demonstration of the application development.

UNIT II TEXT DATABASES 9

Precision and Recall – Stop Lists – Word Stems and Frequency Tables – Latent Semantic Indexing – TV-Trees – Indexing Text and DNA Strings – Access Methods for Text – Full Text Scanning – Inversion – Signature Files – Vector Space Model and Clustering.

Suggested Activities

- Flipped classroom on text databases.
- External learning - Comparison of other retrieval techniques for text databases and its usage.
- Practical - Application development in text databases.

Suggested Evaluation Methods

- Assignments on information retrieval techniques.
- Tutorials - Access methods for text databases.
- Demonstration of the practical implementation.

UNIT III IMAGE RETRIEVAL MECHANISMS 9

Image Databases – Raw Images – Compressed Image Representations – Similarity Based Retrieval – Alternative Image DB Paradigms – Representing Image DBs with Relations – Representing Image DBs with R-Trees – Retrieving Images by Spatial Layout – Implementations.

Suggested Activities

- Flipped classroom on image databases.
- External learning - Retrieving Images.
- Practical - Application development in image databases.

Suggested Evaluation Methods

- Assignments on image retrieval mechanisms.
- Tutorials - R-trees .
- Demonstration of the practical implementation.

UNIT IV AUDIO/VIDEO DATABASES 9

Audio Databases – A General Model of Audio Data – Capturing Audio Content through Discrete Transformation – Indexing Audio Data–Video Databases – Organizing Content of a Single Video – Querying Content of Video Libraries – Video Segmentation.

Suggested Activities

- Flipped classroom on audio/video databases.
- External learning - Capturing and querying audio and video content.
- Practical - Application development in video databases.

Suggested Evaluation Methods

- Assignments on capturing audio/ video content.
- Tutorials - Indexing audio/video databases.
- Demonstration of the practical implementation

UNIT V MULTIMEDIA DATABASE DESIGN 9

Design and Architecture of a Multimedia Database – Organizing Multimedia Data based on the Principle of Uniformity – Media Abstractions – Query Languages for Retrieving Multimedia Data.

Suggested Activities

- Flipped classroom on text databases.
- External learning - Query languages for retrieving multimedia data.
- Practical - Application development.

Suggested Evaluation Methods

- Assignments on organizing multimedia data.
- Tutorials - Query languages for retrieving multimedia data.
- Demonstration of the practical implementation

PRACTICAL EXERCISE: 30

1. Design and implement insertion and deletion in B-Trees.
2. Design and implement insertion and deletion in R –Trees.
3. Design and implement insertion and deletion in TV-Trees.
4. Design and implement access methods for text.
5. Design and implement similarity based retrieval with image databases.
6. Design and implement image processing algorithms.
7. Design and implement capturing, indexing of audio content.
8. Design and implement querying content of video libraries.
9. Design and implement querying in multimedia data.
10. Real time multimedia application development.

TOTAL: 75 PERIODS

Attested

OUTCOMES:

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

1. Demonstrate the multidimensional data structures for multimedia applications
2. Apply database indexing methods for efficient storage and retrieval of multimedia content.
3. Work with Text databases, its storage and retrieval.
4. Formulate and generalize the use of audio and video databases for real time multimedia applications.
5. Demonstrate about Image database, its storage and retrieval.
6. Apply multimedia database design for multimedia architecture.

REFERENCES

1. V. S. Subramanian, “Principles of Multimedia Database Systems”, Third Edition, Elsevier/Morgan Kaufmann, 1998.
2. Christos Faloutsos, “Searching Multimedia databases by Content”, Kluwer Academic Publishers, 2011.
3. S. Khoshafian, A. B. Baker, “Multimedia and Imaging Databases”, Elsevier, 1996.
4. C. Kingsley Nwosu, “Multimedia Database Systems: Design and Implementation Strategies”, Kluwer Academic Publishers, 1996.
5. Lynne Dunckley, “Multimedia Databases: An Object-Relational Approach”, Pearson Education, 2003.
6. R. Elmasri, S. B. Navathe, “Fundamentals of Database Systems”, Seventh edition, Pearson Education, 2017.

