

M.Sc Computer Science

SYLLABUS

With effect from AY 2023-2024

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING,
M S UNIVERSITY,
TIRUNELVLEI – 627 012**

1. Preamble

The Department of Computer Science and Engineering is one of the few departments functioning from the inception of the university in 1990. The Department is offering M.C.A, M.Sc, M.E., M.Phil. and Ph.D. programmes.

The field of computer science has undergone drastic changes in the past three decade. Although Computer Science has an influential presence in all other discipline, the field itself needs to be studied well in order to cope-up with the rapidly changing pace of technology. A three-year B.Sc. (computer Science) or BCA programme could lay a strong foundation in Computer Science at an early stage of the student. The M.Sc. (Computer Science) curriculum on the other hand introduces a student to more advanced development in certain areas and makes them familiar to apply them in the problems concerned with industry and research. This curriculum focuses on (i) the theory and practice behind the core as well as advanced areas of CS (ii) impart the ability to work on research projects (iii) give them an exposure to the emerging area in the form of elective courses. The degree would be awarded upon successful completion of the credit requirements for the course work and satisfactory performance of an independent project work.

Vision

Vision of the University

To provide quality education to reach the un-reached

Mission of the University

- To conduct research, teaching and outreach programmes to improve conditions of human living.
- To create an academic environment that honours women and men of all races, caste, creed, cultures, and an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity.
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development.
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently able.

Vision & Mission of the Department

Vision

To create industrious and research-oriented professionals in the field of Computer Science and Engineering

Mission

To achieve academic excellence by,

Providing an environment that combines Computing practice and research

Giving an exposure to the area of computer Science and the underlying mathematics to impart research skills and career goals

Giving an opportunity to the rural and underprivileged students to pursue Higher Education

Eligibility:

Bachelor degree in B.Sc. (Computer Science.) / B.Sc. (Information Technology)/ B.Sc. (Software Engineering) B.Sc. (Computer Technology) or B.C.A. obtained from any UGC recognized University or any other degree accepted by the Syndicate of Manonmaniam Sundaranar University as equivalent in the 10+2+3 pattern with at least 50% marks or above (45% marks or above for the SC/ST Category) in Part III of the qualifying UG degree examinations are eligible to apply for the programme.

Entrance Test:

Applicants seeking admission to M.Sc. (CS) are required to appear for the University Entrance Test to be conducted by Manonmaniam Sundaranar University. Details of the Entrance test will be provided in the University Website at the time of admission notification.

Selection:

Selection of students for the M.Sc. (Computer Science) programme shall be based on the combined marks obtained by the student in Part-III of the Qualifying UG Degree examination and the University Entrance Test to be conducted by Manonmaniam Sundaranar University for the M.Sc. (Computer Science) programme for the respective year. The weightage for the qualifying UG degree examinations and the University Entrance test will be 50% each.

Selection of students for the available seats shall be based on the rank obtained by the student in the merit list as per Manonmaniam Sundaranar University admission guidelines and the Tamil Nadu Government reservation norms.

Admission:

The Admission of students to the M.Sc. (Computer Science) programme shall be done through a Common Counselling Process. The modalities of the Counselling will be decided by the University at the time of Admission.

Student Evaluation:

- Evaluation is based on continuous internal assessment (25%) and end-semester examination (75%) for theory courses. The Candidates must have a minimum score of 50% in the end semester examinations and 50% of total (internal & External) in each theory courses. The maximum Internal mark is 50 and the maximum External mark is 50 for the Practical courses / Mini Project / Major Project / Field Work / Internship.
- A Minimum of 75% attendance is required to appear for the University Examinations. The student failed to make the minimum required attendance shall not be permitted to appear the end semester examination.
- The student shall be awarded the respective degree upon successful completion of the course as per university norms.

M.Sc., Computer Science

TANSICHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAME WORK FOR POST GRADUATE EDUCATION	
Programme	M.Sc., Computer Science
Programme Code	
Duration	PG - Two Years
Programme Outcomes (Pos)	<p>PO1: Problem Solving Skill Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.</p> <p>PO2: Decision Making Skill Foster analytical and critical thinking abilities for data-based decision-making.</p> <p>PO3: Ethical Value Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.</p> <p>PO4: Communication Skill Ability to develop communication, managerial and interpersonal skills.</p> <p>PO5: Individual and Team Leadership Skill Capability to lead themselves and the team to achieve organizational goals.</p> <p>PO6: Employability Skill Inculcate contemporary business practices to enhance employability skills in the competitive environment.</p> <p>PO7: Entrepreneurial Skill Equip with skills and competencies to become an entrepreneur.</p> <p>PO8: Contribution to Society Succeed in career endeavors and contribute significantly to society.</p> <p>PO 9 Multicultural competence Possess knowledge of the values and beliefs of multiple cultures and a global perspective.</p> <p>PO 10: Moral and ethical awareness/reasoning Ability to embrace moral/ethical values in conducting one's life.</p>
Programme Specific Outcomes (PSOs)	<p>PSO1 – Placement To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.</p> <p>PSO 2 - Entrepreneur To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.</p> <p>PSO3 – Research and Development Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.</p> <p>PSO4 – Contribution to Business World To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p>PSO 5 – Contribution to the Society To contribute to the development of the society by collaborating with stakeholders for mutual benefit.</p>

Credit Distribution for PG Programme

Semester-I	Credit	Semester-II	Credit	Semester-III	Credit	Semester-IV	Credit
Core-I	4	Core-IV	4	Core-VII	4	Major Project with viva voce	15
Core-II	4	Core-V	4	Core-VIII	4		
Core – III	4	Core – VI	4	Core – IX	4		
Elective-I Discipline Centric	4	Elective -III Discipline Centric	4	Elective -V Discipline Centric	4		
Elective - II Discipline Centric	4	Elective-IV Discipline Centric)-IV	4	Elective -VI Discipline Centric	4		
Lab I	2	Lab III	2	Lab V	2		
Lab II	2	Lab IV	2	Mini Project/ Internship/ Industrial Activity	4		
Skill Enhancement Course -I	1	Skill Enhancement Course -II	1	Skill Enhancement Course -Iii	1		
	25		25		27		15
Total Credit Points							92

