DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(AUTONOMOUS)
RE-ACCREDITED WITH 'A++' GRADE BY NAAC
College with Potential for Excellence| Linguistic Minority Institution
Affiliated To University Of Madras
ARUMBAKKAM, CHENNAI -106.

M.Sc. COMPUTER SCIENCE

ACADEMIC YEAR 2025-2026

I – IV Semesters

SCHEME AND SYLLABUS

Effective for the students admitted from the academic year 2025-2026 and onwards

INSTITUTION

VISION

To impart value-based quality academia; to empower students with wisdom and to charge them with rich Indian traditions and culture; to invoke the self, to broaden the same towards nation building, harmony and Universal brotherhood.

MISSION

To ensure sustained progress and development in imparting quality education, to pioneer new avenues of teaching and research and to emerge as an institution with potential for excellence.

DEPARTMENT OF COMPUTER SCIENCE(UG & PG)

VISION

- To facilitate a conducive environment for post-graduate education in the field of computer science and Information technology and to produce graduates for global society with moral values.
- To achieve Excellency in academics by rigorous value based education and outstanding teaching practices.
- The department is offering certificate course in Web Designing, Network Programming and also train the students of various departments both science and humanities in the field of computing skills.
- The Seminars, Guest-Lectures and Symposiums are conducted for the benefit of the students to acquire knowledge on recent trends.
- The department has well equipped computer lab and spacious class rooms.
- Every year 70% of students are placed in leading IT industries through campus and off-campus.

MISSION

M1	• To upgrade the knowledge in Computer science and Information technology through latest technologies
M2	• To organize workshops on latest trends to gain hands on experience
M3	• To equip them with technical and soft skills and make them employable
M4	• To develop young minds with active and creativeness for improving their skill-sets needed for enriched career development, along with imbibing high moral values in them.

PROGRAM EDUCATION OBJECTIVES (PEOs)

PEO1	To motivate the progression of the post graduates into a professional by inculcating knowledge relating to the field of Computer Science.
PEO2	Develop strong skills in systematic planning, developing algorithms and providing solutions for computer based systems which helps in employability.
PEO3	To continue lifelong professional development in computing that benefits personality and societal growth.
PEO4	Able to draw upon foundational knowledge, learn, adapt and successfully bring to bear analytical and computational approaches on changing societal and technological challenges.
PEO5	To keep abreast with latest technologies & research in Computer Science and its applications in all allied areas.

PEO TO MISSION STATEMENT MAPPING

MISSION STATEMENTS	PEO1	PEO2	PEO3	PEO4	PEO5
M1	3	3	3	3	3
M2	2	3	3	3	2
M3	2	2	2	2	3

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

PROGRAM OUTCOMES (PO) IN RELATION TO GRADUATE ATTRIBUTES

At the completion of the M.Sc. Computer Science program, the students of our Department will be able to:

PO1	Demonstrate mastery in theoretical and practical aspects of computer science, applying advanced concepts, tools, and techniques to solve complex computing problems and develop innovative solutions.
PO2	Conduct independent research, analyze scientific literature, and apply appropriate methodologies to explore new areas in computer science, analytics and technologies, contributing to technical advancement and knowledge creation.
PO3	Identify, model, and analyze real-world problems using advanced algorithms, software engineering in advanced algorithms principles, and computing frameworks to design and implement effective, scalable, and sustainable solutions.
PO4	Apply ethical reasoning and professional practices in computing, while assessing the broader impact of technology on individuals, organizations, and society, including legal and environmental concerns.
PO5	Exhibit leadership and teamwork capabilities in multidisciplinary and global environments, effectively managing projects and communicating complex technical information to diverse audiences.
PO6	Engage in continuous learning to stay current with emerging technologies and trends in computer science, also Integrating real-world application, practical exposure, and project-based learning

Mapping of POs TO PEOs

PEO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
PEO 1	3	3	2	2	2	2
PEO 2	3	2	3	3	3	3
PEO 3	3	2	2	2	3	3
PEO 4	3	3	3	3	3	2
PEO 5	3	3	2	2	2	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

PROGRAM SPECIFIC OUTCOMES

PSO 1	To Gain an understanding of the basic knowledge of computer science to appreciate, develop and implement the solutions to problems in Real Time applications.
PSO 2	To Inculcate Skills to analyse a problem and to identify and define the logical modelling of solutions
PSO 3	Ability to apply the theoretical concepts and practical knowledge of Computer Science in analysis, design, development and management of computer based systems and applications in the interdisciplinary domain.
PSO 4	To Demonstrate skills to use modern tools, software and equipment for problem solving in new and emerging disciplines.
PSO 5	Develop workable solutions for problems drawn either from social context or from research corpus.

DEPARTMENT OF COMPUTER SCIENCE(UG & PG)

M.Sc. COMPUTER SCIENCE

ELIGIBILITY FOR ADMISSION

Candidate who has passed the under-mentioned degree examinations of this University or an examination of other institution recognized by this University as equivalent thereto provided they have undergone the course under 10+2+3 or 11+1+3 or 11+2+2 pattern or under the Open University System, shall be eligible for admission to the M.Sc. Degree Course

(a) BCA / B.Sc in Computer Science

DURATION OF THE COURSE

The duration of the course for two academic years consisting of four semesters ad each semester comprises of 90 days.

M.Sc. COMPUTER SCIENCE CURRICULUM

This is a full time course comprising two years (Four Semesters). Through its infrastructure well developed over last 23 years, department offers instructions in wide areas of Computer Science such as Design and Analysis of Algorithms, Programming in Python, Computer networks, Programming in PHP, Object Oriented Software Engineering, Digital Image Processing, Advanced Database Management Systems, Advance Java Programming, Data mining Techniques, IoT and its Applications, DOT NET, Cloud Web Services, Distributed Databases, AI and ML Techniques, Big Data Analytics, Cyber Forensics, Information security, Ethical Hacking, Quantitative Aptitude, Logical reasoning, which is effectively facilitated by well-balanced curriculum consisting of 9 different core papers, 4 Discipline Specific Electives,1 Multi Discipline Elective/Open Elective,2 Skill Enhancement Course - Discipline Specific papers and 6 practical courses. The students should take an internship for a minimum of 15 days to maximum of 20 days and 2 credits will be awarded. Broad based curriculum of the department makes it possible to meet the requirements of various national / international research institutes and industries.

DISSERTATION

Semester IV consists of project and dissertation for 100 marks. Students are allocated individually to dissertation with the faculty of the department. The format for dissertations is similar to the thesis style incorporating introduction, materials & methods, results, discussion and bibliography. The dissertation is submitted in a typewritten and bound form after

plagiarism check and a copy of each dissertation is submitted to the Department for permanent record. Each student should present/publish a paper on his/her project.

ELIGIBILITY FOR THE AWARD OF DEGREE

If he/she fails to submit the Project Work/Dissertation within the stipulated date for a particular semester, he/she may be permitted with the approval of the Head of the Department to submit the Project Work/Dissertation report during the succeeding semesters, within the maximum period of four years from the date of admission to the first semester Project/Dissertation evaluation and Viva-Voce shall be conducted by one external examiner and one internal examiner who shall normally be the project guide. A candidate shall be eligible for the award of the degree only if he/she has undergone prescribed course of study for a period of not less than two academic years, passed the examination of all the four semesters prescribed earning 91 credits and fulfilled such conditions as have been prescribed there for.

SCHEME OF EXAMINATIONS

As per the University Regulation the following split up of marks are to be followed.

(i) SPLIT UP FOR INTERNAL AND EXTERNAL MARKS FOR THEORY AND PRACTICAL PAPER:

Sl.No.	Paper	Internal	External	Total
1.	Theory	50	50	100
2.	Practical	50	50	100

(ii) SPLIT UP FOR INTERNAL ASSESSMENT MARKS FOR THEORY

CIE-Continuous Internal Evaluation (50 Marks)

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CIA	**30**
Generic Skill	**15**
Attendance	**5**
Total	**50**

ESE- Semester End Examination (100 Marks; weightage 50%)

Bloom's Category	Weightage %
Remember	20
Understand	20
Apply	30
Analyse	15
Evaluate	10
Create	5

SCHEME OF I SEMESTER M.Sc. COMPUTER SCIENCE PROGRAM

SEMESTER I												
Component	**Course Category**	**Course Code**	**Name of the course**	**Over All Credits**	**Hrs Distribution**				**Total contact Hours**	**Marks**		
					L	T	P	S		CIA	ESE	Total
Part I	**Core Course I**		Advanced Design and Analysis of Algorithms	4	4	0	0	0	4	50	50	100
	Core Course II		Python for Data Science	4	4	0	0	0	4	50	50	100
	Core Course III		Contemporary Web Technologies	4	4	0	0	0	4	50	50	100
	Discipline Specific Elective I		Data Communication and Networking/Mobile Network System/Artificial Neural Network	3	3	1	0	0	4	50	50	100
	Discipline Specific Elective II		Advanced Software Engineering/Unified Modelling Language/OOAD	3	3	1	0	0	4	50	50	100
	Core Practical I		Practical - I : Python for Data Science Lab	3	0	0	5	0	5	50	50	100
	Core Practical II		Practical - II : Contemporary Web Technologies Lab	3	0	0	5	0	5	50	50	100
Part II	**Soft Skill I**			2								
Total				**26**	**18**	**2**	**10**		**30**	**350**	**350**	**700**

SCHEME OF II SEMESTER M.Sc. COMPUTER SCIENCE PROGRAM

SEMESTER II												
Component	**Course Category**	**Course Code**	**Name of the course**	**Over All Credits**	**Hrs Distribution**				**Total contact Hours**	**Marks**		
					L	T	P	S		CIA	ESE	Total
Part I	**Core Course IV**		Digital Image Processing	4	4	0	0	0	4	50	50	100
	Core Course V		Java Enterprise Edition	4	4	0	0	0	4	50	50	100
	Core Course VI		Data Mining Techniques	4	4	0	0	0	4	50	50	100
	Discipline Specific Elective III		Advanced Database Management Systems/Distributed Databases/Cloud Web Services	3	3	1	0	0	4	50	50	100
	Discipline Specific Elective IV		Internet of Things and its Applications/High Speed Networks / Social Network Analysis	3	3	1	0	0	4	50	50	100
	Core Practical III		Practical - III : Java Enterprise Edition Lab	3	0	0	5	0	5	50	50	100
	Core Practical IV		Practical - IV : Data mining Lab - using Python	3	0	0	5	0	5	50	50	100
Part II	**Soft Skill II**			2								
Total				**26**	**18**	**2**	**10**	**0**	**30**	**350**	**350**	**700**

SCHEME OF III SEMESTER M.Sc. COMPUTER SCIENCE PROGRAM

SEMESTER III												
Component	**Course Category**	**Course Code**	**Name of the course**	**Over All Credits**	**Hrs Distribution**				**Total contact Hours**	**Marks**		
					L	T	P	S		CIA	ESE	Total
Part I	**Core Course VII**		Artificial Intelligence and Machine Learning Techniques	4	4	0	0	0	5	50	50	100
	Core Course VIII		DOT NET Technology	4	4	0	0	0	5	50	50	100
	Core Course IX		Big Data Analytics	4	4	0	0	0	5	50	50	100
	Multi Discipline Elective/Open Elective I		Cyber Forensics/Ethical Hacking/Information security	3	3	1	0	0	3	50	50	100
	Core Practical V		Practical - V : DOT NET Technology Lab	3	0	0	5	0	5	50	50	100
	Core Practical VI		Practical - VI : Big Data Analytics Lab	3	0	0	5	0	5	50	50	100
	Internship			2								
Part II	**SEC-DS I**		Numerical Aptitude	3					3	50	50	100
	Soft Skill III			2								
Total				**28**	**15**	**1**	**10**	**0**	**31**	**350**	**350**	**700**

SCHEME OF IV SEMESTER M.Sc. COMPUTER SCIENCE PROGRAM

SEMESTER IV												
Component	**Course Category**	**Course Code**	**Name of the course**	**Over All Credits**	**Hrs Distribution**				**Total contact Hours**	**Marks**		
					L	T	P	S		CIA	ESE	Total
Part I	**Core Project**		Project & Viva-Voce	5			27		27	50	50	100
Part II	**SEC- DS II**		Logical Reasoning and Verbal ability	3	3	0	0	0	3	50	50	100
	Soft skill IV			2								
	Industrial Visit			1								
Total				**11**	**3**	**0**	**27**	**0**	**30**	**100**	**100**	**200**

OVERALL SEMESTER WISE CREDIT DISTRIBUTION

Post Graduate Course – M.Sc., Computer Science

Component	Credits
Part I	**76**
Part II	**15**
Total	**91**

Sl.No.	Category	Course Category	No. Of Courses	Credits	Total Credits
1.	**Part I**	**Core Theory**	**9**	**4**	**36**
2.		**Core Practical**	**6**	**3**	**18**
3.		**Core Project**	**1**	**5**	**5**
4.		**Core Internship**	**1**	**2**	**2**
5.		**Discipline Specific Elective**	**4**	**3**	**12**
6.		**Multi Disciplinary Elective**	**1**	**3**	**3**
7.	**Part II**	**Skill Enhancement Course – Discipline Specific**	**2**	**3**	**6**
8.		**Soft Skill**	**4**	**2**	**8**
9.		**Industrial Visit**	**1**	**1**	**1**
10.	**Total Mandatory Credits**				**91**
11.	**Extra Credits** **Note: Students can take extra credit course from their own department or from other department as per the Admitting Body / University norms.** **Self-Study course (2C)** – (Department specific, curriculum and Evaluation scheme and assessment to be framed by the department **Value added course –** minimum 30 hrs (2C) **Certificate Course/Short-Time Course** – minimum of 15 days (minimum 45 hrs) (3C) – preferred online. **Swayam/NPTEL/MOOC courses (2C)** – maximum of 12 credits Skilled based vocational courses (2C) e.g. basic computing skill,tailoring,jewel making,beauty parlour course,interiors etc., through skill development cell of college **Other languages (2C)** **International HRD program – 30hrs (2C)**				

FIRST SEMESTER

Course Title

CORE COURSE I – ADVANCED DESIGN AND ANALYSIS OF ALGORITHMS

Course Code :	**Credits**	**: 04**
L:T:P:S: 4:0:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course, student will be able to understand the fundamental approaches in the design of algorithms and the impact of algorithm design in practice.*
- *To analyze the asymptotic performance of algorithm. To analyze different computational models (e.g., divide-and-conquer), order notation and various complexity measures (e.g., running time, disk space).*
- *To analyze and design the complexity/performance of different algorithms.*
- *To learn insights of lower bound theory problems and NP-hard and NP-complete problems.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Know the essentials of algorithms. Analyze the asymptotic performance of algorithms. Gain insights of basic elementary data structures.
CO2	Describe the divide-and-conquer and greedy paradigm. Explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer, greedy algorithms and analyse them.
CO3	Discuss the dynamic-programming paradigm and implementation of dynamic programming in various algorithmic designs and analyze them.
CO4	Define the design of backtracking, branch and bound paradigm. Describe the algorithms using this paradigm. Synthesize and analyze them.
CO5	Know the concepts of non-deterministic algorithms, Lower bounds theory problems.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	2	2	3	3	2	2	2	2
CO 2	3	3	3	2	3	3	3	3	3	3	2
CO 3	2	3	3	2	3	3	3	3	2	3	3
CO 4	2	3	3	2	2	3	3	3	2	3	2
CO 5	2	2	2	2	2	3	3	3	2	2	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I: Introduction**: Notion of Algorithm – Fundamentals of the Analysis of Algorithmic Efficiency – Space complexity, Time complexity – Recursive Algorithms -Asymptotic Notations and their properties (O, Ω, Θ). Elementary Data Structures: Stacks and Queues – Trees – Graphs.	9	CO1
2	**MODULE II: Divide and conquer**: Quick sort- Selection sort – Merge sort-Heap Sort -Bucket Sort-Radix Sort - Count Sort and Strassen's matrix multiplication. **Greedy Method**: Knapsack problem-Prim's algorithm and Kruskal's Algorithm – Tree Vertex Splitting – Job sequencing with deadline .	9	CO2
3	**MODULE III: Dynamic Programming**: Multistage graphs -Optimal Binary Search trees– All pairs shortest paths – Single source shortest paths – Search techniques for Graphs – DFS-BFS-Connected components – Biconnected components.	9	CO3
4	**MODULE IV: Back Tracking**: 8-Queens Problems – Sum of Subsets – Graph Coloring – Hamiltonian Cycles. **Branch and Bound** 0/1 knapsack problem– Traveling Salesperson problem.	9	CO4
5	**MODULE V: Lower Bound Theory**: Comparison trees – NP-Hard and NP Complete Problems: Non-deterministic Algorithms- NP Hard Problem: Clique Decision Problem (CDP)-Chromatic number decision problem	9	CO5