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

OE5091 **BUSINESS DATA ANALYTICS** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

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

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

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

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

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

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

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

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

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

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

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

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

OE5092 **INDUSTRIAL SAFETY** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION **9**

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

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING **9**

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

UNIT III WEAR AND CORROSION AND THEIR PREVENTION **9**

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING **9**

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

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UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

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

OE5093 OPERATIONS RESEARCH L T P C
3 0 0 3

OBJECTIVES:

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

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UNIT I LINEAR PROGRAMMING 9

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

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

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

UNIT III NETWORK ANALYSIS – I 9

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

UNIT IV NETWORK ANALYSIS – II 9

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

UNIT V NETWORK ANALYSIS – III 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

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

CO2: To solve LPP using simplex method

CO3: To formulate and solve transportation, assignment problems

CO4: To solve project management problems

CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

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

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OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

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

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

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

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

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

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

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

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1 – Understand the costing concepts and their role in decision making

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

CO3– Interpret costing concepts with project execution

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

CO5 – Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

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

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION 9

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

UNIT II REINFORCEMENTS 9

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

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

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

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UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

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

UNIT V STRENGTH 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

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

CO2: Know the various reinforcements used in composite materials.

CO3: Understand the manufacturing processes of metal matrix composites.

CO4: Understand the manufacturing processes of polymer matrix composites.

CO5: Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5			✓	✓	✓		✓					

REFERENCES:

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

OE5096 WASTE TO ENERGY L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

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

UNIT II BIOMASS PYROLYSIS 9

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

UNIT III BIOMASS GASIFICATION 9

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

UNIT IV BIOMASS COMBUSTION 9

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

UNIT V BIO ENERGY 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

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

CO2 – Gain knowledge on biomass pyrolysis process and its applications

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

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

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

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AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES

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

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

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

UNIT II PRESENTATION SKILLS 6

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

UNIT III TITLE WRITING SKILLS 6

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

UNIT IV RESULT WRITING SKILLS 6

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

UNIT V VERIFICATION SKILLS 6

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

TOTAL: 30 PERIODS

OUTCOMES

CO1: Understand that how to improve your writing skills and level of readability
CO2: Learn about what to write in each section
CO3: Understand the skills needed when writing a Title
CO4: Understand the skills needed when writing the Conclusion
CO5: Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

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AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

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

UNIT III DISASTER PRONE AREAS IN INDIA 6

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

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

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

UNIT V RISK ASSESSMENT 6

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

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

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

UNIT I ALPHABETS 6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

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

TOTAL: 30 PERIODS

OUTCOMES

CO1: Understanding basic Sanskrit language.
CO2: Write sentences.
CO3: Know the order and roots of Sanskrit.
CO4: Know about technical information about Sanskrit literature.
CO5: Understand the technical concepts of Engineering.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

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

AX5094 **VALUE EDUCATION** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to

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

UNIT I

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

UNIT II

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

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.

Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

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OUTCOMES

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

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

AX5095 CONSTITUTION OF INDIA L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

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

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

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

UNIT IV ORGANS OF GOVERNANCE:

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

UNIT V LOCAL ADMINISTRATION:

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

UNIT VI ELECTION COMMISSION:

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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

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

AX5096 **PEDAGOGY STUDIES** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to:

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

UNIT I INTRODUCTION AND METHODOLOGY:

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

UNIT II THEMATIC OVERVIEW

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

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

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

UNIT IV PROFESSIONAL DEVELOPMENT

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

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UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

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

AX5097 STRESS MANAGEMENT BY YOGA L T P C
2 0 0 0

OBJECTIVES

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

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

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

UNIT III

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

TOTAL: 30 PERIODS

Attested

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OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

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

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

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

UNIT I

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

UNIT II

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

UNIT III

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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

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

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