METHODS OF EVALUATION			
Internal Evaluation	Continuous Internal Assessment Test		25 Marks
	Assignments / Snap Test / Quiz		
	Seminars		
	Attendance and Class Participation		
External Evaluation	End Semester Examination		75 Marks
Total			100 Marks
METHODS OF ASSESSMENT			
Remembering (K1)	<ul style="list-style-type: none"> The lowest level of questions require student store call information from the course content Knowledge questions usually require students to identify information in the text book. 		
Understanding (K2)	<ul style="list-style-type: none"> Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. The questions go beyond simple recall and require 		

	students to combine data together
Application (K3)	<ul style="list-style-type: none"> • Students have to solve problems by using/applying a concept learned in the classroom. • Students must use their knowledge to determine an exact response.
Analyze (K4)	<ul style="list-style-type: none"> • Analyzing the question is one that asks the students to break down something into its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.
Evaluate (K5)	<ul style="list-style-type: none"> • Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem-solving. • Evaluation questions do not have single right answers.
Create (K6)	<ul style="list-style-type: none"> • The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem solving skills

**PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO)
MAPPING**

PROGRAMME SPECIFIC OUTCOMES (PSO)					
	PO1	PO2	PO3	PO4	PO5
PSO1	3	3	3	3	3
PSO2	3	3	3	3	3
PSO3	3	3	3	3	3
PSO4	3	3	3	3	3
PSO5	3	3	3	3	3

Level of Correlation between PO's and PSO's

(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)

Assign the value

1 – Low

2 – Medium

3 – High

0 – No Correlation

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
Core - I	Paper I: Analysis & Design of Algorithms	4	4		25	75	100
Core – II	Paper II: Object Oriented Analysis and Design & C++	4	4		25	75	100
Core – III	Paper III: Python Programming	4	4		25	75	100
Elective - I	Advanced Software Engineering	4	4		25	75	100
Elective - II	Advanced Computer Networks	4	4				
Lab I	Practical I: Algorithm And OOPS Lab	2	4		50	50	100
Lab II	Python Programming Lab	2	4		50	50	100
Skill Enhancement Course		1	2	-	25	75	100
Total		25	30				
SECOND SEMESTER							
Core - IV	Paper V: Data Mining And Warehousing	4	4		25	75	100
Core – V	Paper VI: Advanced Operating Systems	4	4		25	75	100
Core - VI	Paper VII: Advanced Java Programming	4	4		25	75	100
Elective – III	Artificial Intelligence and Machine Learning	4	4		25	75	100
Elective –IV	Internet of Things	4	4		25	75	100
Lab– III	Data Mining using R Lab	2	4		50	50	100
Lab – IV	Advanced Java Programming Lab	2	4		50	50	100
Skill Enhancement Course		1	2	-	25	75	100
Total		25	30				

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
THIRD SEMESTER							
Core - I	Cloud Computing	4	4		25	75	100
Core – II	Network Security and Cryptography	4	4		25	75	100
Core – III	Data Science & Analytics	4	4		25	75	100
Elective - I	Digital Image Processing / Deep Learning	4	4		25	75	100
Elective - II	Web Application Development and Hosting / Mobile Application Development	4	4				
Lab I	DIP Lab	2	4		50	50	100
	Mini Project /Internship / Industry Activity	2	4		50	50	100
Skill Enhancement Course	MOOC course	1	2	-	25	75	100
Total		25	30				

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I.A	ESE	Total
Semester - IV						
Major Project Viva-Voce	15	30	-	50	50	100
Total	15	30				

I – SEMESTER

Course code	ANALYSIS & DESIGN OF ALGORITHMS			L	T	P	C
Core/Elective/Supportive	Core -I			4			4
Pre-requisite	Basic Data Structures & Algorithms						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Enable the students to learn the Elementary Data Structures and algorithms. 2. Presents an introduction to the algorithms, their analysis and design 3. Discuss various methods like Basic Traversal And Search Techniques, divide and conquer method, Dynamic programming, backtracking 4. Understood the various design and analysis of the algorithms. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Get knowledge about algorithms and determines their time complexity. Demonstrate specific search and sort algorithms using divide and conquer technique.					K1,K2	
2	Gain good understanding of Greedy method and its algorithm.					K2,K3	
3	Able to describe about graphs using dynamic programming technique.					K3,K4	
4	Demonstrate the concept of backtracking & branch and bound technique.					K5,K6	
5	Explore the traversal and searching technique and apply it for trees and graphs.					K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					15 hours	
Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity- Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heap sort- Graph.							
Unit:2	TRAVERSALANDSEARCHTECHNIQUES					15 hours	
Basic Traversal And Search Techniques: Techniques for Binary Trees-Techniques for Graphs -Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.							
Unit:3	GREEDY METHOD					15 hours	
The Greedy Method:-General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path.							

Unit:4	DYNAMICPROGRAMMING	15 hours
Dynamic Programming-General Method–Multistage Graphs–All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.		
Version		

Unit:5	BACKTRACKING	13 hours
Backtracking:-General Method–8-Queens Problem–Sum Of Subsets–Graph Coloring–Hamiltonian Cycles – Branch And Bound: - The Method – Traveling Salesperson.		

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars– webinars		

	Total Lecture hours	75 hours
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Text Books

1	Ellis Horowitz, “Computer Algorithms”, Galgotia Publications.
2	Alfred V.Aho, John E.Hopcroft, Jeffrey D.Ullman, "Data Structures and Algorithms".

Reference Books

1	Good rich, “Data Structures & Algorithms in Java”, Wiley 3rd edition.
2	Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008
3	Anany Levith, “Introduction to the Design and Analysis of algorithm”, Pearson Education Asia, 2003.
4	Robert Sedge wick, Phillipe Flajolet, “An Introduction to the Analysis of Algorithms”, Addison-Wesley Publishing Company, 1996.

Related Online Contents [MOOC, SWAYAM, NPTEL, Website setc.]