TEXT BOOKS:

1. E Horowitz, S Sahni and S Rajasekaran (2008). *Computer Algorithms* (2001 edition), Galgotia Publishers, ISBN 81-7515-257-5
2. G Brassard and P Bratley (1997). *Fundamentals of Algorithms* (1st Edition), Prentice Hall India Learning Private Limited, ISBN 8120311310
3. Rajesh K. Shukla (2015). Analysis and Design of Algorithms: A Beginners's Approach (1st Edition), Wiley, ISBN 978-8126554775

REFERENCE BOOKS:

1. Cormen Thomas H, Charles S. Leisorson, Ronald L. Rivest, Clifford Stein (2012). *Introduction to Algorithms* (3rd edition), MIT Press Ltd, ISBN 9780262033848
2. Anany Levitin (2017). *Introduction to the Design and Analysis of Algorithms* (3rd edition) Pearson, ISBN 978-0132316811
3. Jon Kleinberg, Eva Tardos (2006). *Algorithm Design*(3rd edition revised),Pearson Education, ISBN 9780132131087

E- REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs27
3. https://www.cs.duke.edu/courses/fall08/cps230/Book.pdf

Course Title

CORE COURSE II: PYTHON FOR DATA SCIENCE

Course Code : **L:T:P:S: 4:0:0:0**	**Credits** **CIA Marks**	**: 04** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *To introduce Python programming language through its core language basics and program design techniques suitable for modern applications.*
- *To understand the data structures available in python, to work with databases and data visualization and exploration.*
- *To utilize high-performance programming constructs available in Python to develop solutions in real life scenarios.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Examine Python syntax and semantics and be fluent in the use of Python input output functions.
CO2	Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
CO3	Interpret/Evaluate the concepts of Object-Oriented Programming using Python.
CO4	Demonstrate proficiency in handling Strings and File Systems.
CO5	Discover the capabilities of numpy, scipy and matplotlib for scientific programming.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	1	1	3	1	3	3	3	2	1	3
CO 2	3	2	2	2	2	1	3	3	2	2	3
CO 3	3	2	2	2	2	1	3	3	3	3	2
CO 4	3	2	2	2	1	1	3	3	3	2	3
CO 5	3	3	2	2	2	2	3	3	3	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I : Introduction to Python** – Python Interpreter - Interactive mode- - Basic Programming concepts - Variables Expressions and statements - Input/Output –Operators. – Conditiona statements –loops	9	CO1
2	**MODULE II:** Functions - Arguments - Return values – Keyword Argument function – Function with default values - Lambda function - Data Structures –Strings - Lists - Dictionaries - Tuples - Sets Sequences - Modules and Packages	9	CO2
3	**MODULE III :** Introduction to NumPy-Standard Data Types-Basic Array Types - Indexing, Slicing, Reshaping, Concatenation. Ufuncs and its features. Aggregations	9	CO3
4	**MODULE IV: Visualization with MatplotLib- Line Plots, Scatter Plots. Visualizing Error, Density & Contour plots, customizing color bar, visualization with seaborn.**	9	CO4
5	**MODULE V:** Introduction to Pandas-Creation of Series- Operations- Creation of Data Frames--Simple plot using pandasOperations- Import/Export of different types of Files-Slicing - Filtering- groupby- Aggregation- to check for missing values, outliers and imbalance in dataset – case study :real time dataset analysis	9	CO5

TEXT BOOKS:

1. Allen B Downey (2012) *Think Python: How to Think Like a Computer Scientist* (1st Edition), O'Reilly.
2. Vamsi Kurama, *Python Programming: A Modern Approach*, Pearson Education.
3. R. Nageswara Rao, *Core Python Programming*, 2nd Edition, Dreamtech.

REFERENCE BOOKS:

1. Mark Lutz, *Learning Python*, Orielly.
2. W.Chun, *Core Python Programming*, Pearson.
3. Kenneth A. Lambert, *Introduction to Python*, Cengage.

E- REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106182/
2. https://nptel.ac.in/courses/106/106/106106145/
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs36/

Course Title

CORE COURSE III: CONTEMPORARY WEB TECHNOLOGIES

Course Code :	**Credits**	**: 04**
L:T:P:S: 4:0:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- To understand and practice Hypertext Markup Language.
- To understand Dynamic Scripting on Client-side Internet Programming.
- To obtain knowledge on Node.js.
- To understand and practice NoSQL
- MongoDB Database.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain knowledge about static web page design using HTML and HTML5
CO2	Have a good knowledge of HTML tags and CSS.
CO3	To gain knowledge of scripting in designing a dynamic web page.
CO4	Understand the fundamentals of Node.js and its architecture, Utilize core modules and manage packages using NPM,Implement asynchronous programming concepts in Node.js. Develop basic web servers handling HTTP requests and responses..
CO5	Learn the basic knowledge of NOSQ database.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	2	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**Introduction to HTML -Anchor Tag – Hyperlink - Head and Body Section– Heading - Horizontal Ruler – Paragraphs – Tags - Images and Picture – Lists – Tables – Frames. HTML5: What is HTML5 - Features of HTML5 – Difference Between HTML and HTML5, Semantic Tags – New Input Elements and tags-Media tags (audio and video tags) – Designing Graphics using Canvas API - Drag and Drop features	9	CO1
2	**MODULE II:**DHTML and Style sheets (CSS3) - What is CSS3 – Features of CSS3 Defining styles - Elements of style - Linking a style sheet to a html documents - Inline style - External style sheets - Multiple styles- Implementation of border radius, box shadow, image border, custom web font, backgrounds - Advanced text effects(shadow) - 2D and 3D Transformations - Transitions to elements - Animations to text and elements	9	CO2
3	**MODULE III:** INTRODUCTION TO JAVASCRIPT : Introduction –Advantages of JavaScript - Variables – Data types -Operators – Control Statements – Looping statements - Functions –Dialog boxes- Array, Date and number related methods - Document Object Model - Event Handling –Browser Object Model - Windows and Documents - Form handling and validations. - Built in Object - User Defined Object.	9	CO3
4	**MODULE IV:** INTRODUCTION TO NODE.js: Node.js runtime environment-Node.js architecture and event-driven programming-Core Modules and NPM-Using built-in modules like fs, http, and path-Managing packages with Node Package Manager (NPM)-Asynchronous ProgrammingCallbacks, Promises, and async/await-Handling asynchronous operations-Creating a Basic Web Server-Using the http module to create servers-Handling requests and responses	9	CO4
5	**MODULE V:**INTRODUCTION TO NOSQL DATABASE – MONGODB: What is NoSQL Database - Why to Use MongoDB - Difference between MongoDB & RDBMS - Download & Installation - Common Terms in MongoDB – Implementation of Basic CRUD Operations using MongoDB.	9	CO5

TEXT BOOKS:

1. Web Technologies-A Computer Science Perspective-Jeffrey C. Jackson, 4th Edition, 2007
2. Amol Nayak, “MongoDB Cookbook ” , Second Edition, Packt Publishing, 2016
3. Krasimir Tsonev, “Node.js by Example”, Packt Publishing, 2015
4. Mario Casciaro and Luciano Mammino ,"Node.js Design Patterns", Third Edition, Packt Publishing, 2020.

REFERENCE BOOKS:

1. An Introduction to web development and Programming- Michael Mendez Suny Fredonia, 2014
2. David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011
3. Sandro Pasquali, “Mastering Node.js”, First Edition, Packt Publishing,2013.

E- References:

1. https://www.w3schools.com/html/
2. https://www.javatpoint.com/html5-tutorial

DISCIPLINE SPECIFIC ELECTIVE I (A)
Course Title: DATA COMMUNICATION AND NETWORKING

Course Code :	**Credits**	**: 03**
L:T:P:S: 3:1:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course the student will be able to understand the concepts and fundamentals of data communication and computer networks.*
- *To familiarize with the basic taxonomy and terminology of the computer networking area.*
- *To experience the designing and managing of communication protocols while getting a good exposure to the TCP/IP protocol suite.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Have knowledge of the basic principles, concepts of computer networks and the design of OSI layers.
CO2	To get insights into the Data Link Layer protocols
CO3	To provide overview of the Protocols of Medium Access sub layer
CO4	To identify the design issues and solutions in the Network Layer
CO5	To have basic knowledge of TCP protocol

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	2	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** Introduction : Network Hardware – Software – Reference Models – OSI and TCP/IP models – Physical layer: Transmission media–Wireless Transmission–Narrowband ISDN.	9	CO1
2	**MODULE II:** Telephones structure –local loop– trunks and multiplexing, switching. Data link layer: Design issues – error detection and correction, Elementary data link protocols – Sliding window protocols.	9	CO2
3	**MODULE III:** Medium Access Sub Layer: Channel Allocation Problem – Multiple Access Protocols: ALOHA– Carrier Sense MultipleAccess Protocols – Collision Free Protocols – Limited Contention Protocols Bridges – Transparent Bridges – Spanning Tree Bridges – Source Routing Bridges.	9	CO3
4	**MODULE IV:** Network layer – design issues – Routing Algorithms: Shortest Path Routing – Flooding – Distance Vector Routing – Link State Routing – Hierarchical Routing Congestion control algorithms: General Principles – Congestion Control in Virtual Circuit Subnets – Choke Packets – Load Shedding – Jitter Control– IP protocol – IP Address –Subnets – Internet Control Protocol.	9	CO4
5	**MODULE V:** Transport layer –Elements– Connection management – Addressing, Establishing & Releasing a connection – Transport Control Protocol: TCP Protocol – TCP segment Header– Connection Management –Application Layer – Network Security-Traditional Cryptography - DNS-DNS Name Space -Electronic Mail - Message Formats.	9	CO5

TEXT BOOKS:

1. A.S.Tanenbaum (2013). *Computer Networks* (5th Edition), Pearson Education, ISBN-13 : 978-8131770221.
2. B Forouzan (1998). *Introduction to Data Communications in Networking*, Tata McGraw Hill.
3. Halsall (1995). *Data Communications, Computer Networks and Open Systems (*20th edition), Addison Wesley.

REFERENCE BOOKS:

1. ***Data Communication and Networks: An Engineering Approach*** *by David Harle and James R. Irvine:*
2. *Gupta, P.C., Data Communications and Computer Networks, 2nd Edition, PHI Learning Private Limited, Delhi, India, 2014.*
3. *Duck, M. and R. Read, Data Communications and Computer Networks: For Computer Scientists and Engineers, 2nd Edition, Prentice-Hall, 2009.*

E- REFERENCES:

1. www.technolamp.co.in/2010/08/computer-networks-tanenbaum-powerpoint.html
2. https://www.ece.rutgers.edu/~marsic/books/CN/

DISCIPLINE SPECIFIC ELECTIVE I (B)
Course Title: MOBILE NETWORK SYSTEM

Course Code :	**Credits**	**: 03**
L:T:P:S: 3:1:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- To understand the fundamentals of Mobile communication systems.
- To understand the different multiplexing scheme.
- To understand the significance of different layers in mobile system.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Have knowledge of the basic concepts of wireless, , mobile and cellular mobile systems
CO2	To get insights into the MAC
CO3	To provide overview of the Communication System
CO4	To identify the design issues and solutions in the Mobile Network Layer
CO5	To have basic knowledge of Transport Layer

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	2	2
CO 2	3	3	3	3	3	3	3	3	3	2	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I - INTRODUCTION** Introduction to wireless, mobile and cellular mobile systems- cellular mobile telephone systems, analog and digital cellular systems-frequency reuse, co-channel interference.	9	CO1
2	**MODULE II – MAC** Medium access control - MAC, SDMA, FDMA, TDMA, CDMA, Hand offs and dropped calls-initiation of handoff, power difference, mobile assisted cell-site and Intersystem handoff.	9	CO2
3	**MODULE III – COMMUNICATION SYSTEMS** Mobile Telecommunication standards, GSM, DECT, TETRA, IMT-2000, CTEO, satellite systems – GEO, LEO and MEO, and broadcast systems –Digital audio and video broadcasting, IEEE 802.11, HIPERLAN, Bluetooth, Wireless ATM, WATM services.	9	CO3
4	**MODULE IV – MOBILE NETWORK LAYER** Network support for mobile systems – Mobile IP- IP packet delivery-Agent discovery- tunneling and encapsulation, reverse tunneling, IPV6, DHCP.	9	CO4
5	**MODULE V – MOBILE TRANSPORT LAYER** Mobile transport and application layer protocol - Review of traditional TCP, fast retransmit/fast recovery, transmission/timeout freezing, file systems, WWW, WAP.	9	CO5

Text Book

1. Jochen Sciiiller, "Mobile Communications ", Pearson Education India, 2009.
2. Tony Wakefield,Dave McNally,David Bowler,Alan Mayne ,"Introduction to Mobile Communications: Technology, Services", Kindle Edition 1st Edition.
3. Rishabh Anand," Wireless and Mobile Communication", S Chand And Company Ltd,second edition.

Reference Book

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2/e, Pearson Education, 2010.
2. William C.Y Lee, "Mobile Cellular Telecommunications ", McGraw Hill International
   Editions, 1995.
3. C. Siva Ram Murthy, B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Second Edition, Pearson Education, 2008

E- REFERENCES:

1. www.technolamp.co.in/2010/08/computer-networks-tanenbaum-powerpoint.html
2. https://www.ece.rutgers.edu/~marsic/books/CN/

DISCIPLINE SPECIFIC ELECTIVE I (C)
Course Title: ARTIFICIAL NEURAL NETWORK

Course Code :	**Credits**	**: 03**
L:T:P:S: 3:1:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- Understand and implement advanced neural network architectures
- .Gain hands-on experience with modern tools for deep learning
- .Explore the latest research trends and techniques in ANN.
- Apply advanced ANN methods to real-world problems.