1	https://nptel.ac.in/courses/106/106/106106131/
2	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
3	https://www.javatpoint.com/daa-tutorial

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	L	M	L	S	M
CO2	S	S	S	S	S	M	S	M	S	M
CO3	S	S	S	S	S	M	S	M	S	M
CO4	S	S	S	S	S	M	S	M	S	M
CO5	S	S	S	S	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code	OBJECT ORIENTED ANALYSIS AND DESIGN & C++	L	T	P	C
Core/Elective/Supportive	Core -II	4			4
Pre-requisite	Basics of C++ and Object Oriented Concepts				
Course Objectives:					
The main objectives of this course are to:					
<ol style="list-style-type: none"> 1. Present the object model, classes and objects, object orientation, machine view and model management view. 2. Enables the students to learn the basic functions, principles and concepts of object oriented analysis and design. 3. Enable the students to understand C++ language with respect to OOAD 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the concept of Object-Oriented development and modeling techniques				K1,K2
2	Gain knowledge about the various steps performed during object design				K2,K3
3	Abstract object-based views for generic software systems				K3
4	Link OOAD with C++ language				K4,K5
5	Apply the basic concept of OOPs and familiarize to write C++ program				K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create					
Unit:1	OBJECTMODEL				15 hours
The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects.					
Unit:2	CLASSESANDOBJECTS				15 hours
Classes and Object: Nature of Class – Relationship Among classes – The Inter play of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects –Key Abstractions and Mechanism.					
Unit:3	C++INTRODUCTION				15 hours
Introduction to C++- Input and output statements in C++-Declarations- control structures– Functions in C++.					

Unit:4	INHERITANCEANDOVERLOADING	13 hours
Classes and Objects–Constructors and Destructors–operators overloading–Type Conversion- Inheritance – Pointers and Arrays.		

Unit:5	POLYMORPHISM AND FILES	15 hours
Memory Management Operators-Polymorphism–Virtual functions–Files–Exception Handling – String Handling -Templates.		

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		

	Total Lecture hours	75 hours
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Text Books	
1	“Object Oriented Analysis and Design with Applications”, Grady Booch, Second Edition, Pearson Education.
2	“Object-Oriented Programming with ANSI & Turbo C++”, Ashok N.Kamthane, First Indian Print -2003, Pearson Education.

Reference Books	
1	Balagurusamy “Object Oriented Programming with C++”, TMH, Second Edition,2003.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	M	S	M	S	S
CO2	S	S	S	M	S	M	S	M	S	S
CO3	S	S	S	M	S	M	S	M	S	S
CO4	S	S	S	M	S	M	S	M	S	S
CO5	S	S	S	M	S	M	S	M	S	S

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code	PYTHON PROGRAMMING				L	T	P	C
Core/Elective/Supportive	Core - III				4			4
Pre-requisite	Basics of any OOP Programming Language							
Course Objectives:								
The main objectives of this course are to:								
<ol style="list-style-type: none"> 1. Presents an introduction to Python, creation of web applications, network applications and working in the clouds 2. Use functions for structuring Python programs 3. Understand different Data Structures of Python 4. Represent compound data using Python lists, tuples and dictionaries 								
Expected Course Outcomes:								
On the successful completion of the course, student will be able to:								
1	Understand the basic concept of Python Programming						K1,K2	
2	Understand File operations, Classes and Objects						K2,K3	
3	Acquire Object Oriented Skills in Python						K3,K4	
4	Develop web applications using Python						K5	
5	Develop Client Server Networking applications						K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create								
Unit:1	INTRODUCTION						15 hours	
Python: Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets–Comparison.								
Unit:2	CODESTRUCTURES						15 hours	
Code Structures: if, else if, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions.								
Unit:3	MODULES,PACKAGESANDCLASSES						15 hours	
Modules, Packages, and Programs: Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. Objects and Classes: Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent with super–In self Defense –Get and Set Attribute Values with Properties –Name Mangling for Privacy – Method Types – Duck Typing – Special Methods –Composition.								
Unit:4	DATATYPESANDWEB						13 hours	
Data Types: Text Strings–Binary Data. Storing and Retrieving Data: File Input/Output– Structured Text Files – Structured Binary Files - Relational Databases – No SQL Data Stores.								
Web: Web Clients –Web Servers–Web Services and Automation								

Unit:5	SYSTEMSANDNETWORKS	15 hours
Systems: Files–Directories–Programs and Processes–Calendars and Clocks.		
Concurrency: Queues– Processes–Threads–Green Threads and event–twisted–Redis.		
Networks: Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – Zero MQ – Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and Map Reduce – Working in the Clouds.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	75 hours
Text Books		
1	BillLubanovic,“IntroducingPython”,O’Reilly,FirstEdition-SecondRelease,2014.	
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.	
Reference Books		
1	David M. Beazley, “Python Reference”, Developer’s Essential Edition,2009.	Fourth Library
2	Sheetal Taneja, Naveen Kumar , Approach”, Pearson Publications.	“Python Programming-A Modular
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.programiz.com/python-programming/	
2	https://www.tutorialspoint.com/python/index.htm	
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	M
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	S	M
CO5	S	S	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code	PRACTICAL I : ALGORITHM AND OOPS LAB	L	T	P	C
Core/Elective/Supportive	Lab - I			4	4
Pre-requisite	Basic Programming of C++ language				
Course Objectives:					
The main objectives of this course are to:					
<ol style="list-style-type: none"> 1. This course covers the basic data structures like Stack, Queue, Tree, List. 2. This course enables the students to learn the applications of the data structures using various techniques 3. It also enable the students to understand C++ language with respect to OOAD concepts 4. Application of OOPS concepts. 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the concepts of object oriented with respect to C++				K1,K2
2	Able to understand and implement OOPS concepts				K3,K4
3	Implementation of data structures like Stack, Queue, Tree, List using C++				K4,K5
4	Application of the data structures for Sorting, Searching using different techniques.				K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create					
LISTOF PROGRAMS				75 hours	
<ol style="list-style-type: none"> 1) Write a program to solve the tower of Hanoi using recursion. 2) Write a program to traverse through binary search tree using traversals. 3) Write a program to perform various operations on stack using linked list. <ol style="list-style-type: none"> 4) Write a program to perform various operation in circular queue. 5) Write a program to sort an array of an elements using quick sort. 6) Write a program to solve number of elements in ascending order using heap sort. 7) Write a program to solve the knapsack problem using greedy method 8) Write a program to search for an element in a tree using divide& conquer strategy. 9) Write a program to place the 8 queens on an 8X8 matrix so that no two queens Attack. 10) Write a C++ program to perform Virtual Function 11) Write a C++ program to perform Parameterized constructor 12) Write a C++ program to perform Friend Function 13) Write a C++ program to perform Function Overloading 14) Write a C++ program to perform Single Inheritance 					

15) Write a C++ program to perform Employee Details using files.