CO1	• Understanding the Fundamentals of Neural Networks and Optimization Techniques: • Mastering Deep Learning Frameworks and Advanced Techniques
CO2	• Understanding CNN Architecture and Advanced Techniques for Image Processing • Mastering RNNs for Sequence Data and NLP Applications
CO3	• Mastering Generative Models for Data Generation and Augmentation • Understanding and Applying Reinforcement Learning Techniques
CO4	• Exploring Advanced Neural Network Techniques and Meta-Learning • Addressing Ethical Considerations and Challenges in Deep Learning
CO5	• Understanding and Applying Advanced AI Techniques in Computer Vision and NLP • Exploring Speech Recognition and Autonomous Systems

Mapping of Course Outcomes to Program Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	**3**	**3**	**2**	**2**	**2**
CO 2	3	3	3	3	3	3	**3**	**3**	**3**	**2**	**3**
CO 3	3	3	3	3	3	3	**3**	**2**	**3**	**2**	**3**
CO 4	3	3	3	3	3	2	**3**	**3**	**3**	**2**	**3**
CO 5	3	3	3	3	3	3	**3**	**3**	**2**	**3**	**2**

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

Sl.No.	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**Review of Basic Neural Networks-Introduction to Neural Networks-Perceptron, Activation Functions, Loss Functions-Backpropagation and Gradient Descent-Overfitting and Regularization Techniques	9	CO1
2	**MODULE II:**Convolutional Neural Networks (CNNs)-CNN Architecture and Components-Convolution, Pooling, Flattening, Fully Connected Layers-Stride, Padding, Filter Sizes-Advanced CNN Techniques-Transfer Learning (Fine-Tuning Pretrained Networks)	9	CO2
3	**MODULE III:**Generative Models-Generative Adversarial Networks (GANs)-GAN Architecture and Training Dynamics-Conditional GANs, CycleGANs, StyleGAN-Applications in Image Generation, Art, and Data Augmentation	9	CO3
4	**MODULE IV:**Advanced Topics in Neural Networks-Meta-Learning and Few-Shot Learning-Model-Agnostic Meta-Learning (MAML)-Few-shot Learning Architectures-Self-Supervised Learning-Contrastive Learning, Pretext Tasks	9	CO4
5	**MODULE V:**Real-World Applications-Computer Vision-Object Detection, Image Classification, Image Segmentation-Natural Language Processing (NLP)-Language Modeling, Text Generation, Question Answering	9	CO5

TEXT BOOKS:

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
2. Artificial Neural Networks: A Practical Course by Ivan Nunes da Silva et al.
3. Artificial Neural Networks by Robert J. Schalkoff.

REFERENCE BOOKS:

1. "Neural Networks and Deep Learning: A Textbook" by Charu Aggarwal
2. "Deep Learning with Python" by François Chollet
3. Artificial Neural Networks by B. Yegnanarayana:

E-REFERENCES:

1. https://www.deeplearningbook.org/https://mrcet.com/downloads/digital_notes/CSE/III%20Year/AIML/Neural-Networks.pdf
2. https://www.springer.com/gp/book/9783030393487

DISCIPLINE SPECIFIC ELECTIVE II (A)
Course Title: ADVANCED SOFTWARE ENGINEERING

Course Code :	**Credits**	**: 03**
L:T:P:S: 3:1:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking the course, the students will be able to Develop the knowledge and practical skills needed to successfully participate in the analysis, design and development of large software systems, using object-oriented approaches.*
- *They can Apply team dynamics by working in teams.*
- *Focus on object-oriented approaches and project management techniques Communicate the science and Development of graphical user interfaces, and quality assurance.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Knows the reason about the basic Software life cycle models Importance of various kinds of Project Management methods, Tracking Software Quality, Quality Standards and Metrics.
CO2	Develop System Concepts for Object Modelling Design and implement a software design concepts to meet desired needs and Requirements. Design the UML concepts like sequential, Use cases and Activity diagram
CO3	Concepts of Use cases, actors, and common modelling techniques. Implement the concept use cases, business actors , Significance of identifying the subsystems and business requirements
CO4	Explain Design Workflow and System Design Concept Create Mapping Object Model to Database Schema Testing and verification process
CO5	Usage of Software Configuration Management Define maintenance and its types. Build Reverse and re-engineering process.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	2	2	2	3	2
CO 2	3	3	2	3	3	3	2	3	3	3	3
CO 3	3	3	2	3	3	3	2	3	3	3	3
CO 4	3	3	2	3	3	3	2	3	3	3	3
CO 5	3	3	2	2	2	2	2	3	2	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**Software life cycle models: Waterfall, RAD,AGILE and Spiral model Process metric – Product metrics – Estimation – LOC, FP, COCOMO models – Project Management – Planning, Scheduling and Tracking Software Quality – Quality Standards, Quality Metrics.	9	CO1
2	**MODULE II:** System Concepts for Object Modeling – Abstraction, Inheritance, Polymorphism, Encapsulation, Message Sending, Association, Aggregation – Requirement Workflow Functional, Non-functional – Characteristics of Requirements – Requirement Elicitation Techniques – Requirement Documentation – Use case specification, Activity Diagram.	9	CO2
3	**MODULE III:** Use-Case Modeling – Actors, Use Cases, Use Case Relationships. The Process of Requirements Use-Case – Identify Business Actors, Identify Business Requirements, Use Cases, Construct, Use Case Model Diagram – Class Diagrams and Object Diagrams – Package Diagrams – Sequence and Collaboration diagrams, State chart diagram.	9	CO3
4	**MODULE IV:** Design Workflow: System Design Concept – Coupling and Cohesion – Architectural Styles – Identifying Subsystems and Interfaces – Design Patterns Implementation Workflow – Mapping models to Code – Mapping Object Model to Database Schema Testing – Formal Technical Reviews – Walkthrough and Inspection.	9	CO4
5	**MODULE V:** Software Configuration Management - Managing and controlling Changes – Managing and controlling versions Maintenance –Types of maintenance – Maintenance Log and defect reports – Reverse and re-engineering.	9	CO5

TEXT BOOKS:

1. Roger Pressman, (2005). *Software Engineering*, (Sixth Edition), TMH. ISBN no: 13:978-007-126782-3.
2. Bahrami, (2008). *Object Oriented Systems Development*, (Second edition), TMH. ISBNno: 13 978-0070265127.
3. Bernd Bruegge, (2004). *Object oriented software engineering*, (Second Edition), Pearson Education. ISBN no: 13 978-93332518681.

REFERENCE BOOKS:

1. Stephan R Schach, (2007). *Object oriented software engineering*, (Second edition), TMH. ISBN no: 9780071259415
2. Timothy C Lethbridge, Robert Laganiere (2004). *Object-Oriented Software Engineering Practical software development using UML and Java*, (Second edition), TMH.

E- REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105224/
2. https://nptel.ac.in/courses/106/101/106101061/
3. https://www.edutechlearners.com/oose-notes/

DISCIPLINE SPECIFIC ELECTIVE II (B)
Course Title: UNIFIED MODELING LANGUAGE

Course Code :	**Credits**	**: 03**
L:T:P:S: 3:1:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- On taking the course, the students will be able to understand the importance of various basic concepts of object modeling .
- To gain the knowledge about various basic structural modeling along with their applicability contexts.
- The students can Analyze various basic Behavioral modeling of object-oriented software design (UML) and review the concepts of Advance Behavioral modeling.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Analyse the basic concepts of object modeling.
CO2	Demonstrate various Basic Structural Modeling using the appropriate notation
CO3	Demonstrate various Basic Behavioral Modeling using the appropriate notation
CO4	Analyse various Advanced Behavioral Modeling using the appropriate notation
CO5	Analyse Architectural Modeling using the appropriate notation

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	2	2	2	2	3	2	2	2	2
CO 2	3	3	2	2	3	1	1	3	3	3	2
CO 3	3	2	2	2	3	2	2	3	2	3	2
CO 4	2	3	2	2	2	2	2	2	2	2	3
CO 5	3	3	2	2	3	2	2	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**Introduction to UML: Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture	9	CO1
2	**MODULE II**:Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Interfaces, Types and Roles, Packages. Class & Object Diagrams: Terms, Concepts, modeling techniques for Class & Object Diagrams.	9	CO2
3	**MODULE III:**Basic Behavioral Modeling: Interactions, Interaction diagrams. Use cases, Use case Diagrams, Activity Diagrams.	9	CO3
4	**MODULE IV:**Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams.	9	CO4
5	**MODULE V:**Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams.	9	CO5

TEXT BOOKS:

1. Grady Booch, James Rumbaugh, Ivar Jacobson (2005). *The Unified Modeling Language User Guide*, (Second Edition), Pearson Education, ISBN no:0-201-57168-4
2. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado (2003). *UML Toolkit*, (Second Edition), WILEY-Dreamtech India Pvt. Ltd, ISBN no:13:978-81-265-0466-4
3. Grady Booch (2007). *Object Oriented Analysis and Design*, (Third Edition), Addison Wesley, ISBN no :0-8053-5340-2

REFERENCE BOOKS:

1. Pascal Roques,Modeling (2007). *Software Systems Using UML2*, (Fourth Edition), WILEY-Dreamtech India Pvt. Ltd. ISBN no :13-978-81-265-0505-0
2. AtulKahate, (2000). *Object Oriented Analysis &Design*, Tata McGraw-Hill. ISBN no: 0-07-058376-5
3. Ali Bahrami, (1999). *Object Oriented Systems Development*, McGraw Hill. ISBN no:13-978-0-07-026512-7

E- REFERENCES:

1. www.uml-tutorials.trireme.com
2. www.smartdraw.com/resources/tutorials/uml-diagrams

DISCIPLINE SPECIFIC ELECTIVE II (C)
Course Title: OBJECT ORIENTED ANALYSIS AND DESIGN

Course Code :	**Credits**	**: 03**
L:T:P:S: 3:1:0:0	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking the course, the students will be able*
- *To understand the concept of object-oriented development, and create a static object model and a dynamic behavioral model and a functional model of the system.*
- *They can easily understand the approaches to system design and object design, and the techniques of translating design to implementation.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Analyze object basics and UML.
CO2	Gain knowledge about attributes and relationships.
CO3	Interpret axioms and do a case study.
CO4	Detailed study about Micro level process.
CO5	Digital signatures.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	2	2	2	2	3	2	2	2	2
CO 2	3	3	2	2	3	1	1	3	3	3	2
CO 3	3	2	2	2	3	2	2	3	2	3	2
CO 4	2	3	2	2	2	2	2	2	2	2	3
CO 5	3	3	2	2	3	2	2	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I** :System development - object basics - development life cycle - methodologies - patterns - frameworks - unified approach - UML.	9	CO1
2	**MODULE II:** Use Case models - object analysis - object relations - attributes - methods, class and object responsibilities - case studies	9	CO2
3	**MODULE III:** Design processes - design axioms - class design - object storage - object interoperability - case studies.	9	CO3
4	**MODULE IV:** User interface design - view layer classes - micro - level processes - view layer interface - case studies.	9	CO4
5	**MODULE V:**Quality assurance tests - testing strategies - object orientation on testing - test cases - test plans.	9	CO5

TEXT BOOKS:

1. Ali Bahrami, (1999). *Object Oriented Systems Development*, McGraw Hill. ISBN no:13-978-0-07-026512-7
2. Grady Booch (2007). *Object Oriented Analysis and Design*, (Third Edition), Addison Wesley, ISBN no :0-8053-5340-2
3. Bernd Bruegge, (2004). *Object oriented software engineering*, (Second Edition), Pearson Education. ISBN no: 13 978-93332518681.

REFERENCE BOOKS:

1. James Rumbaugh, Michael R. Blaha, (2004). *Object-Oriented Modeling and Design with UML* , (Second Edition),Prentice Hall ISBN no: 978-81-317-1106-4
2. AtulKahate, (2000). *Object Oriented Analysis & Design*, Tata McGraw-Hill. ISBN no: 0-07-058376-5
3. Roger Pressman, (2005). *Software Engineering*, (Sixth Edition), TMH. ISBN no: 13:978-007-126782-3.

E- REFERENCES:

1. http://www.exforsys.com/tutorials/ooad/ooad-introduction.html
2. http://www.devshed.com/c/a/Practices/Introducing-UMLObjectOriented-Analysis-and-Design

Course Title: PYTHON FOR DATA SCIENCE LAB

Course Code : **L:T:P:S:0:0:5:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 50**

LEARNING OBJECTIVES:

- *On taking this course, students will be able*
- *To interpret the programming language and implement the various programs in handling data, strings, files, graphics, and data exploration.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Interpret the programming task logically and make the pseudo code.
CO2	Understand the IDE and write, execute and debug.
CO3	Implement the basic string functions.
CO4	Apply the concept of pygtk.
CO5	Understand the concept of interpret data exploration and data munging.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	1	1	3	1	3	3	3	2	2	3
CO 2	3	2	2	2	2	1	3	2	2	2	3
CO 3	3	2	2	2	2	1	3	3	3	3	2
CO 4	3	2	2	2	1	1	3	2	2	3	3
CO 5	3	3	2	2	2	2	3	3	3	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	a) Simple calculator to do all the arithmetic operations. b) Programs to use control flow tools like if. c) Programs to use for loop.	5	CO1
2	a) Data structures ● Use list as stack ● Use list as queue ● Tuple, sequence b) New module for mathematical operations and use in your program. c) Programs to read and write files, create and delete directories.	5	CO2
3	a) Programs with exception handling. b) Programs using classes and objects. c) Connect with MYSQL and create an address book and do the operations. ● Insert, read, update and delete	7	CO3
4	a) GUI program using PYGTK. b) programs Using Numpy. c) Programs Using scipy.	8	CO4
5	a) Programs using series and data frames. b) Programs using charts/graphs.	10	CO5

TEXT BOOKS:

4. Allen B Downey (2012) *Think Python: How to Think Like a Computer Scientist* (1st Edition), O'Reilly.
5. Vamsi Kurama, *Python Programming: A Modern Approach*, Pearson Education.
6. R. Nageswara Rao, *Core Python Programming*, 2nd Edition, Dreamtech.

REFERENCE BOOKS:

4. Mark Lutz, *Learning Python*, Orielly.
5. W.Chun, *Core Python Programming*, Pearson.
6. Kenneth A. Lambert, *Introduction to Python*, Cengage.

E- REFERENCES:

4. https://nptel.ac.in/courses/106/106/106106182/
5. https://nptel.ac.in/courses/106/106/106106145/
6. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs36/

Course Title: CONTEMPORARY WEB TECHNOLOGIES LAB

Course Code : **L:T:P:S:0:0:5:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 50**

LEARNING OBJECTIVES:

- Be familiar with Web page design using HTML 5 and style sheets CSS 3.
- Be exposed to creation of user interfaces using Java frames and applets.
- Learn to create dynamic web pages using server side scripting.
- Be familiar with the Node.js
- Be familiar with the NOSQL database and its installation process.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Develop a static web page using various HTML Tags.
CO2	Develop an application to embed a map, fixing hotspot, using CSS and hyperlinks.
CO3	Validating a web page using Java Script.
CO4	Build and implement applications using XML.
CO5	Build and develop applications using MongoDB.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	2	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	Create a static webpage to online shoppe like flipkart, amazon etc. The web page must have Home page, Catalogue page etc. Apply various HTML tags to design attractive page.	5	CO1
2	Design a web page with the following using HTML a. To embed a map in a web page b. To fix the hot spots in that map c. Show all the related information when the hot spots are clicked.	5	CO2
3	Design a web page with the following using HTML a. To embed a map in a web page b. To fix the hot spots in that map c. Show all the related information when the hot spots are clicked.	7	CO3
4	Create a web page with the following. a. Cascading style sheets. b. Embedded style sheets. c. Inline style sheets. Use our college information for the web pages.	8	CO4
5	a) Create a web page for advertisements. The web page should include textual information, audio, video and hyperlink to refer to other pages. b) Perform page validation using JavaScript to required form elements. c) Create a script that reads and writes to a file using the fs module. d) Build a simple HTTP server that responds with "Hello World". e) Write a program that demonstrates the use of callbacks, Promises, and async/await. f) NoSQL and MongoDB : Create the followings: · Collection · Document · Field · Index g) In MongoDB, Demonstrate a selection operation and projection h) MongoDB: Implement arrays /embedded docs to handle many-to-one relationships.	20	CO5

TEXT BOOKS:

1. Web Technologies-A Computer Science Perspective-Jeffrey C. Jackson, 4th Edition, 2007
2. Amol Nayak, “MongoDB Cookbook ” , Second Edition, Packt Publishing, 2016
3. Krasimir Tsonev, “Node.js by Example”, Packt Publishing, 2015
4. Mario Casciaro and Luciano Mammino ,"Node.js Design Patterns", Third Edition, Packt Publishing, 2020.

REFERENCE BOOKS:

1. An Introduction to web development and Programming- Michael Mendez Suny Fredonia, 2014
2. David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011
3. Sandro Pasquali, “Mastering Node.js”, First Edition, Packt Publishing,2013.

E- References:

1. https://www.w3schools.com/html/
2. https://www.javatpoint.com/html5-tutorial

Course Title: SPOKEN TUTORIAL - PYTHON

S.No	CONTENTS OF MODULE
1	Getting started with python – Using the plot command interactively – Embellishing a plot –Saving plots – Multiple plots – Additional features of Python – loading data from files – Plotting the data – Other types of plots – Getting started with sage notebook – Getting started with symbolic – Using Sage – Using sage to teach – Getting started with lists – Getting started with for – Getting started with strings – Getting started with files – Parsing data – Statistics – Getting started with arrays – Accessing parts of arrays – Matrices – Least square fit – Basic data types and operators – I/O – conditionals – Loops – Manipulating lists – Manipulating strings – Getting started with tuples – Dictionaries – Sets – Getting started with functions – Advanced features of functions – Using python modules – Writing python scripts – Testing and debugging

Note:
Courses Offered by IIT Mumbai through Spoken Tutorial Projects MHRD, Government of India. At the end of the course Online Examination will be conducted for 45 minutes and qualified students (Minimum passing 40%) will be issued certificate by IIT, Mumbai.

Spoken Tutorial - 1 credit

SECOND SEMESTER

Course Title

CORE COURSE IV: DIGITAL IMAGE PROCESSING

Course Code : **L:T:P:S: 4:0:0:0**	**Credits** **CIA Marks**	**: 04** **: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course, students will be able*
- *To understand digital image processing fundamentals, to compare and contrast the classification of image Enhancement techniques in detail.*
- *To identify and analyze the concepts of image restoration and degradation, to get good understanding of image segmentation and image compression techniques.*
- *To apply the knowledge in research.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Describe the fundamentals of image processing and its applications.
CO2	Gain adequate knowledge of Image enhancement techniques in spatial domain
CO3	Detailed classification of Image enhancement techniques in frequency domain and compare with spatial domain techniques
CO4	Analyze the Image restoration and degradation concepts Identify the fundamentals techniques in image segmentation
CO5	Acquire a good knowledge of Image compression techniques

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	2	2	3	3	3	2	2	2	3
CO 2	3	2	3	3	2	3	2	3	2	3	3
CO 3	3	2	2	3	2	3	3	3	2	3	3
CO 4	3	2	3	2	2	3	3	3	2	3	2
CO 5	3	2	2	3	2	3	3	3	2	2	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** Introduction–Origin of Digital Image Processing-steps in image processing –Components of Image Processing System - Image acquisition, representation, sampling and quantization, relationship between pixels.	9	CO1
2	**MODULE II:** Image enhancement in spatial domain – some basic gray level transformations – histogram processing – enhancement using arithmetic, logic operations – basics of spatial filtering and smoothing	9	CO2
3	**MODULE III:** Image enhancement in Frequency domain – Introduction to Fourier transform: 1-D, 2-D DFT and its inverse transform, smoothing frequency domain filters – Ideal low pass filters, Butterworth Low-pass filter, Gaussian Low-pass filters sharpening frequency domain filters – Ideal High pass filter, Butterworth high pass filter, Gaussian High Pass filter	9	CO3
4	**MODULE IV:** Image restoration: Model of degradation and restoration process – noise models – restoration in the presence of noise – periodic noise reduction. Image segmentation: Detection of Discontinuities -Point Detection - Line Detection – Edge Detection-Thresholding : Basic Global and Adaptive Thresholding - Region-based segmentation.	9	CO4
5	**MODULE V:** Image compression: Fundamentals – models – error free compression – Lossy compression: Lossy predictive coding, Transform coding, Wavelet coding.	9	CO5

TEXT BOOKS:

1. RC Gonzalez, RE Woods (2018). *Digital Image processing* (4th Edition), Pearson Education, ISBN 0201180758
2. RC Gonzalez (2020). Digital Image Processing using MATLAB (3rd edition), GP Publishers, ISBN 978-0070702622
3. Maria Petrou, Costas Petrou (2010). *Image Processing: The Fundamentals (*2nd edition*)*, Wiley, ISBN 978-0470745861

REFERENCE BOOKS:

1. Chris Solomon. *Fundamentals of Digital Image Processing* (1st edition), Wiley, ISBN 978-0470844731.
2. Anil. K. Jain (1988). *Fundamentals of Digital Image Processing* (1st edition), Pearson ISBN 978-0133361650.
3. P. K. Sinha (2012). *Image Acquisition and preprocessing for machine vision systems* (1st edition), SPIE Press, ISBN 978-0819482020.

E- REFERENCES:

1. www.nptel.iitm.ac.in/video.php?subjectId=117105079
2. http://www.library.cornell.edu/preservation/tutorial/contents.html
3. https://freevideolectures.com/course/2316/digital-image-processing-iit-kharagpur

Course Title

CORE COURSE V: JAVA ENTERPRISE EDITION

Course Code : **L:T:P:S: 4:0:0:0**	**Credits** **CIA Marks**	**: 04** **: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course, student will be able*
- *To understand the various concepts of Enterprise programming, developing RMI Application, Servlet and session management.*
- *To learn data manipulation using JDBC, develop web applications using JSP, implement Javamail API and Spring Boot familiarize the students with the concepts of reusable classes using JavaBeans, Client server and RPC applications.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand various concepts of Enterprise programming, analyze and implement the RMI Architecture for the necessary applications.
CO2	Implement Session management using Servlet and implement JDBC for the database connectivity.
CO3	Develop Web applications using JSP and JSP error pages.
CO4	Design an application that sends and receives email with attachments.
CO5	Study the framework of Spring Boot tool with JPA and use the applications

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2	3	3	2	3	3	3	2	3
CO 2	3	3	2	3	3	2	2	3	3	3	3
CO 3	2	3	2	2	3	2	2	3	3	2	3
CO 4	3	3	2	3	3	2	2	3	2	3	2
CO 5	2	3	3	3	3	3	3	3	2	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE 1:**Need for Enterprise Programming – J2EE Advantage – Enterprise Architecture types– Architecture of J2EE – J2EE Components – J2EE Containers – Introducing RMI – RMI Architecture – Application Development with RMI – RMI over IIOP.	9	CO1
2	**MODULE I1:**Introduction to Servlets – Servlet Life Cycle – Servlet API Basics – HTTP Redirects –Cookies –State and Session Management –Hidden Fields – URL rewriting –Session Management with the Servlet API –Inter Servlet Communication – Server Side Includes and Request Forwarding –Data Base Access with JDBC.	9	CO2
3	**MODULE II1:**Javamail: Working with Java Mail –Understanding Protocols for Javamail –Components –Javamail API –Understanding Java Messaging Services: JMS Components EJB Fundamentals – EJB Architecture – EJB Roles –Introduction to Session Beans, Entity Beans & Message Driven Beans.	6	CO3
4	**MODULE 1V:**Client / Server Concepts: Client-Server - File server - Database server - Group server - Object server – Web server- Middleware - General middleware - Service specific middleware - Client / server building blocks - RPC - Messaging - Peer-to-Peer	9	CO4
5	**MODULE V:** Introduction to Spring Framework and Spring Boot-Spring Initializer-Dependency Injection (Constructor/Setter-based) Inversion of Control -Building RESTful API with spring Boot-Data Access with Spring data JPA- Security-Testing and Deploying Spring Boot Applications.	9	CO5

TEXT BOOKS:

1. Jason hunter, William Crawford (2011). *Java Server Programming* (2nd Edition), O'Reilly Media, Inc., ISBN: 9780596000400.
2. J McGovern, R Adatia, Y Fain (2003). *J2EE 1.4 Bible*, Wiley-dreamtech India Pvt Ltd.
3. H.Schildt (2002). *Java 2 Complete Reference* (5th Edition), TMH.

REFERENCE BOOKS:

1. K Moss (1999). *Java Servlets* (Second Edition), TMH.
2. Joseph O'Neil (1998) *Java Beans from the Ground Up*, TMH.
3. TomValesky (2000) *Enterprise JavaBeans*, Addison Wesley.

E- REFERENCES:

1. https://www.tutorialspoint.com/servlets/servlets-first-example.htm
2. http://www.servlets.com/jservlet2/examples/
3. http://www.j2eetutorials.50webs.com/JSP_example1html

Course Title

CORE COURSE VI: DATA MINING TECHNIQUES

Course Code : **L:T:P:S: 4:0:0:0**	**Credits** **CIA Marks**	**: 04** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course the student will be able*
- *To understand and implement classical models and algorithms in data warehousing and data mining, analyze the data, identify the problems.*
- *To choose the relevant algorithms for the chosen dataset, compare and contrast different conceptions of data mining.*
- *To characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Appreciate the basic principles, concepts and applications of data mining
CO2	Have a good knowledge of the pre processing techniques
CO3	Perform Data Mining using association rules
CO4	Get insights from data using classification and prediction techniques
CO5	Acquire knowledge of clustering techniques and outliers

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** What is Data Mining – What Kinds of Data can be mined- Kinds of Patterns that can be mined - Technologies used - Issues in Data Mining – Data Objects and Attribute Types- Basic Statistical Description of Data- Data Visualization.	9	CO1
2	**MODULE II:** Data Preprocessing: Why preprocess the data – Data cleaning – Data Integration – Data Transformation – Data Reduction – Data Discretization. Data Warehouse: Basic concepts-Data Warehouse Modelling:Data Cube and OLAP	9	CO2
3	**MODULE III:** Data Mining Techniques: Association Rule Mining – The Apriori Algorithm – Multilevel Association Rules – Multidimensional Association Rules – Constraint Based Association Mining.	9	CO3
4	**MODULE IV:** Classification and Prediction: Issues regarding Classification and Prediction – Decision Tree induction – Bayesian Classification – Back Propagation – Classification Methods – Prediction – Classifiers accuracy.	9	CO4
5	**MODULE V:** Clustering Techniques: cluster Analysis – Clustering Methods – Similarity and Distance Measures – Hierarchical Methods – Partitional Methods – Outlier Analysis	9	CO5

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber, Jian Pei (2008). *Data Mining: Concepts and Techniques* (2nd edition), Morgan Kaufmann, ISBN- 9780123814791
2. Dunham MH, (2003). *Data Mining: Introductory and Advanced Topics*, Pearson Education.
3. Paulraj Ponnaiah, (2001). *Data Warehousing Fundamentals*, Wiley Publishers.

REFERENCE BOOKS:

1. Dunham MH, (2003). *Data Mining: Introductory and Advanced Topics*, Pearson Education.
2. Paulraj Ponnaiah, (2001). *Data Warehousing Fundamentals*, Wiley Publishers.
3. SN Sivananda and S Sumathi, (2006). *Data Mining*, Thomsan Learning, Chennai

E- REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview/
2. https://www.udemy.com/fundamentals-of-data-mining/
3. https://www.coursera.org/specializations/data-mining/

DISCIPLINE SPECIFIC ELECTIVE III (A)

Course Title: ADVANCED DATABASE MANAGEMENT SYSTEM

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course, student will be able*
- *To understand the role of a database management system in an organization and the basic concepts and terminology related to DBMS.*
- *To evaluate the normality of a logical data model, and correct any anomalies, understand the Object model and Object Relational database management system.*
- *To understand the basics of data warehousing and Distributed Databases, and emerging database technologies.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Describe the characteristics of Database Management Systems and about the concepts and models of database.
CO2	Design ER-models to represent simple database application scenarios.
CO3	Convert the ER-model to relational tables, populate relational database. Improve the database design by normalization.
CO4	Describe the fundamental elements of Object and Object relational database management systems.
CO5	Get the knowledge of Data Warehousing And Distributed DBMS

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	2	3	3	3	3	3	3
CO 2	3	3	3	3	3	2	3	3	3	2	3
CO 3	3	3	3	3	3	2	3	3	3	2	3
CO 4	3	2	2	3	3	2	3	2	2	3	3
CO 5	3	2	2	3	3	3	3	2	2	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** Database System Concepts And Architectures: Data Models – Schemas – Instances – Three Schema Architecture – Data Independence – Database Languages. E-R Model and EER Model: Entity Types – Entity Sets – Attributes – Key – Relationship Types – Relationship Sets – Weak Entity Types – ER Diagram – Naming Conventions – Subclasses – Super classes – Inheritance – Specialization And Generalization – Constraints and Characteristics Of Specialization and Generalization Hierarchies.	9	CO1
2	**MODULE II:** Normalization: Basic Definitions – Functional Dependencies – Types of FD – Introduction to Normalization – Decomposition – Dependency Preservation – First, Second, Third Normal Forms – BCNF – Multivalued Dependencies and Fourth Normal Form – Join Dependency and Fifth Normal Form.	9	CO2
3	**MODULE III**: Object And Object Relational Databases – Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects Object Database Standards and Languages: Overview of ODMG Model – ODL – OQL.	9	CO3
4	**MODULE IV** Data Warehousing And Distributed DBMS – Data Warehousing – Characteristics Of Data Warehouses – Data Modeling For Data Warehouses – Typical Functionality Of A Data Warehouse – Distributed DBMS – Features – Factors Encouraging DDBMS – Advantages Of Distributed Data Bases – Distributed DBMS Architecture – Types Of Distributed Data Bases.	9	CO4
5	**MODULE V**: Emerging Technologies – Mobile Databases – Architecture and Data Management Issues – Multimedia Databases – Nature of Data, Data Management Issues and Applications.	9	CO5

TEXT BOOKS:

1. R Elmasri, SB Navathe (2017). *Fundamentals of Database Systems* (7th Edition), Pearson Education/Addison Wesley.
2. Henry F Korth, Abraham Silberschatz, S Sudharshan (2013). *Database System Concept*s (6th Edition), TMH.
3. CJ Date, A Kannan and S Swamynathan (2006). *An Introduction to Database Systems* (8th Edition), Pearson Education.

REFERENCE BOOKS:

1. **Raghu Ramakrishnan & Johannes Gehrke** (2002). *Database Management Systems* (3rd Edition). McGraw-Hill.
2. **Thomas Connolly & Carolyn Begg** (2014). *Database Systems: A Practical Approach to Design, Implementation, and Management* (6th Edition). Addison-Wesley.
3. **C. Mohan & C. S. S. R. Anjaneyulu** (2005). *Advanced Database Management Systems* (2nd Edition). Wiley-IEEE Press..