Expert lectures, online seminars –webinars

Total Lecture hours **75 hours**

Text Books

1 Goodrich, “Data Structures & Algorithms in Java”, Wiley3rd edition.

2 Skiena, ”The Algorithm Design Manual”, Second Edition, Springer, 2008

Reference Books

1 Anany Levith, “Introduction to the Design and Analysis of algorithm”, Pearson Education Asia, 2003.

2 Robert Sedgewick, Phillipe Flajolet, “An Introduction to the Analysis of Algorithms”, Addison-Wesley Publishing Company,1996.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://onlinecourses.nptel.ac.in/noc19_cs48/preview

2 <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/>

3 https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code	PRACTICALII:PYTHON PROGRAMMING LAB			L	T	P	C
Core/Elective/Supportive	Lab - II					4	4
Pre-requisite	Basics of any OOPS Programming Language						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. This course presents an overview of elementary data items, lists, dictionaries ,sets and tuples 2. To understand and write simple Python programs 3. To Understand the OOPS concepts of Python 4. To develop web applications using Python 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Able to write programs in Python using OOPS concepts					K1,K2	
2	To understand the concepts of File operations and Modules in Python					K2,K3	
3	Implementation of lists, dictionaries, sets and tuples as programs					K3,K4	
4	To develop web applications using Python					K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
LISTOF PROGRAMS						75 hours	
Implement the following in Python:							
<ol style="list-style-type: none"> 1. Programs using elementary data items, lists, dictionaries and tuples 2. Programs using conditional branches, 3. Programs using loops. 4. Programs using functions 5. Programs using exception handling 6. Programs using inheritance 7. Programs using polymorphism 8. Programs to implement tfile operations. 9. Programs using modules. 10. Programs for creating dynamic and interactive web pages using forms. 							
Total Lecture hours						75 hours	
Text Books							
1	Bill Lubanovic, “Introducing Python”, O’Reilly, First Edition-Second Release, 2014.						

2	MarkLutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.
Reference Books	

1	David M. Beazley, “Python Reference”, Developer’s Fourth Essential Edition,2009. Library
2	Sheetal Taneja, Naveen Kumar, “Python Programming-A Modular Approach”, Pearson Publications.

Related Online Contents [MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

Mapping with Programming Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium ;L-Low

II – SEMESTER

Course code	DATA MINING AND WAREHOUSING	L	T	P	C
Core/Elective/Supportive	Core - IV	4			4
Pre-requisite	Basics of RDBMS & Algorithms				
Course Objectives:					
The main objectives of this course are to:					
<ol style="list-style-type: none"> 1. Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing. 2. Develop skills of using recent data mining software for solving practical problems. 3. Develop and apply critical thinking, problem-solving, and decision-making skills. 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the basic data mining techniques and algorithms				K1,K2
2	Understand the Association rules, Clustering techniques and Data warehousing contents				K2,K3
3	Compare and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining				K4,K5
4	Design data warehouse with dimensional modeling and apply OLAP operations				K5,K6
5	Identify appropriate data mining algorithms to solve real world problems				K6
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create					
Unit:1	BASICS AND TECHNIQUES	12 hours			
<p>Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.</p> <p>Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.</p>					
Unit:2	ALGORITHMS	12 hours			
<p>Classification: Introduction –Statistical –based algorithms -distance–based algorithms- decision tree-basedalgorithms-neuralnetwork–basedalgorithms–rule-basedalgorithms– combining techniques.</p>					
Unit:3	CLUSTERING AND ASSOCIATION	12 hours			
<p>Clustering: Introduction–Similarity and Distance Measures–Outliers–Hierarchical Algorithms -Partitional Algorithms.</p> <p>Association rules: Introduction - large item sets - basic algorithms – parallel & distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.</p>					

Unit:4	DATA WAREHOUSING AND MODELING	11 hours
Data warehousing :introduction-characteristics of a data warehouse–data marts –other aspects		
Of data mart. Online analytical processing: introduction –OLTP & OLAP systems Data modeling –star schema for multi dimensional view –data modeling – multi fact star schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.		
Unit:5	APPLICATIONS OF DATA WAREHOUSE	11 hours
Developing a data WAREHOUSE: why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse. Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	60 hours
Text Books		
1	MargarethH.Dunham,“DataMining:IntroductoryandAdvancedTopics”,Pearson education,2003.	
2	C.S.R. Prabhu, “Data Warehousing Concepts, Techniques, Products and Applications”, PHI, Second Edition.	
Reference Books		
1	Arun K. Pujari, “Data Mining Techniques”, Universities Press (India) Pvt. Ltd.,2003.	
2	Alex Berson, Stephen J.Smith, “Data Warehousing, Data Mining and OLAP”, TMCH, 2001.	
3	Jiawei Han & Micheline Kamber, “Data Mining Concepts & Techniques”, 2001, Academic press.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.javatpoint.com/data-warehouse	
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/	
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code	ADVANCED OPERATING SYSTEMS	L	T	P	C
Core/Elective/Supportive	Core - V	4			4
Pre-requisite	Basics of OS & its functioning				
Course Objectives:					
<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> 1. Enable the students to learn the different types of operating systems and their functioning. 2. Gain knowledge on Distributed Operating Systems 3. Gain insight into the components and management aspects of real time and mobile operating systems. 4. Learn case studies in Linux Operating Systems 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the design issues associated with operating systems				K1,K2
2	Master various process management concepts including scheduling, deadlocks and distributed file systems				K3,K4
3	Prepare Real Time Task Scheduling				K4,K5
4	Analyze Operating Systems for Handheld Systems				K5
5	Analyze Operating Systems like LINUX and iOS				K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create					
Unit:1	BASICS OF OPERATING SYSTEMS	12 hours			
Basics of Operating Systems: What is an Operating System? – Main frame Systems – Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems – Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery.					
Unit:2	DISTRIBUTED OPERATING SYSTEMS	12 hours			
Distributed Operating Systems: Issues – Communication Primitives – Lamport’s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda.					
Unit:3	REAL TIME OPERATING SYSTEM	10 hours			