E- REFERENCES:

1. www.cse.iitb.ac.in/dbms/Data/Courses/CS632/
2. www.nptel.iitm.ac.in/video.php?subjectId=106106093
3. www.tutorialspoint.com/distributed_dbms/distributed_dbms_tutorial.pdf

DISCIPLINE SPECIFIC ELECTIVE III (B)

Course Title: DISTRIBUTED DATABASES

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On completing a course on distributed databases, students should be able to understand the advantages and disadvantages of distributed database systems.*
- *To compare different distributed database methods, and apply their knowledge to real-world problems.*
- *To analyze the characteristics of distributed database algorithms and model engineering problems using these algorithms.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand theoretical and practical aspects of distributed database systems.
CO2	Study and identify various issues related to the development of distributed database system.
CO3	Understand the design aspects of query processing and distributed query optimization
CO4	Understand the concepts of Transaction Management and Distributed concurrency control.
CO5	Understand the concepts of Distributed DBMS Reliability and Parallel Database Systems.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	2	3	3	3	3	3	3
CO 2	3	3	3	3	3	2	3	3	3	2	3
CO 3	3	3	3	3	3	2	3	3	3	2	3
CO 4	3	2	2	3	3	2	3	2	2	3	3
CO 5	3	2	2	3	3	3	3	2	2	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I: Introduction:** Distributed Data Processing - Promises of DDBs - Complicating Factors and Problem Areas. **Architecture of distributed systems:** Homogeneous – Heterogeneous - Client/server - Distributed Databases versus Replicated Databases.	9	CO1
2	**MODULE II: Distributed Database Design:** Alternative Design strategies - Distribution Design Issues – Fragmentation - Allocation. **Data and Access Control:** View management – Data security – Semantic Integrity Control	9	CO2
3	**MODULE III**: **Query processing:** Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data. **Distributed query Optimization:** Query optimization, centralized query optimization, distributed query optimization algorithms.	9	CO3
4	**MODULE IV: Transaction Management:** Definition - Properties of transaction - Types of transactions - **Distributed Concurrency Control:** Serializability, Concurrency Control Mechanisms & Algorithms, Time - Stamped & Optimistic Concurrency Control Algorithms, Deadlock Management.	9	CO4
5	**MODULE V**: **Distributed DBMS Reliability**: Reliability Concepts and Measures - Fault-Tolerance in Distributed Systems - Failures in Distributed DBMS - Local & Distributed Reliability Protocols - Site Failures and Network Partitioning. **Parallel Database System**s: Parallel Database System Architectures - Parallel Data Placement - Parallel Query Processing - Load Balancing - Database Clusters.	9	CO5

TEXT BOOKS:

1. M. Tamer OZSU and Patuck Valduriez. *Principles of Distributed Database Systems*, Pearson Edn. Asia, 2001.
2. Stefano Ceri and Giuseppe Pelagatti. *Distributed Databases*, Tata McGraw Hill.
3. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: "*Database Systems: The Complete Book*", Second Edition, Pearson International Edition

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry Korth, S, Sudarshan *Database system concepts*, 6th Edition, (McGraw Hill International)
2. Ray Chhanda, Distributed Database Systems, Khanna Publishing House.

E- REFERENCES:

1. https://www.slideshare.net/slideshow/principles-of-distributed-database-systemspdf/253016692
2. https://www.tutorialspoint.com/distributed_dbms/index.htm
3. https://www.scaler.com/topics/dbms/distributed-database-in-dbms/

DISCIPLINE SPECIFIC ELECTIVE III (C)

Course Title: CLOUD WEB SERVICES

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- Introducing cloud computing and Amazon web services.
- Understanding and using EC2 instances.
- Deploying and managing applications on AWS cloud.
- Using AWS security services.
- Implementing the networking concepts on AWS cloud

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To gain fundamental understanding of AWS cloud technologies.
CO2	Be able to start a Windows or Linux server in the cloud with its own private address.
CO3	Be able to start up a CRM / Word Press / etc. website hosted in cloud.
CO4	Be able to start a highly scalable MySQL or Oracle database in the cloud with multiple read-replica databases (for scalability of database)
CO5	Be able to setup a load-balancer in the cloud.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	2	3	3	3	3	3	3
CO 2	3	3	3	3	3	2	3	3	3	2	3
CO 3	3	3	3	3	3	2	3	3	3	2	3
CO 4	3	2	2	3	3	2	3	2	2	3	3
CO 5	3	2	2	3	3	3	3	2	2	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** INTRODUCTION TO CLOUD COMPUTING AND AMAZON WEB SERVICES Introduction to Cloud Computing, Cloud Service Delivery Models (IAAS, PAAS, SAAS), Cloud Deployment Models (Private, Public, Hybrid and CommMODULEy), Cloud Computing Security, Case Study-Introduction to Amazon Web Services, Why Amazon? Use Cases, AWS Storage Options, AWS Compute Options, AWS Database Options, AWS Workflow Automation and Orchestration Options, AWS Systems Management and Monitoring Options, AWS Virtual Private Cloud Introduction, Pricing Concepts	9	CO1
2	**MODULE II:** INTRODUCTION TO EC2 Introduction to EC2, Instance Types and Uses, Auto scaling Instances, Amazon Machine Images (AMIS), Modifying Existing Images, Creating New Images of Running Instances, converting an Instance Store AMI to an EBS AMI, Instances Backed by Storage Types, Elastic IPS, Elastic Load Balancing	9	CO2
3	**MODULE III:** WEB APPLICATIONS AND SECURITY Introduction to Elastic Beanstalk, Deploying Scalable Application On AWS, Selecting and Launching an Application Environment, Provisioning Application Resources with Cloud formation, Introduction to Cloud Lookout, Describe Amazon Cloud Watch metrics and alarms, AWS Messaging 93 Services (SNS, SQS, SES). Introduction to AWS Security, Describe Amazon Identity and Access Management (IAM), AWS Directory Service, AWS Key Management Service, Securing Data at Rest and in Motion.	9	CO3
4	**MODULE IV:** AWS STORAGE Amazon Storage, S3 Storage Basics, Buckets and Objects, Creating A Web Server Using S3 Endpoints, Managing Voluminous Information with EBS, Glacier Storage Service, Describe Amazon Dynamo, understand key aspects of Amazon RDS, Launch an Amazon RDS instance.	9	CO4
5	**MODULE V:** AWS NETWORKING Introduction to AWS Networking, Access Control Lists (ACLs), Setting Up a Security Group, Setting Up VPC and Internet Gateway, Setting Up A VPN, Setting Up a Customer Gateway for VPN, Setting Up Dedicated Hardware for VPC, Route53 for DNS System, Cloud front, Case Study.	9	CO5

TEXT BOOK

1. Joe Baron, Hisham Baz , Tim Bixler , Biff Gaut , Kevin E. Kelly , Sean Senior , John Stamper ,"AWS Certified Solutions Architect Official Study Guide: Associate Exam, John Wiley and Sons Publications, 2017
2. Yohan Wadia , "AWS Certified Solutions Architect Official Study Guide: Associate Exam, John Packt Publishing, 2016
3. Bernald Golden, "Amazon Web Services for Dummies", John Wiley & Sons, 2013

REFERENCE BOOK

1. **Thomas Erl** (2013). *Cloud Computing: Concepts, Technology & Architecture*. Prentice Hall.
2. **Rajkumar Buyya, Christian Vecchiola, & S.T. Selvi** (2013). *Mastering Cloud Computing: Foundations and Applications Programming*. Morgan Kaufmann.
3. **Lee Chao** (2014). *Cloud Computing: A Hands-On Approach*. CreateSpace Independent Publishing.

E-REFERENCES

1. **https://aws.amazon.com/training/**
2. **https://Google Cloud Docs/**
3. **https://learn.microsoft.com/en-us/training/**

DISCIPLINE SPECIFIC ELECTIVE IV (A)

Course Title: IoT AND ITS APPLICATIONS

Course Code :	**Credits**	**: 03**
L:T:P:S:3:1:0:0	**CIA Marks**	**: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- **On taking this course students will be able to assess the vision of IoT, understand the design methodology of IoT platforms.**
- **To classify real world IoT applications in various domains.**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students will be able to understand the vision of IoT
CO2	Students will be exemplifying the application of IoT in various domains
CO3	Students will be able to understand the differences and similarities between IoT and M2M
CO4	Students will be able to interpret the different IoT platforms design methodology
CO5	Students will be illustrating various IoT physical devices

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	1	1	3	2	1	3	3	3	2	2	3
CO 2	3	2	3	3	3	2	3	2	2	2	1
CO 3	3	3	3	2	3	1	3	2	2	3	2
CO 4	3	3	1	3	2	3	3	2	2	3	3
CO 5	3	3	2	2	2	2	3	3	3	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**INTRODUCTION TO INTERNET OF THINGS: Definition and characteristics of IoT- Physical design of IoT - Things in IoT - IoT Protocols - Logical Design of IoT - IoT functional blocks - IoT communication Models - IoT communication API's - IoT enabling Technologies Wireless sensor networks - Cloud Computing - Big Data Analytics - Communication protocols - embedded systems. IoT Levels and Deployment templates	9	CO1
2	**MODULE II:**DOMAIN SPECIFIC IOT: Home Automation – IoT in Cities, Environment – IoT in smart grids, retails, logistics – IoT in agriculture, Industry, health & lifestyle	9	CO2
3	**MODULE III:**IOT AND M2M: M2M - Difference between IoT and M2M - SDN and NFV for IoT- Software defined networking - network function virtualization .	9	CO3
4	**MODULE IV:**IOT PLATFORMS DESIGN METHODOLOGY: IoT Design and Methodology- Purpose and requirements specification - Process specification - Domain model specification - Information model specification - service specification - IoT level specification - functional view specification - Operational view specification - Device and component integration - application development	9	CO4
5	**MODULE V:**IOT PHYSICAL DEVICES AND ENDPOINTS: IoT device - Basic Building blocks of an IoT Device. Exemplary Device: Raspberry Pi - About the Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Other IoT devices.	9	CO5

TEXT BOOKS:

1. Internet of Things – A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011 3. Honbo Zhou,―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.

REFERENCES:

1. **Arshdeep Bahga & Vijay Madisetti (2014).** ***Internet of Things: A Hands-On Approach*****.**
2. **Oliver Hersent, David Boswarthick, & Omar Elloumi (2011).** ***The Internet of Things: Key Applications and Protocols*****. Wiley.**
3. **an Holler, Vlasios Tsiatsis, and David Mulligan (2014).** ***From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*****. Academic Press.**

E-REFERENCES:

1. http://www.tutorialspoint.com/internet_of_things/
2. http://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
3. https://www.smartgrid.gov/the_smart_grid/smart_grid.html

DISCIPLINE SPECIFIC ELECTIVE IV (B)

Course Title: HIGH SPEED NETWORKS

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course the student will be able*
- *To Understand evolution of communication and networking.*
- *To enhance future networks and principles of operation, Provide the various high speed digital access and broadband technologies, Performance issues and quality of service required for better performance of high speed networks.*
- *To develop an in-depth understanding, in terms of architecture, protocols and applications, of major high- speed networking technologies and Discusses logical, routing, Addressing, addressing, protocols and about ATM.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Identify the existing communication networks, understand the algorithm and technologies involved in internet and associated networks.
CO2	Develop specialized knowledge related to the building blocks and operation of high speed networking technology.
CO3	Demonstrate the knowledge of network planning and optimization
CO4	Apply the concepts to optimize and troubleshoot high speed network.
CO5	Use and assist in network design and implementation.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	2	2
CO 2	3	3	3	3	3	3	3	3	3	2	2
CO 3	3	3	3	3	3	3	3	3	3	2	2
CO 4	3	3	3	3	3	3	3	3	3	2	2
CO 5	3	3	3	3	3	3	3	3	3	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** High Speed Networks Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL High Speed LAN's: Fast Ethernet, Gigabit Ethernet, Fibre Channel – Wireless LAN's: applications, requirements – Architecture of 802.11	9	CO1
2	**MODULE II:** Congestion And Traffic Management Queuing Analysis – Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.	9	CO2
3	**MODULE III:** TCP And ATM Congestion Control TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management.	9	CO3
4	**MODULE IV:** Integrated And Differentiated Services: Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services.	9	CO4
5	**MODULE V:** Protocols For Qos Support – RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.	9	CO5

TEXT BOOKS:

1. William Stallings (2002). *High Speed Networks and Internet* (2nd Edition), Pearson Education, ISBN- 978-8177585698.
2. Warland, Pravin Varaiya (2001). *High Performance Communication Networks* (2nd Edition), Jean Harcourt Asia Pvt Ltd.
3. Irvan Pepelnjk, Jim Guichard and Jeff Apcar (2003). *MPLS and VPN Architecture*, Cisco Press

REFERENCE BOOKS:

1. **James F. Kurose & Keith W. Ross (2021). *Computer Networking: A Top-Down Approach* (8th Edition). Pearson.**
2. **William A. Hersh (2007). *High-Speed Networks: Design, Control, and Management*. Wiley.**
3. **R. K. Gupta (2018). *High-Speed Networks and Communication Systems*. PHI Learning.**

E- REFERENCES:

1. http://www.sterbenz.org/jpgs/tutorials/hsn/
2. https://www.slideshare.net/ayyakathir/unit1-29753217
3. http://pages.cpsc.ucalgary.ca/~carey/CPSC641/archive/Sept2005/

DISCIPLINE SPECIFIC ELECTIVE IV (C)

Course Title: SOCIAL NETWORK ANALYSIS

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- **On taking this course student will be able**
- **To Understand the concept of semantic web and its applications, learn knowledge representation using ontology. To**
- **Understand Social CommMODULEies and human behaviour in social web and related commMODULEies and also Learn visualization of social networks.**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students will be able to define the semantic web and the related applications
CO2	Students will be able to outline the knowledge using ontology
CO3	Students will be able to interpret the social commMODULEy and its organization.
CO4	Students will be able to identify human behaviour in social web and related commMODULEie
CO5	Students will be able to analyse social network

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2	2	2	2	3	3	3	3	2
CO 2	3	3	2	3	3	2	2	2	3	2	2
CO 3	3	3	2	3	3	3	3	3	3	2	2
CO 4	3	3	2	3	3	3	3	3	3	2	3
CO 5	3	3	2	3	3	3	3	3	3	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**INTRODUCTION: Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online commMODULEies - Web-based networks - Applications of Social Network Analysis	9	CO1
2	**MODULE II:**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data	9	CO2
3	**MODULE III:**EXTRACTION AND MINING COMMMODULEIES IN WEB SOCIAL NETWORKS: Extracting evolution of Web CommMODULEy from a Series of Web Archive - Detecting commMODULEies in social networks - Definition of commMODULEy - Evaluating commMODULEies - Methods for commMODULEy detection and mining - Applications of commMODULEy mining algorithms - Tools for detecting commMODULEies social network infrastructures and commMODULEies - Decentralized online social networks	9	CO3
4	**MODULE IV:**PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES: Understanding and predicting human behaviour for social commMODULEies - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - 129 Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons.	9	CO4
5	**MODULE V:**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS: Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - CommMODULEy welfare - Collaboration networks - Co-Citation networks.	9	CO5

TEXT BOOKS

1. 1 Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.
3. Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition Springer, 2011.

REFERENCES BOOKS:

1. 1. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
2. John G. Breslin, Alexandre Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009
3. **Wasserman, S., & Faust, K.** (1994). *Social Network Analysis: Methods and Applications*. Cambridge University Press

E- REFERENCES:

1. http://www.sterbenz.org/jpgs/tutorials/hsn/
2. https://www.slideshare.net/ayyakathir/unit1-29753217
3. http://pages.cpsc.ucalgary.ca/~carey/CPSC641/archive/Sept2005/

Course Title: **JAVA ENTERPRISE EDITION LAB**

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 50**

LEARNING OBJECTIVES:

- *On taking this course, student will be able*
- *To equip the students with the advanced feature of contemporary java,*
- *To enable them in handling complex programs relating to managing data and processes over the network,*
- *To provide a sound foundation on the concepts, precepts and practices, in a field that is of immense concern to the industry and business.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Invoke the remote methods in an application using Remote Method Invocation, Access database through Java programs, using Java Database Connectivity.
CO2	Manage sessions within an application and communication between sessions.
CO3	Implement and manage web sessions using Servlet and JSP. Handling Errors and Exceptions in any web application
CO4	Understanding Java Messaging Services done through javamail API.
CO5	Develop applications with database connectivity using JDBC

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2	3	2	3	3	2	3	3	3
CO 2	3	2	2	2	3	2	2	3	2	2	2
CO 3	3	2	2	3	2	2	3	3	2	3	2
CO 4	3	2	3	2	3	2	3	2	2	3	3
CO 5	3	3	3	3	2	3	3	2	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

1	a. Develop an RMI Application for arithmetic operations b. Simple Servlet Application with login page.	5	CO1
2	a. Design Web application using HTML and java servlet for session tracking and management using cookies, Hidden form field, URL rewriting, HTTP session. b. Display session details of any web application.	9	CO2
3	a. Implementation of JSP: student scoring system b. Implement exception handling using Error pages in JSP. c. Design web page using JSP and implement the concept of Java Bean in JSP	6	CO3
4	a. Design web page using HTML and java servlet pages for the implementation of inter servlet communication using Request Dispatcher.	7	CO4
5	a. MYSQL database connectivity using JDBC. b. Design a web page with options for sending email using Java mail API.	8	CO5

TEXT BOOKS:

1. Jason hunter, William Crawford (2011). *Java Server Programming* (2nd Edition), O'Reilly Media, Inc., ISBN: 9780596000400.
2. J McGovern, R Adatia, Y Fain (2003). *J2EE 1.4 Bible*, Wiley-dreamtech India Pvt Ltd.
3. H.Schildt (2002). *Java 2 Complete Reference* (5th Edition), TMH.

REFERENCE BOOKS:

1. K Moss (1999). *Java Servlets* (Second Edition), TMH.
2. Joseph O'Neil (1998) *Java Beans from the Ground Up*, TMH.
3. TomValesky (2000) *Enterprise JavaBeans,* Addison Wesley.

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1. https://www.tutorialspoint.com/servlets/servlets-first-example.htm
2. http://www.servlets.com/jservlet2/examples/
3. http://www.j2eetutorials.50webs.com/JSP_example1html

Course Title: DATA MINING LAB USING PYTHON

Course Code : **L:T:P:S: 0:0:5:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course the student will be able*
- *To create a Data Frame, load a dataset and perform data cleaning operations,*
- *To integrate data from different sources,*
- *To select the relevant data and remove the irrelevant data,*
- *To perform classification using classification algorithms and apply clustering algorithms to cluster the data.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Perform Data Cleaning, Data Integration
CO2	Perform Data Transformation
CO3	Remove Outliers
CO4	Perform Association Mining
CO5	Do Classification using Classification algorithms

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S. No	CONTENTS OF MODULE	Hrs	COs
1	Data Preprocessing and Data Integration	9	CO1
2	Programs using Min max Normalization, Zscore Normalization	9	CO2
3	Programs to remove Outliers	9	CO3
4	Programs using Association Mining	9	CO4
5	Programs using Naïve Bayes Classification, Decision Tree Classification, Clustering using Kmeans and Agglomerative.	9	CO5

TEXT BOOKS:

4. Jiawei Han, Micheline Kamber, Jian Pei (2008). *Data Mining: Concepts and Techniques* (2nd edition), Morgan Kaufmann, ISBN- 9780123814791
5. Dunham MH, (2003). *Data Mining: Introductory and Advanced Topics*, Pearson Education.
6. Paulraj Ponnaiah, (2001). *Data Warehousing Fundamentals*, Wiley Publishers.

REFERENCE BOOKS:

4. Dunham MH, (2003). *Data Mining: Introductory and Advanced Topics*, Pearson Education.
5. Paulraj Ponnaiah, (2001). *Data Warehousing Fundamentals*, Wiley Publishers.
6. SN Sivananda and S Sumathi, (2006). *Data Mining*, Thomsan Learning, Chennai

E- REFERENCES:

4. https://onlinecourses.nptel.ac.in/noc21_cs06/preview/
5. https://www.udemy.com/fundamentals-of-data-mining/
6. https://www.coursera.org/specializations/data-mining/

Course Title: SPOKEN TUTORIAL - LINUX

S.No	CONTENTS OF MODULE
1	Ubuntu Desktop- Desktop Customization- Synaptic Package Manager- Ubuntu Software Center- Basic Commands- General Purpose Utilities in Linux- File System- Working with Regular Files- File Attributes- Redirection Pipes- Working with Linux Process- The Linux Environment- Basics of System Administration- Simple filters- The grep command- More on grep command- The sed command- More on sed command- Basics of AWK.

Note:

Courses Offered by IIT Mumbai through Spoken Tutorial Projects MHRD, Government of India. At the end of the course Online Examination will be conducted for 45 minutes and qualified students (Minimum passing 40%) will be issued certificate by IIT, Mumbai.

Spoken Tutorial – 1 credit

THIRD SEMESTER

Course Title

CORE COURSE VII: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNIQUES

Course Code : **L:T:P:S:4:0:0:0**	**Credits** **CIA Marks**	**: 04** **: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- Detailed understanding of the history of artificial intelligence (AI) and its foundations. Explaining the current scope, potential, limitations, and implications of intelligent systems.
- Exploring the current scope, potential, limitations, and implications of intelligent systems
- Understand the basics of Machine Learning and data cleaning.
- know about the implementation of training models..
- Implement the concepts of decision trees, dimensionality reduction,clustering and preprocessing techniques in Machine Learning

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
CO2	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them
CO3	Impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
CO4	Understand the Machine learning types and its main challenges and Perform Data cleaning.
CO5	Describe and know about various data classification and Training models .

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	2	3	3	3	3	2
CO 2	3	2	3	3	3	3	3	2	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	2	3	3
CO 5	3	3	2	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**Introduction of Artificial Intelligence: Overview of Artificial Intelligence – Knowledge: General Concepts – Lisp and other AI Programming Languages. Knowledge Representation – Formalized Symbolic logics – Dealing with Inconsistencies and Uncertainties – Probabilistic Reasoning. Structured Knowledge : Graphs, Frames and Related Structures – Object – Oriented Representations	9	**CO1**
2	**MODULE II:**Knowledge Organization and Manipulation: Search and control Strategies - Matching Techniques - Knowledge Organization and Management. Perception and Communication: - Natural Language Processing - Pattern Recognition - visual Image Processing. Expert System Architecture: Rule-Based System Architecture - Non-Production System Architecture.	9	**CO2**
3	**MODULE III:**The Machine Learning Landscape : Introduction - Types of Machine Learning Systems - Supervised/Unsupervised Learning, Batch and Online Learning, InstanceBased Versus Model-BasedLearning - Main Challenges of Machine Learning - Nonrepresentative Training Data, Poor-Quality Data - Underfitting the Training Data - Testing and Validating - Frame the Problem - Select a Performance Measure - Check the Assumptions - Create a Test Set - Visualizing Geographical Data- correlation - Prepare the Data for Machine Learning Algorithms.	9	**CO3**
4	**MODULE IV:**Data Cleaning - Handling Text and Categorical Attributes- Feature ScalingTransformation Pipelines- Select and Train a Model- Training and Evaluating on the Training Set- Fine-Tune Your Model- Grid Search- Randomized Search. Classification: MNIST- Training a Binary Classifier- Performance MeasuresMeasuring Accuracy Using Cross-Validation- Confusion Matrix- Precision and Recall – Multiclass, multi-label and multi-output classification	9	**CO4**
5	**MODULE V:**Training Models: Linear Regression- The Normal Equation- Computational Complexity- Gradient and batch gradient Descent- Stochastic Gradient DescentMini-batch Gradient Descent-Polynomial Regression- Learning Curves- Ridge Regression- Lasso Regression- Logistic Regression- Estimating ProbabilitiesTraining and Cost Function- Decision Boundaries.	9	**CO5**

TEXT BOOKS:

1. 1. Dan W. Patterson," Introduction to Artificial Intelligence and Expert System", 2005, PHI Learning.
2. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron, 2019Aurélien Géron. Published by O'Reilly Media, Inc.
3. **Stuart Russell & Peter Norvig** (2020). *Artificial Intelligence: A Modern Approach* (4th Edition). Pearson

REFERENCE BOOKS:

1. Machine Learning Step-by-Step Guide to Implement Machine Learning Algorithms with Python ByRudolph Russell-Copyright 2018.
2. Machine learning for dummies, John Paul Muller, Luca Massaron, Weily, 2 nd Edition, 2021.
3. **Ethem Alpaydin** (2016). *Introduction to Machine Learning* (4th Edition). MIT Press.

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1. http://www.ddegjust.ac.in/studymaterial/mca-5/mca-402.pdf.
2. https://hooshio.com/wp-content/uploads/2021/12/2-Aurelien-Geron-Hands-On-Machine-Learning-with-Scikit-Learn-Keras-and-Tensorflow_-Concepts-Tools-and-Techniques-to-Build-Intelligent-Systems-OReilly-Media-2019.pdf

Course Title

CORE COURSE VIII: DOT NET TECHNOLOGY

Course Code : **L:T:P:S:4:0:0:0**	**Credits** **CIA Marks**	**: 04** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course, student will be able*
- *To gain knowledge on concepts of .NET environment and C# basics,*
- *To create console application in C# using object-oriented concepts, to integrate C# and ASP.NET in developing web application,*
- *To build a web application using database connectivity,*
- *To construct a web application with enhanced Add-on services which includes web services, cookies and session*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Acquire the knowledge of the .NET environment. Expertise the fundamental concepts in developing the basics of C# programming
CO2	Develop, compile and execute console application in C# using object-oriented concepts. Construct console application in C# program using delegates and events
CO3	Build a web application in ASP.NET using web server controls
CO4	Demonstrate web application with database connectivity
CO5	Integrate web application using cookies, sessions and web services

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	2	3	2	3	3	2	3	2	2
CO 2	3	3	3	3	2	3	2	3	2	3	2
CO 3	3	2	2	3	2	3	3	3	2	3	2
CO 4	3	2	3	2	2	3	3	3	2	3	2
CO 5	3	2	2	3	2	3	3	3	2	2	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** Introduction to .NET – Overview of C#, Literals, Variables, Data Types, Operators and Expressions, Branching, Looping, Methods, Arrays and Structures, Enumerations.	9	CO1
2	**MODULE II:** Classes, Objects, Inheritance, Interfaces, Delegates, Events, Errors and Exceptions.	9	CO2
3	**MODULE III:** Programming Web Applications with Web Forms – Standard Web server Controls – Label, Textbox, Button, Link Button, Image, Image map, Links, Check & Radio button. Rich controls – Calendar, Ad Rotator – List Controls – Check box list, Radio button list, Drop down list, List box, Data controls – Data grid, Repeater – Validation Controls.	9	CO3
4	**MODULE IV**: Working with Data – OLEDB connection class, command class, data adaptor class, data reader – data set class – Web services.	9	CO4
5	**MODULE V:** Session & Application Object: Application Object – global.asa file, Webconfig files – creating & reading application variables, Session object – introduction, storing session-information, contents & identifying session, controlling when session ends, creating & reading cookies.	9	CO5

TEXT BOOKS:

1. E Balagurusamy (2004). *Programming in C#* (3rd edition), Tata McGraw-Hill India. ISBN 9780070702073
2. Stephen Walter (2006). *Asp.net 2.0 Unleashed*, (1st edition), Pearson Education, ISBN 978-8131703236
3. Greg Buczek (2010). *ASP.NET Developer's guide* (1st edition), Tata McGraw-Hill India, ISBN 978-0070499171

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1. Herbert Schildt (2010). *The Complete Reference: C#4.0*, Tata McGraw-Hill Education India ISBN: 9780070703681.
2. Mathew Macdonald (2017). *ASP.NET: The Complete Reference,* McGraw Hill Education, ISBN 978-0070495364
3. Bill Evjen, Scott Hanselman, Devin Rader (2008). *Professional ASP.NET 3.5 In C# and VB* (Pap/Psc edition), Wrox publishers, ISBN 978-0470187579
4. Dino Sposito (2019). *Programming ASP.NET Core*, PHI learning | Microsoft Press, ISBN 978-9388028431

E- REFERENCES:

1. http://www.csharp-station.com/tutorial.aspx
2. http://www.tutorialspoint.com/csharp
3. http://asp.net-tutorials.com
4. http://www.aspnetbook.com

Course Title

CORE COURSE IX: BIG DATA ANALYTICS

Course Code : **L:T:P:S:4:0:0:0**	**Credits** **CIA Marks**	**: 04** **: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking the course, the students will be able*
- *To demonstrate the insight of an exciting growing field of Big Data analytics. They Gain analytical challenges traditional data mining algorithms face when analyzing Big Data,*
- *To prove the building initiative of Hadoop, NoSql, MapReduce,*
- *To Derive the coding to manage and analyze big data like Hadoop, NoSql, MapReduce.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Knows the reason about the evolution of data science and its development. Study the basics of big data analytics and develop the code. Importance of various kinds of data comparing the other language.
CO2	Develop HDFS environment using NOSQL Implementing the queries. Aggregate the data using NOSQL
CO3	Concept of basic Hadoop, data format and analysing the data in the HDFS environment. Implementing the concept Hadoop pipes and implementations and java interfaces Significance of various methods of compression, serialization
CO4	Apply Mapreduce applications, MODULE test , MRMODULE, Create a file using Mapreduce sorting and shuffling process. Creating input and output format of Mapreduce.
CO5	Usage Hadoop related tools. Definition of hbase,Hbase clients, Cassandra, Pig, HiveQL Life Build data manipulation byHiveQL queries.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	2	2	2	2	3	2	2	2	2
CO 2	3	3	2	2	3	1	1	3	3	3	2
CO 3	3	2	2	2	3	2	2	3	2	3	2
CO 4	2	3	2	2	2	2	2	2	2	2	3
CO 5	3	3	2	2	3	2	2	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MOUDLE I:U**nderstanding big data: What is big data – why big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine.	9	CO1
2	**MOUDLE II:**Nosql data management: Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency – version stamps – map-reduce – partitioning and combining – composing map-reduce calculations.	9	CO2
3	**MOUDLE III:**Basics of Hadoop: Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures.	9	CO3
4	**MOUDLE IV:**Mapreduce applications: Mapreduce workflows – MODULE tests with MRMODULE – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.	9	CO4
5	**MOUDLE V:**Hadoop related tools: hbase – data model and implementations – Hbase clients – Hbase examples – praxis.Cassandra – cassandra data model – cassandra examples – cassandra clients. Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.	9	CO5

TEXT BOOKS:

1. Minelli, M., Chambers, M., & Dhiraj, A. (2013). *Big data, big analytics: emerging business intelligence and analytic trends for today's businesses*. John Wiley & Sons.Michael, ISBN no: 9781118-14760-354995
2. Sadalage, P. J., & Fowler, M. (2013). *NoSQL distilled: a brief guide to the emerging world of polyglot persistence*. Pearson Education. ISBN no: 13:978-0-321-82662-6
3. Tom White, **(**2012). *Hadoop: The Definitive Guide*, (Third Edition), O'Reilley. ISBN no: 978-1-491-90163-2
4. Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman (2011) for Mining of Massive Datasets. Third edition.