Real time Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling		
Unit:4	HANDHELD SYSTEM	12 hours
Operating Systems for Handheld Systems: Requirements –Technology Overview – Handheld Operating Systems–Palm OS-Symbian Operating System-Android–Architecture of android– Securing handheld systems		
Unit:5	CASE STUDIES	12 hours
Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars–webinars		
	Total Lecture hours	60 hours
Text Books		
1	AbrahamSilberschatz;PeterBaerGalvin;GregGagne,“OperatingSystemConcepts”, Seventh Edition, John Wiley & Sons, 2004.	
2	Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems –Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001.	
Reference Books		
1	Rajib Mall, “Real-Time Systems:TheoryandPractice”,PearsonEducationIndia,2006.	
2	Pramod Chandra P.Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.	
3	Daniel.P.Bovet&MarcoCesati,“UnderstandingtheLinuxkernel”,3 rd edition,O’ Reilly,2005	
4	NeilSmyth,“iPhoneiOS4DevelopmentEssentials–Xcode”,FourthEdition,Payload media, 2011.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.nptel.ac.in/noc20_cs04/preview	
2	https://www.udacity.com/course/advanced-operating-systems--ud189	
3	https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	M	M	M
CO2	S	M	S	S	S	S	S	M	S	M
CO3	S	M	S	S	S	S	S	M	S	M
CO4	S	M	S	S	S	S	S	M	S	M
CO5	S	M	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code	ADVANCED JAVA PROGRAMMING	L	T	P	C
Core/Elective/Supportive	Core - VI	4			4
Pre-requisite	Basics of Java & its Usage				
Course Objectives:					
The main objectives of this course are to:					
<ol style="list-style-type: none"> 1. Enable the students to learn the basic functions, principles and concepts of advanced java programming. 2. Provide knowledge on concepts needed for distributed Application Architecture. 3. Learn JDBC, Servlet packages, JQuery, Java Server Pages and JAR file format 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the advanced concepts of Java Programming				K1,K2
2	Understand JDBC and RMI concepts				K2,K3
3	Apply and analyze Java in Database				K3,K4
4	Handle different event in java using the delegation event model, event listener and class				K5
5	Design interactive applications using Java Servlet, JSP and JDBC				K5,K6
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create					
Unit:1	BASICSOFLAVA				12 hours
Java Basics Review: Components and event handling –Threading concepts–Networking features – Media techniques					
Unit:2	REMOTEMETHOD INVOCATION				12 hours
Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons- Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces					
Unit:3	DATABASE				10hours
JavainDatabases-JDBCprinciples–databaseaccess-Interacting-databasesearch–Creating multimedia databases – Database support in web applications					
Unit:4	SERVLETS				12hours
Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Readingdata from a client-Reading http request header-sending data to a client andwriting the http response header-working with cookies Java Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page-Expressions- Scriptlets-Directives-Declarations-A complete example					

Unit:5	ADVANCEDTECHNIQUES	12 hours
JARfileformatcreation–Internationalization–SwingProgramming–Advancedjava		

techniques

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		

	Total Lecture hours	60 hours
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Text Books

1	Jamie Jaworski, “Java Unleashed”, SAMS Tech media Publications,1999.
2	Campione, Walrath and Huml, “The Java Tutorial”, Addison Wesley,1999.

Reference Books

1	Jim Keogh, “The Complete Reference J2EE”, Tata McGraw Hill Publishing Company Ltd, 2010.
2	David Sawyer McFarland, “JavaScript And JQuery -The Missing Manual”, Oreilly Publications, 3rd Edition, 2011.
3	Deitel and Deitel, “Java How to Program”, Third Edition, PHI/Pearson Education Asia.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	M	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	PRACTICALIII:DATAMINING USING R		L	T	P	C
Core/Elective/Supportive	Lab - III				4	4
Pre-requisite	Basics of DM Algorithms & R Programming					
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, regression.... 2. To understand & write programs using the DM algorithms 3. To apply statistical interpretations for the solutions 4. Able to use visualizations techniques for interpretations 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Able to write programs using R for Association rules, Clustering techniques				K1,K2	
2	To implement data mining techniques like classification, prediction				K2,K3	
3	Able to use different visualizations techniques using R				K4,K5	
4	To apply different data mining algorithms to solve real world applications				K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
LISTOF PROGRAMS					75 hours	
<ol style="list-style-type: none"> 1. Implement Apriori algorithm to extract association rule of data mining. 2. Implement k-means clustering technique. 3. Implement any one Hierarchal Clustering. 4. Implement Classification algorithm. 5. Implement Decision Tree. 6. Linear Regression. 7. Data Visualization. 						
Total Lecture hours					75 hours	
Text Books						
1	MargaretH.Dunham,“DataMining:IntroductoryandAdvancedTopics”,Pearson education,2003.					
2	C.S.R. Prabhu, “Data Warehousing Concepts, Techniques, Products and Applications”, PHI, Second Edition					

Reference Books	
1	ArunK. Pujari, "Data Mining Techniques", Universities Press (India) Pvt. Ltd., 2003.
2	Alex Berson, Stephen J.Smith, "Data Warehousing, Data Mining and OLAP", TMCH, 2001.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
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1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

Mapping with Programming Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	PRACTICAL IV:ADVANCED JAVA LAB		L	T	P	C
Core/Elective/Supportive	Lab - IV				4	4
Pre-requisite	Basics in Java Programming					
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. To enable the students to implement the simple programs using JSP,JAR 2. To provide knowledge on using Servlets, Applets 3. To introduce JDBC and navigation of records 4. To understand RMI& its implementation 5. To introduce to Socket programming 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand to the implement concepts of Java using HTML forms, JSP & JAR				K1,K2	
2	Must be capable of implementing JDBC and RMI concepts				K3,K4	
3	Able to write Applets with Event handling mechanism				K4,K5	
4	To Create interactive web based applications using servlets and jsp				K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
LISTOF PROGRAMS					75 hours	
<ol style="list-style-type: none"> 1. Display a welcome message using Servlet. 2. Design a Purchase Order form using Html form and Servlet. 3. Develop a program for calculating the percentage of marks of a student using JSP. 4. Design a Purchase Order form using Html form and JSP. 5. Prepare a Employee pay slip using JSP. 6. Write a program using JDBC for creating a table, Inserting, Deleting records and list out the records. 7. Write a program using Java servlet to handle form data. 8. Write a simple Servlet program to create a table of all the header sit receives along with their associated values. 9. Write a program in JSP by using session object. 10. Write a program to build a simple Client Server application using RMI. 11. Create an applet for a calculator application. 12. Program to send a text message to another system and receive the text message from the system (use socket programming). 						
Expert lectures, online seminars –webinars						
Total Lecture hours					75 hours	