REFERENCE BOOKS:

1. Lars George, (2011). *HBase: The Definitive Guide*, (First Edition) O'Reilley. ISBN no:10 144396100
2. Eben Hewitt, (2010). *Cassandra: The Definitive Guide*, (First Edition) O'Reilley. ISBN no :9781491933664
3. Eric Sammer, (2012). *Hadoop Operations*, (First Edition) O'Reilley., ISBN no: 978-1149327057

E- REFERENCES:

1. Hadoop: http://hadoop.apache.org/,
2. Hadoop:https://www.edureka.co/blog/hadoop-tutorial
   Hive: https://cwiki.apache.org/confluence/display/Hive/Home

MULTI DISCIPLINE ELECTIVE/OPEN ELECTIVE I (A)

Course Title: Cyber Forensics

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking the course, the students will be able*
- To equip individuals with the knowledge and skills to identify, preserve, analyze,
- To present digital evidence for investigations and prosecutions of cybercrimes, encompassing both technical and legal aspects.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To define the concepts and principles of collecting and analyzing the digital evidence
CO2	To get an adequate knowledge on the technology and laws needed to do digital forensics.
CO3	To get the basics understanding of information..
CO4	To know the artifacts of the cybercrimes.
CO5	To understand the best practices and examination guidelines for handling a crime scene

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2	2	2	2	3	3	3	3	2
CO 2	3	3	2	3	3	2	2	2	3	2	2
CO 3	3	3	2	3	3	3	3	3	3	2	2
CO 4	3	3	2	3	3	3	3	3	3	2	3
CO 5	3	3	2	3	3	3	3	3	3	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**Digital Investigation Digital Evidence and Computer Crime - History and Terminology of Computer Crime Investigation - Technology and Law - The Investigative Process - Investigative Reconstruction - Modus Operandi, Motive and Technology - Digital Evidence in the Courtroom.	9	CO1
2	**MODULE II:**Understanding information Methods of storing data: number systems, character codes, record structures, file formats and file signatures - Word processing and graphic file formats - Structure and Analysis of Optical Media Disk Formats - Recognition of file formats and internal buffers used by the most common CD and DVD writing applications - Extraction of forensic artifacts with a view to establishing possible provenance of a CD or DVD	9	CO2
3	**MODULE II:**Computer Basics for Digital Investigators- Computer Forensic Fundamentals - Applying Forensic Science to computers - Computer Forensic Services - Benefits of Professional Forensic Methodology - Steps taken by computer forensic specialists.	9	CO3
4	**MODULE II:**Types of Computer Forensics : Tools and Types of Military Computer Forensics Technology - Tools and Types of Law Enforcement Computer Forensic Technology - Tools and Types of Business Computer Forensic Technology	9	CO4
5	**MODULE II:**Standards, Guidelines and Best Practices Handling the Digital Crime Scene - Digital Evidence Examination Guidelines – ACPO – IOCE – SWGDE – DFRWS – IACIS – HTCIA - ISO 27037	9	CO5

TEXT BOOKS

1. Computer Forensics: Cyber Criminals, Laws and Evidence by Marie-Helen Maras, 1st edition, Jones and Bartlett Publishers, 1 February 2011
2. Computer Forensics, Computer Crime Scene Investigation by John.R.Vacca, 2nd Edition, Charles River Media Publication, 15 June 2002
3. Handbook of Digital Forensics by Eoghan Casey, 2010, Elsevier

REFERENCES

1. Cyber Forensics: A field manual for collecting, Examining, preserving evidence of computer crimes by Albert Marcella, Jr., Doug Menendez, Second Edition, CRC Press 2007.
2. Guide to Computer Forensics and Investigations, Processing Digital Evidence by Bill Nelson, Amelia Phillips, Christopher Steuart, 4th edition, Delmar Cengage Learning, 28 Oct 2009.
3. Digital Forensics for Legal Professionals - Understanding Digital Evidence from the Warrant to the Courtroom by Larry Daniel, Lars Daniel, 1st edition, Syngress, 14 October 2011.

E- REFERENCES:

1. https://www.cyberforensics.in
2. https://www.splunk.com/en_us/blog/learn/cyber-forensics.html
3. https://gifsa.ac.in/digital-and-cyber-forensic.

MULTI DISCIPLINE ELECTIVE/OPEN ELECTIVE I (B)

Course Title: Ethical Hacking

Course Code :	**Credits**	**: 03**
L:T:P:S:3:1:0:0	**CIA Marks**	**: 50**
Exam Hours :3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking the course, the students will be able*
- **To equip individuals with the knowledge and skills to identify, preserve, analyze,**
- **To present digital evidence for investigations and prosecutions of cybercrimes, encompassing both technical and legal aspects.**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To define the concepts and principles of collecting and analyzing the digital evidence
CO2	To get an adequate knowledge on the technology and laws needed to do digital forensics.
CO3	To get the basics understanding of information..
CO4	To know the artifacts of the cybercrimes.
CO5	To understand the best practices and examination guidelines for handling a crime scene

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2	2	2	2	3	3	3	3	2
CO 2	3	3	2	3	3	2	2	2	3	2	2
CO 3	3	3	2	3	3	3	3	3	3	2	2
CO 4	3	3	2	3	3	3	3	3	3	2	3
CO 5	3	3	2	3	3	3	3	3	3	3	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:**INTRODUCTION :Ethical Hacking Overview – Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land – Overview of TCP/IP- The Application Layer – The Transport Layer – The Internet Layer – IP Addressing .- Network and Computer Attacks – Malware – Protecting Against Malware Attacks.- Intruder Attacks – Addressing Physical Security.	9	CO1
2	**MODULE II:**FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKSFootprinting Concepts – Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email – Competitive Intelligence – Footprinting through Social Engineering - Footprinting Tools – Network Scanning Concepts – Port-Scanning Tools – Scanning Techniques – Scanning Beyond IDS and Firewall	9	CO2
3	**MODULE III:**ENUMERATION AND VULNERABILITY ANALYSIS :Enumeration Concepts – NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration – Vulnerability Assessment Concepts – Desktop and Server OS Vulnerabilities -Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss	9	CO3
4	**MODULE IV:**SYSTEM HACKING:Hacking Web Servers – Web Application Components- Vulnerabilities – Tools for Web Attackers and Security Testers Hacking Wireless Networks – Components of a Wireless Network – WardrivingWireless Hacking – Tools of the Trade	9	CO4
5	**MODULE V:**NETWORK PROTECTION SYSTEMS 6Access Control Lists. – Cisco Adaptive Security Appliance Firewall – Configuration and Risk Analysis Tools for Firewalls and Routers – Intrusion Detection and Prevention Systems – Network-Based and Host-Based IDSs and IPSs – Web Filtering – Security Incident Response Teams – Honeypots.	9	CO5

TEXT BOOKS

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2. The Basics of Hacking and Penetration Testing – Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3. Hacking-The Art of Exploitation by John Erickson,2nd Edition.

REFERENCES

1. Black Hat Python: Python Programming for Hackers and Pen testers, Justin Seitz, 2014.
2. Hacking: A Beginner's Guide to Learn and Master Ethical Hacking with Practical Examples to Computer, Hacking, Wireless Network, Cybersecurity and Penetration Test by Peter Bradley.
3. Computer Hacking Beginners Guide: How to Hack Wireless Network, Basic Security and Penetration Testing-ALAN.T. Norman.

E- REFERENCES:

1. http://www.informatica64.com/foca.aspx.
2. http://www.tenable.com/products/nessus.
3. http://www.fastandeasyhacking.com/.

MULTI DISCIPLINE ELECTIVE/OPEN ELECTIVE I (C)
Course Title: INFORMATION SECURITY

Course Code : **L:T:P:S:3:1:0:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 100**

LEARNING OBJECTIVES:

- *On taking this course the student will be able*
- *To understand and revise the common threats faced today,*
- *To understand the foundational theory behind information security and analyze What are the basic principles and techniques when designing a secure system,*
- *To apply attacks and defenses work in practice and how to assess threats for their significance and how to gauge the protections and limitations provided by today's technology.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand Information Security Principles such as security attacks and services.
CO2	Design Terms, concepts related to public key cryptography and digital signatures.
CO3	Apply the Concepts of various privacy methods.
CO4	Analyse Typical Network Attacks and Threats from the Internet.
CO5	Create SNMP, Firewall design Principles and Intrusion detection system.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	2	3
CO 2	3	3	3	3	3	3	3	3	3	2	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	2	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I:** Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms.	9	CO1
2	**MODULE II:** Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos,X.509 Directory Authentication Service	9	CO2
3	**MODULE III:** Email privacy: Pretty Good Privacy (PGP) and S/MIME.P Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management	9	CO3
4	**MODULE IV:** Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET	9	CO4
5	**MODULE V:**Basic concepts of SNMP, SNMPv1 CommMODULEy facility and SNMPv3, Intruders, Viruses and related threats Firewall Design principles, Trusted Systems, Intrusion Detection Systems	9	CO5

TEXT BOOKS:

1 **William Stallings (2008).** ***Network Security Essentials (Applications and Standards),*** **Pearson Education.**

2 **Chris McNab(2016).** ***Network Security*** **(3rd edition), O'Reilly Media.**

3 **Joseph Migga Kizza (2014).** ***Computer Network Security,*** **Springer International Publishing.**

REFERENCE BOOKS:

1. **Eric Maiwald(2004).** ***Fundamentals of Network Security,*** **Dreamtech press.**
2. **CharlieKaufman, Radia Perlman and Mike Speciner.** ***Network Security – Private Communication in a Public World*** **(Second Edition), Pearson/PHI.**
3. **Chuck Easttom (2018).** ***Computer Security Fundamentals*** **(5th Edition). Pearson.**

E-REFERENCES:

1. **https://www.wiley.com/en-us/Securing+the+Internet+of+Things%3A+A+Systematic+Approach+to+Cybersecurity-p-9781118754095**
2. **https://www.openvas.org/**
3. **www.FutureLearn.com**

Course Title: DOT NET TECHNOLOGY LAB

Course Code : **L:T:P:S:0:0:5:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 50**

LEARNING OBJECTIVES:

- *On taking this course, student will be able*
- *To develop simple console applications using control flow, loops, arrays,*
- *To create console application using strings, delegates and events,*
- *To design and develop console applications using object-oriented concepts,*
- *To create simple web page using ASP.NET, to design a website utilizing database and connect to the database from ASP.NET, to develop web application using cookies, sessions and Web services.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Design the algorithm
CO2	Develop console application using C#
CO3	Build and develop web-application using ASP.NET controls and validations
CO4	Develop web application using ASP.NET incorporating database connection
CO5	Develop web application using ASP.NET using cookies and session

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	3	2	2	3	2	2	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	2
CO 3	3	2	2	3	2	3	3	3	2	3	2
CO 4	3	2	3	2	2	3	3	3	2	3	2
CO 5	3	2	2	3	2	3	3	3	2	2	2

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**C#** 1. Creating a simple Console application 2. Programs using Array and Array List 3. Programs using string 4. Create a console application containing classes and Inheritance 5. Programs using Interface 6. Programs using Structures and Enumerations 7. Create a console application to implement delegates 8. Create a console application for exception handling	23	CO1, CO2
2	1. Create a Website containing various standard controls 2. Create a Webform that demonstrate using Validator controls 3. Create a Website that contains AdRotator and Calendar controls. 4. Create a Web application using Data Base Connections 5. Create a Web application using web services	22	CO3, CO4, CO5

TEXT BOOKS:

1. E Balagurusamy (2004). *Programming in C#* (3rd edition), Tata McGraw-Hill India. ISBN 9780070702073
2. Stephen Walter (2006). *Asp.net 2.0 Unleashed*, (1st edition), Pearson Education, ISBN 978-8131703236
3. Greg Buczek (2010). *ASP.NET Developer's guide* (1st edition), Tata McGraw-Hill India, ISBN 978-0070499171

REFERENCE BOOKS:

1. Herbert Schildt (2010). *The Complete Reference: C#4.0*, Tata McGraw-Hill Education India ISBN: 9780070703681.
2. Mathew Macdonald (2017). *ASP.NET: The Complete Reference*, McGraw Hill Education, ISBN 978-0070495364
3. Bill Evjen, Scott Hanselman, Devin Rader (2008). *Professional ASP.NET 3.5 In C# and VB* (Pap/Psc edition), Wrox publishers, ISBN 978-0470187579
4. Dino Sposito (2019). *Programming ASP.NET Core*, PHI learning | Microsoft Press, ISBN 978-9388028431

E- REFERENCES:

1. http://www.csharp-station.com/tutorial.aspx
2. http://www.tutorialspoint.com/csharp
3. http://asp.net-tutorials.com
4. http://www.aspnetbook.com

Course Title: BIG DATA ANALYTICS LAB

Course Code : **L:T:P:S:0:0:5:0**	**Credits** **CIA Marks**	**: 03** **: 50**
Exam Hours : 3	**ESE Marks**	**: 50**

LEARNING OBJECTIVES:

- *On taking the course, the students will be able*
- *To demonstrate the insight of an exciting growing field of Big Data analytics. They can derive the scripts of Hadoop, NoSql, MapReduce to develop the knowledge of data science.*
- *To derive the coding, manage and analyze big data like Hadoop, No Sql, MapReduce. Practice big data analytics and machine learning approaches, which include the study of modern computing big data technologies.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Derive the steps of algorithms for every exercise.
CO2	Scaling up machine learning techniques focusing on industry applications.
CO3	Exhibit the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
CO4	Implementation of big data analytics
CO5	Practice bigdata tools Pig, Hive etc.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	2	2	2	2	3	3	3	3	3
CO 2	3	3	3	3	3	3	1	3	3	3	2
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	2	3	2	2	2	2	2	2	2	2	3
CO 5	3	3	2	2	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, fully distributed Use web based tools to monitor your Hadoop setup.	9	**CO1**
2	Implement the following file management tasks in Hadoop: a) Adding files and directories b) Retrieving files Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.	9	**CO2**
3	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	9	**CO3**
4	Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.	9	**CO4**
5	Implement Matrix Multiplication with Hadoop Map Reduce Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.	9	**CO5**

TEXT BOOKS:

1. Minelli, M., Chambers, M., & Dhiraj, A. (2013). *Big data, big analytics: emerging business intelligence and analytic trends for today's businesses*. John Wiley & Sons.Michael, ISBN no: 9781118-14760-354995
2. Sadalage, P. J., & Fowler, M. (2013). *NoSQL distilled: a brief guide to the emerging world of polyglot persistence*. Pearson Education. ISBN no: 13:978-0-321-82662-6
3. Tom White, **(**2012). *Hadoop: The Definitive Guide*, (Third Edition), O'Reilley. ISBN no: 978-1-491-90163-2
4. Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman (2011) for Mining of Massive Datasets. Third edition.

REFERENCE BOOKS:

1. Lars George, (2011). *HBase: The Definitive Guide*, (First Edition) O'Reilley. ISBN no:10 144396100
2. Eben Hewitt, (2010). *Cassandra: The Definitive Guide*, (First Edition) O'Reilley. ISBN no :9781491933664
3. Eric Sammer, (2012). *Hadoop Operations*, (First Edition) O'Reilley., ISBN no: 978-1149327057

E- REFERENCES:

1. Hadoop: http://hadoop.apache.org/,
2. Hadoop:https://www.edureka.co/blog/hadoop-tutorial
3. Hive: https://cwiki.apache.org/confluence/display/Hive/Home

SKILL ENHANCEMENT COURSE – DISCIPLINE SPECIFIC I
Course Title: NUMERICAL APTITUDE

Course Code :	**Credits**	**: 05**
L:T:P:S:3:0:0:0	**CIA Marks**	**: 50**
Exam Hours :	**ESE Marks**	**: 50**

LEARNING OBJECTIVES:

- *To develop a student's ability to solve numerical problems with speed and accuracy*
- *Equip students with various methods and strategies to efficiently solve different types of aptitude problems.*
- *The course aims to help students build a strong foundation in mathematics and improve their problem-solving skill.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	• Understanding of Different Number Types,conversions • Apply the concepts of HCF and LCM to real-world problems, such as:Scheduling events etc
CO2	• Able to translate real-life scenarios into mathematical expressions and equations, and solve a wide range of word problems efficiently
CO3	• Understand how to interpret the data and analyse the data
CO4	• Understand how to express work in terms of rate, such as the work completed per MODULE of time.
CO5	• Able to calculate distance and speed with short tricks

Mapping of Course Outcomes to Program Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	2	2
CO 2	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	2	3
CO 4	3	3	3	3	3	2	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

S.No	CONTENTS OF MODULE	Hrs	COs
1	**MODULE I**: **Number Systems:** Understanding different types of numbers, divisibility rules, and operations, LCM and HCF. **Averages**: Calculating and applying averages in data sets.	6	**CO1**
2	**MODULE II**: **Arithmetic**: **Ratio and proportion**: Understanding and applying ratios, direct and inverse proportions. **Percentages**- Calculating percentages, percentage increase/decrease and applications.	6	**CO2**
3	**MODULE III**: **Profit and Loss:** Calculating profit, loss, and selling price. **Simple and Compound Interest**: Understanding and calculating interest. **Data Interpretation:** Analysing data presented in tables, charts, and graphs.	6	**CO3**
4	**MODULE IV**: **Time and Work:** Calculating work efficiency, combined work problems, and time taken- **Permutations and Combinations**: Basics of Understanding arrangements and selections.	6	**CO4**
5	**MODULE V**: **Time, Speed, and Distance:** Calculations involving speed, time, and distance relationships	6	**CO5**

TEXT BOOK:

1. "**QUANTITATIVE APTITUDE**" by R.S. Aggarwal: A comprehensive book covering various topics and practice questions.
2. "**Quantitative Aptitude for Competitive Examinations**" by Trishna's

REFERENCE BOOK:

1. "**Quantitative Aptitude for Competitive Examinations**" by K.K. Kapoor.

E- REFERENCES:

1. https://www.learntheta.com/aptitude-syllabus-placement/
2. https://ambitiousbaba.com/quantitative-aptitude-topic-wise-pdf-download-here/

Course Title: SPOKEN TUTORIAL - JAVA

S.No	CONTENTS OF MODULE
1	Getting started java Installation – First Java Program – Installing Eclipse – Getting started Eclipse-Hello World Program in Eclipse – Errors and Debugging in Eclipse – Programming features Eclipse – Numerical Datatypes – Arithmetic Operations – Strings – Primitive type conversions – Relational Operations – Logical Operations – if else – Nested if – switch case – while loop – For loop – do while – introduction to Array – Array operations – creating class – creating object – instance fields – Methods – Default constructor – Parameterized constructors – using this keyword – Non static block – Constructor overloading – Method overloading – userinput – subclassing and method overriding – Calling methods of the superclass – Using final keyword – Polymorphism – Abstract Classes – Java Interfaces – Static Variables – Static Methods – Static Blocks.

Note:

Courses Offered by IIT Mumbai through Spoken Tutorial Projects MHRD, Government of India. At the end of the course Online Examination will be conducted for 45 minutes and qualified students (Minimum passing 40%) will be issued certificate by IIT, Mumbai.

Spoken Tutorial – 1 credit

FOURTH SEMESTER

Course Title

PROJECT & VIVA-VOCE

Course Code :	**Credits**	**: 05**
L:T:P:S:	**CIA Marks**	**: 50**
Exam Hours : 3	**ESE Marks**	**: 50**

LEARNING OBJECTIVES:

- *On taking the course, the students will be able*
- *To Implement the solution for the chosen problem using the concepts and the techniques learnt in the curriculum, Identify, formulate and implement computing solutions,*
- *To Design and conduct experiments, analyze and interpret data, Record the result, demonstrate skills to use modern tools, software and equipments to analyse the chosen problem.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate a depth of knowledge of modern technology.
CO2	Complete an independent research project, resulting in dissertation.
CO3	Communicate effectively and to present ideas clearly and coherently to specific audience in both the written and oral forms.
CO4	Self-study, reflect on their learning and take appropriate actions to improve it.
CO5	Communicate effectively to publish paper

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

SKILL ENHANCEMENT COURSE – DISCIPLINE SPECIFIC II
COURSE TITLE- LOGICAL REASONING AND VERBAL ABILITY

Course Code :	**Credits**	**: 03**
L:T:P:S:3:0:0:0	**CIA Marks**	**: 50**
Exam Hours :	**ESE Marks**	**: 50**

COURSE OBJECTIVES:

- To enhance logical thinking and analytical reasoning abilities.
- To develop problem-solving and decision-making skills.
- To build effective communication skills and verbal aptitude.
- To prepare students for competitive exams and campus placements.
- To improve reading comprehension and vocabulary.

CO1	Understand and apply basic concepts of logical reasoning
CO2	Analyse number series, letter series, and analogies
CO3	Evaluate complex logical puzzles and deduction problems
CO4	Develop and improve verbal skills sentence correction, and usage
CO5	Apply comprehension techniques and vocabulary-building methods for effective communication

Mapping of Course Outcomes to Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	3	2	2	2	3	2	2	1	1
CO2	3	3	3	2	2	2	3	3	2	1	2
CO3	3	3	3	3	3	2	3	2	3	2	2
CO4	2	2	2	2	2	3	2	2	1	3	3
CO5	2	3	2	2	3	3	2	3	2	3	3

CORRELATION:3-STRONG,2-MEDIUM,1-LOW

Sl No.	Contents of Module	Hrs	COs
1	**MODULE I:**Introduction to Logical Reasoning: Basics of logic, deductive and inductive reasoning, statements and assumptions, conclusions, arguments, syllogism.	6	CO1
2	**MODULE II:**Analytical Reasoning: Number series, letter series, blood relations, directions.	6	CO2
3	**MODULE III:**Critical Reasoning & Puzzle Solving: Logical puzzles, coding-decoding, seating arrangements, input-output, data sufficiency, cause and effect.	6	CO3
4	**MODULE IV:**Verbal Ability - sentence correction, idioms and phrases, , word analogy, synonyms & antonyms, one-word substitution.	6	CO4
5	**MODULE V:**Verbal Ability - Comprehension & Vocabulary: Reading comprehension, para jumbles, sentence completion.	6	CO5

TEXT BOOKS

1. R.S. Aggarwal, A Modern Approach to Logical Reasoning, S. Chand Publishing.
2. Arun Sharma, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGraw-Hill Education.

REFERENCE BOOKS

1. Nishit K. Sinha, Logical Reasoning and Data Interpretation for CAT, Pearson.
2. Norman Lewis, Word Power Made Easy, Goyal Publishers.
3. Wren & Martin, High School English Grammar and Composition, S. Chand Publishing.

E- REFERENCES:

1. https://www.learntheta.com/aptitude-syllabus-placement/
2. https://ambitiousbaba.com/quantitative-aptitude-topic-wise-pdf-download-here/

Course Title: SPOKEN TUTORIAL - LATEX

S.No	CONTENTS OF MODULE
1	Beamer – Bibliography – Equations – Inside Story of Bibliography – Latex on Windows using Texworks – Letter-Writing – Mathematical Typesetting – Report Writing – Tables and Figures.

Note:

Courses Offered by IIT Mumbai through Spoken Tutorial Projects MHRD, Government of India. At the end of the course Online Examination will be conducted for 45 minutes and qualified students (Minimum passing 40%) will be issued certificate by IIT, Mumbai.

Spoken Tutorial – 1 credit

APPENDIX

Appendix A

OUTCOME-BASED EDUCATION (OBE)

Outcome-Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportMODULEies, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation.

Program Educational Objectives (PEOs)

The Program Educational Objectives of a program are the statements that describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation.

Program Outcomes (POs)

Program outcomes are finer statements that designate what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

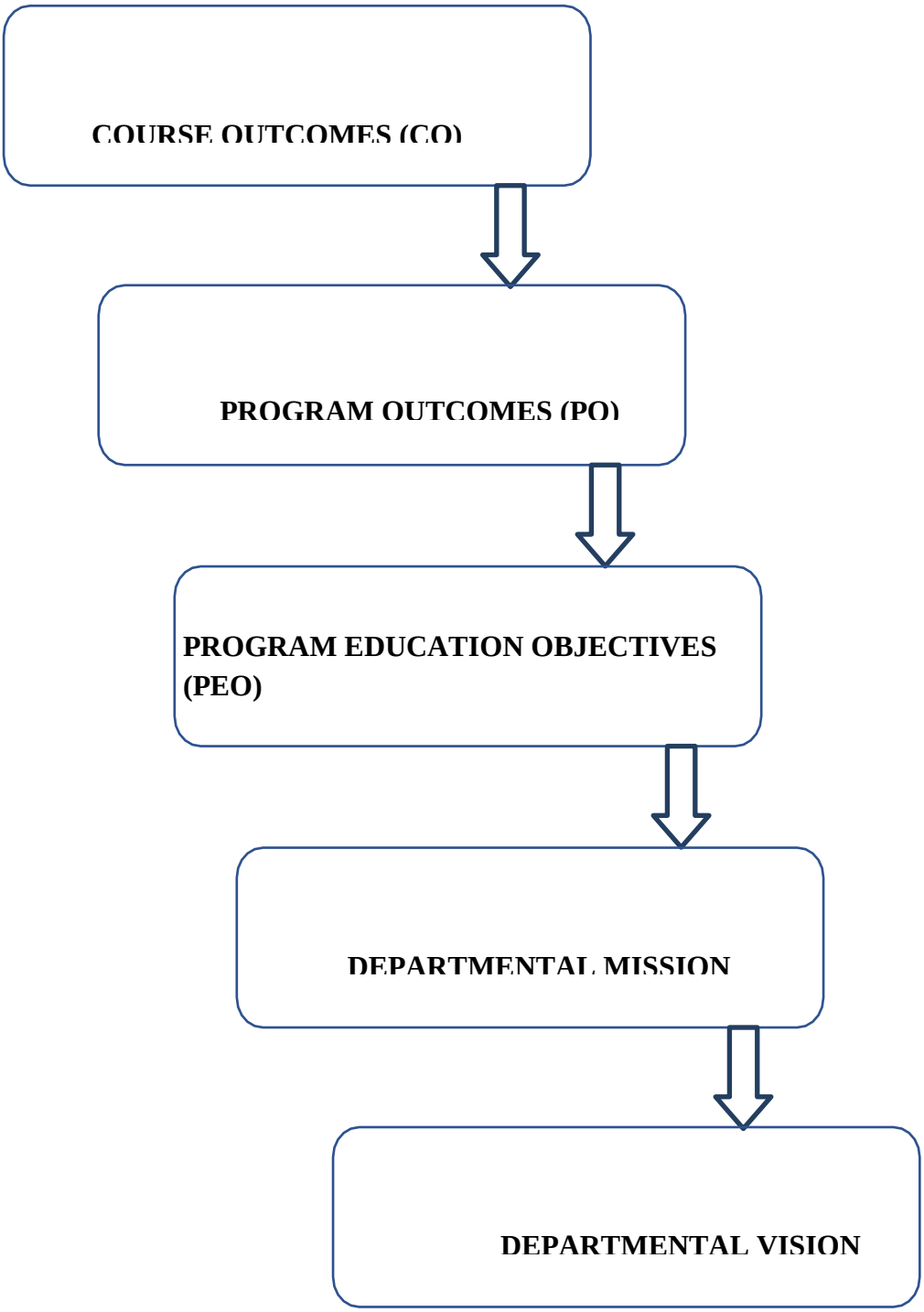
Program Specific Outcomes (PSO)

Program Specific Outcomes are what the students should be able to do at the time of graduation with reference to a specific discipline.

Course Outcome (CO)

Course outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course.

MAPPING OF OUTCOMES



Appendix B

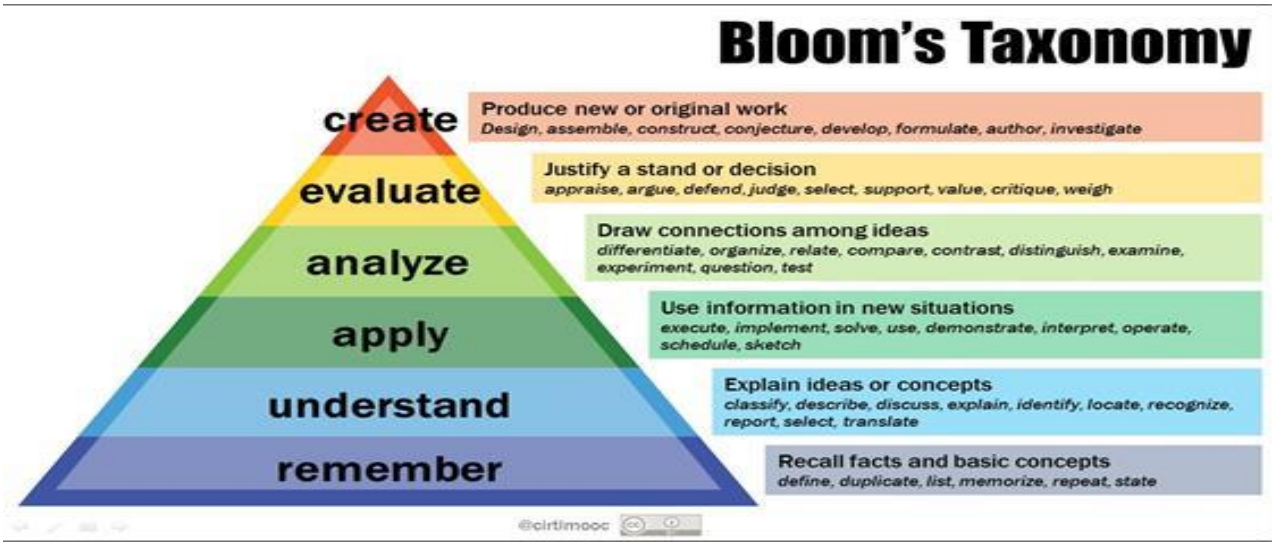
PROGRAM OUTCOMES IN RELATION TO GRADUATE ATTRIBUTES

S.No	GRADUATE ATTRIBUTES	PROGRAMME OUTCOMES
1.	**Knowledge**	Capability of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an postgraduate programme of study
2.	**Critical Thinking**	Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
3.	**Problem Solving**	Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
4.	**Usage of modern tools**	Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
5.	**Communication**	Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
6.	**Life-long Learning**	Ability to acquire knowledge and skills, including 'learning how to learn', that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
7.	**Ethical Practices and Social Responsibility**	Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work.
8.	**Independent and Reflective Learning**	Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society

Appendix C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (MODULEs, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. [eduglosarry.org]



Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

Level	Parameter	Description
K1	Knowledge	It is the ability to remember the previously learned material/information
K2	Comprehension	It is the ability to grasp the meaning of material
K3	Application	It is the ability to use learned material in new and concrete situations
K4	Analysis	It is the ability to break down material/concept into its component parts/subsections so that its organizational structure may be understood
K5	Synthesis	It is the ability to put parts/subsections together to form a new whole material/idea/concept/information
K6	Evaluation	It is the ability to judge the value of material/ concept/statement/creative material /research report) for a given purpose