Text Books	
1	Jamie Jaworski, "Java Unleashed", SAMS Tech media Publications, 1999.
2	Campione, Walrath and Huml, "The Java Tutorial", Addison Wesley, 1999.
Reference Books	
1	Jim Keogh, "The Complete Reference J2EE", Tata McGraw Hill Publishing Company Ltd, 2010.
2	David Sawyer McFarland, "Java Script And JQuery -The Missing Manual", Oreilly Publications, 3rd Edition, 2011.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

Mapping with Programming Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Electives

Course code	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
Core/Elective/Supportive	Elective	4			4
Pre-requisite	Basics of Software Engineering & SPM				
Course Objectives:					
The main objectives of this course are to:					
<ol style="list-style-type: none"> 1. Introduce to Software Engineering, Design, Testing and Maintenance. 2. Enable the students to learn the concepts of Software Engineering. 3. Learn about Software Project Management, Software Design & Testing. 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand about Software Engineering process				K1,K2
2	Understand about Software project management skills, design and quality management				K2,K3
3	Analyze on Software Requirements and Specification				K3,K4
4	Analyze on Software Testing, Maintenance and Software Re-Engineering				K4,K5
5	Design and conduct various types and levels of software quality for a software project				K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create					
Unit:1	INTRODUCTION				15 hours
Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.					
Unit:2	SOFTWARE REQUIREMENTS				15 hours
Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Result management system. Software Quality Management – Software Quality, Software Quality Management System, ISO 9000, SEI CMM.					

Unit:3	PROJECT MANAGEMENT	15 hours
Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead" s software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.		
Unit:4	SOFTWARE DESIGN	15 hours
Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.		
Unit:5	SOFTWARE TESTING	13 hours
Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging–Testingtools-Metrics-ReliabilityEstimation.SoftwareMaintenance - Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
		Total Lecture hours
		75 hours
Text Books		
1	An Integrated Approach to Software Engineering–Pankaj Jalote, Narosa Publishing House, Delhi, 3rd Edition.	
2	Fundamentals of Software Engineering –Rajib Mall, PHI Publication,3rdEdition.	
Reference Books		
1	Software Engineering–K.K.Aggarwal and Yogesh Singh, New Age International Publishers, 3 rd edition.	
2	A Practitioners Approach-Software Engineering, -R.S.Pressman, McGraw Hill.	
3	Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Manodrioli, PHI Publication.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.javatpoint.com/software-engineering-tutorial	

2	https://onlinecourses.swayam2.ac.in/cec20_cs07/preview
3	https://onlinecourses.nptel.ac.in/noc19_cs69/preview

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	ADVANCED COMPUTER NETWORKS		L	T	P	C
Core/Elective/Supportive	Elective		4			4
Pre-requisite	Basic Knowledge on mathematics and networking					
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Have a detailed knowledge on the concept of networks 2. Know the idea on protocols, OSI layers and its functions. 3. Get knowledge on protocols used in different layers. 4. Know about the function of Internet 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand fundamental underlying principles of computer networking				K1,K2	
2	Understand details and functionality of layered network architecture.				K2,K3	
3	Apply mathematical foundations to solve computational problems in computer networking				K3,K4	
4	Analyze and evaluate performance of various communication protocols.				K4,K5,K6	
5	Compare and create new routing algorithms.				K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1	INTRODUCTION				12 hours	
Introduction- data communications – networks – The internet – Protocols and standards – OSI model – layers in OSI model – TCP/IP protocol suite – addressing – guided media – Unguided media						
Unit:2	DATA LINK LAYER				12 hours	
Switching – Circuit switched networks – datagram networks – virtual circuit networks – Framing – Flow and error control Multiple access – random access – wired Lan – wireless Lan – Cellular telephony – satellite networks						
Unit:3	NETWORK LAYER				12 hours	
Network layer – IP V4 addressing – IPV6 addressing – ICMP – IGMP –Network layer delivery – forwarding – unicast and multicast routing protocols						
Unit:4	TRANSPORT LAYER				12 hours	

Transport layer – Process to process delivery – UDP -TCP -Congestion – congestion control – QOS – Techniques to improve QOS		
Unit:5	APPLICATION LAYER	12 hours
Domain name system – name space – domain name space – distribution of name space – DNS in the internet – remote logging - email – file transfer -Network management system – SNMP Protocol		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars– webinars		
	Total Lecture hours	60 hours
Text Books		
1	Data communications and networking – Behrouz A Forouzan McGraw Hill 4 th Edition 2015 reprint	
Reference Books		
1	Computer Networks – Tenenbaum -Pearson -2022	
2	Computer networking –Kurose James F, Ross Keith W -Pearson – 2017	
3	Data and computer communications – William Stallings – Pearson 2017	
4	Computer networks and Internet – Douglas E Comer – Pearson - 2018	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106105080	
2	https://www.tutorialspoint.com/computer-networks/index.asp	
3	https://www.javatpoint.com/computer-network-tutorial	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	M	M	S	L	M	L
CO2	S	M	M	S	M	M	S	L	M	L
CO3	S	S	M	S	S	M	S	M	M	M
CO4	S	S	S	S	S	M	S	M	M	M
CO5	S	S	S	S	S	S	S	M	M	M

*S-Strong; M-Medium; L-Low

Course code	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING			L	T	P	C
Core/Elective/Supportive	Elective			4			4
Pre-requisite	Basics of AI & An Introduction about ML						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Enable the students to learn the basic functions of AI, Heuristic Search Techniques. 2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic. 3. Introduce Machine Learning with respect Data Mining, Big Data and Cloud. 4. Study about Applications & Impact of ML. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Demonstrate AI problems and techniques					K1,K2	
2	Understand machine learning concepts					K2,K3	
3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning					K3,K4	
4	Analyze the impact of machine learning on applications					K4,K5	
5	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system					K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					12 hours	
Introduction: AI Problems - AI techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.							
Unit:2	SEARCHTECHNIQUES					12 hours	
Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations - Issues in Knowledge representations - Frame Problem.							
Unit:3	PREDICATELOGIC					12 hours	
Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming							

-Forward Vs Backward reasoning -Matching-Control knowledge.		
Unit:4	MACHINELEARNING	12 hours

Understanding Machine Learning: What Is Machine Learning?-Defining Big Data-Big Data in Context with Machine Learning-The Importance of the Hybrid Cloud – Leveraging the Power of Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.

Unit:5	APPLICATIONS OF MACHINE LEARNING	10 hours
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Looking Inside Machine Learning: The Impact of Machine Learning on Applications - Data Preparation-The Machine Learning Cycle.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		

		Total Lecture hours	60 hours
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Text Books

1	Elaine Richand Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Publishers company Pvt Ltd, Second Edition, 1991.
2	George FLuger, "Artificial Intelligence", 4 th Edition, Pearson Education Publ,2002.

Reference Books

1	Machine Learning For Dummies ®, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch.
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Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.ibm.com/downloads/cas/GB8ZMQZ3
2	https://www.javatpoint.com/artificial-intelligence-tutorial
3	https://nptel.ac.in/courses/106/105/106105077/

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	INTERNET OF THINGS			L	T	P	C
Core / Elective / Supportive	Elective			4			4
Pre-requisite	Basics of Sensors & its Applications						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. About Internet of Things where various communicating entities are controlled and managed for decision making in the application domain. 2. Enable students to learn the Architecture of IoT and IoT Technologies 3. Developing IoT applications and Security in IoT, Basic Electronics for IoT, Arduino IDE, Sensors and Actuators Programming NODEMCU using Arduino IDE. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand about IoT, its Architecture and its Applications					K1,K2	
2	Understand basic electronics used in IoT & its role					K2,K3	
3	Develop applications with C using Arduino IDE					K4	
4	Analyze about sensors and actuators					K5,K6	
5	Design IoT in real time applications using today's internet & wireless technologies					K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					12 hours	
Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT– Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT							
Unit:2	BASIC ELECTRONICS FOR IoT					12 hours	
Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – Binary Calculations – Logic Chips – Micro controllers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation.							
Unit:3	PROGRAMMINGUSINGARDUINO					12hours	
Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions.							
Unit:4	SENSORSANDACTUATORS					10hours	
Sensors and Actuators: Analog and Digital Sensors–Interfacing temperature sensor, ultrasound							

Ensenor and infrared (IR)sensor with Arduino– Interfacing LED and Buzzer with Arduino.		
Unit:5	SENSOR DATA IN INTERNET	12 hours
Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (Thing Speak).		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	hours
Text Books		
1	Arshdeep Bahga, Vijay Madiseti, “Internet of Things: A Hands-On Approach”, 2014. ISBN: 978-0996025515	
2	Boris Adryan, Dominik Obermaier, Paul Fremantle, “The Technical Foundations of IoT”, Artech Houser Publishers, 2017.	
Reference Books		
1	Michael Margolis, “Arduino Cook book”, O’ Reilly, 2011	
2	Marco Schwartz, “Internet of Things with ESP8266”, Packet Publishing, 2016.	
3	Dhivya Bala, “ESP8266: Step by Step Tutorial for ESP8266 IoT, Arduino NODEMCU Dev. Kit”, 2018.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.nptel.ac.in/noc20_cs66/preview	
2	https://www.javatpoint.com/iot-internet-of-things	
3	https://www.tutorialspoint.com/internet_of_things/index.htm	

Mapping with Programming Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	M	M	S	M
CO2	M	S	M	S	M	S	M	S	S	S
CO3	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong ; M-Medium; L-Low

Course code	MULTIMEDIA AND ITS APPLICATIONS			L	T	P	C
Core/Elective/Supportive	Elective			4			4
Pre-requisite	Basics of Multimedia						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. To introduce the students the concepts of Multimedia, Images & Animation. 2. To introduce Multimedia authoring tools 3. To understand the role of Multimedia in Internet 4. To know about High Definition Television and Desktop Computing –Knowledge based Multimedia systems 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand the basic concepts of Multimedia					K1,K2	
2	Demonstrate Multimedia authoring tools					K2,K3	
3	Analyze the concepts of Sound, Images, Video & Animation					K4	
4	Apply and Analyze the role of Multimedia in Internet and real time applications					K4,K5	
5	Analyze multimedia applications using HD TV					K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					12 hours	
What is Multimedia?–Introduction to making Multimedia–Macintosh and Windows Production platforms – Basic Software tools.							
Unit:2	MULTIMEDIA TOOLS					12 hours	
Making Instant Multimedia–Multimedia authoring tools–Multimedia building blocks–Text– Sound.							
Unit:3	ANIMATION					10 hours	
Images–Animation–Video.							
Unit:4	INTERNET					12hours	
Multimedia and the Internet–The Internet and how it works–Tools for World Wide Web–Designing for the World Wide Web.							
Unit:5	MULTIMEDIA SYSTEMS					12hours	

High Definition Television and Desktop Computing –Knowledge based Multimedia systems.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	60 hours
Text Books		
1	Tay Vaughan, “Multimedia making it work”, Fifth Edition, Tata McGraw Hill.	
2	John F.Koegel Bufford, “Multimedia Systems”, Pearson Education.	
Reference Books		
1	JudithJeffloate, “Multimedia in Practice (Technology and Applications)”, PHI, 2003.	
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/multimedia/index.htm	
2	https://www.tutorialspoint.com/basics_of_computer_science/basics_of_computer_science_multimedia.htm	
3	https://nptel.ac.in/courses/117/105/117105083/	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	M	M	M	S
CO2	S	S	S	S	M	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	EMBEDDED SYSTEMS			L	T	P	C
Core/Elective/Supportive	Elective			4			4
Pre-requisite	Basics of Micro Controller						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Present the introduction to 8051 Microcontroller Instruction Set, concepts on RTOS & Software tools. 2. Gain the knowledge about the embedded software development. 3. Learn about Microcontroller and software tools in the embedded systems. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand the concept of 8051 microcontroller					K1,K2	
2	Understand the Instruction Set and Programming					K2,K3	
3	Analyze the concepts of RTOS					K3,K4	
4	Analyze and design various real time embedded systems using RTOS					K5	
5	Debug the malfunctioning system using various debugging techniques					K5,K6	
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6- Create							
Unit:1	8051 MICRO CONTROLLER					12 Hours	
8051 Microcontroller: Introduction-8051 Architecture-Input / Output Pins, Ports and Circuits- External Memory - Counters / Timers - Serial Data Input / Output – Interrupts							
Unit:2	PROGRAMMING BASICS					12 Hours	
Instruction Set and Programming Moving Data-Addressing Modes-Logical operations-Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts.							
Unit:3	CONCEPTS ON RTOS					12 Hours	
CONCEPTS ON RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data- Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions-Events - Memory Management-Interrupt Routines in an RTOS Environment.							
Unit:4	DESIGN USING RTOS					10Hours	
Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power- introductions to RTL & QNX.							
Unit:5	SOFTWARE TOOLS					12Hours	
SOFTWARE TOOLS: Embedded software Development Tools: Hosts and Target Machines-							

Linker/ Locators for Embedded software-getting Embedded software into the Target systems. Debugging Techniques: Testing on your Host machine -Instruction set simulators- The assert macro- using laboratory tools.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	60 Hours
Text Books		
1	David E.Simon, “An Embedded Software primer” Pearson Education Asia, 2003.	
2	Kenneth JAYala, “The 8051 Microcontroller and Architecture programming and application”, Second Edition, Penram International.	
Reference Books		
1	Raj Kamal, “Embedded Systems –Architecture, programming and design”, Tata McGraw– Hill, 2003.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.nptel.ac.in/noc20_cs14/preview	
2	https://www.javatpoint.com/embedded-system-tutorial	
3	https://www.tutorialspoint.com/embedded_systems/index.htm	

Mapping with Programming Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	S	M	S	S	M	M	S
CO2	M	M	S	S	M	S	M	S	S	S
CO3	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	CRITICAL THINKING, DESIGN THINKING AND PROBLEM SOLVING			L	T	P	C
Core/Elective/Supportive	Elective			4			4
Pre-requisite	Basics of Logical & Reasoning Skills						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Learn critical thinking and its related concepts 2. Learn design thinking and its related concepts 3. Develop Thinking patterns, Problem solving & Reasoning 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand the concepts of Critical thinking and its related technology					K1,K2	
2	Focus on the explicit development of critical thinking and problem solving skills					K2,K3	
3	Apply design thinking in problems					K3,K4	
4	Make a decision and take actions based on analysis					K4,K5	
5	Analyze the concepts of Thinking patterns, Problem solving & Reasoning in real time applications					K5,K6	
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	CRITICAL THINKING					12 hours	
Critical Thinking: Definition, Conclusions and Decisions, Beliefs and Claims, Evidence – finding, evaluation, Inferences, Facts – opinion, probable truth, probably false, Venn diagram. Applied critical thinking: Inference, Explanation, Evidence, Credibility, Two Case Studies, critical thinking and science, critical evaluation, self assessment.							
Unit:2	DESIGN THINKING					12 hours	
Design Thinking: Introduction, Need of Design Thinking, problem to question - design thinking process, Traditional Problem Solving versus Design Thinking, phases of Design Thinking, problem exploration, Stake holder assessment, design thinking for manufacturers, smart Idea to implementation.							
Unit:3	CASE STUDY					12 hours	
Thinking to confidence, fear management, duty Vs passion, Team management, Tools for Thinking, prototype design, Relevance of Design and Design Thinking in engineering, human centered design, case study: apply design thinking in problem.							

Unit:4	PROBLEMSOLVING	10 hours
Problem solving: problem definition, problem solving methods, selecting and using information, dataprocessing,solutionmethods,solvingproblemsbysearching,recognizingpatterns,spatial		

Reasoning necessity and sufficiency, choosing and using models, making choices and decisions.

Unit:5	REASONING	12 hours
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Reasoning: Deductive and hypothetical reasoning, computational problem solving; generating, implementing, and evaluating solutions, interpersonal problem solving. Advanced problem solving: Combining skills – using imagination, developing models, Carrying out investigations, Data analysis and inference. Graphical methods of solution, Probability, tree diagrams and decision trees

Unit:6	Contemporary Issues	2 hours
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Expert lectures, online seminars –webinars

Total Lecture hours		60 hours
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Text Books

1	John Butterworth and Geoff Thwaites, Thinking skills: Critical Thinking and Problem Solving, Cambridge University Press, 2013.
2	H.S.FoglerandS .E.LeBlanc, Strategies for Creative Problem Solving, 2 nd edition, Pearson, Upper Saddle River, NJ, 2008.

Reference Books

1	A. Whimbey and J. Lochhead, Problem Solving & Comprehension, 6th edition, Lawrence Erlbaum, Mahwah, NJ, 1999.
2	M. Levine, Effective Problem Solving, 2nd edition, Prentice Hall, Upper Saddle River, NJ, 1994.
3	Michael Baker, The Basic of Critical Thinking, The Critical Thinking Copress, 2015.
4	David Kelley and Tom Kelley, Creative Confidence, 2013.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.tutorialspoint.com/critical_thinking/index.htm
2	https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm
3	https://nptel.ac.in/courses/109/104/109104109/

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	MOBILECOMPUTING			L	T	P	C
Core/Elective/Supportive	Elective			4			4
Pre-requisite	Basics of Mobile Communication						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Present the overview of Mobile computing, Applications and Architectures. 2. Describe the futuristic computing challenges. 3. Enable the students to learn the concept of mobile computing. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand the need and requirements of mobile communication					K1,K2	
2	Focus on mobile computing applications and techniques					K2,K3	
3	Demonstrate satellite communication in mobile computing					K4	
4	Analyze about wireless local loop architecture					K5,K6	
5	Analyze various mobile communication technologies					K6	
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					12 hours	
Introduction: Advantages of Digital Information - Introduction to Telephone Systems – Mobile communication: Need for Mobile Communication – Requirements of Mobile Communication – History of Mobile Communication.							
Unit:2	MOBILE COMMUNICATION					12 hours	
Introduction to Cellular Mobile Communication – Mobile Communication Standards – Mobility Management – Frequency Management – Cordless Mobile Communication Systems.							
Unit:3	MOBILE COMPUTING					12 hours	
Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Changeover from one satellite to other – Global Mobile Communication – Interferences in Cellular Mobile Communication.							
Unit:4	MOBILE COMMUNICATION SYSTEM					11 hours	
Important Parameters of Mobile Communication System – Mobile Internet: Working of Mobile IP – Wireless Network Security – Wireless Local Loop Architecture: Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol.							

Unit:5	COMMUNICATION TECHNOLOGY	11 hours
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WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system – Fourth Generation Mobile Communication systems.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars–webinars		

	Total Lecture hours	60 hours
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Text Books

1	T.G.Palanivelu, R.Nakkeeran, “Wireless and Mobile Communication”, PHI Limited, 2009.
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2	Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2007.
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Reference Books

1	AsokeK Talukder, Hasan Ahmed, RoopaYavagal, “Mobile Computing”, TMH, 2010.
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Related Online Content s[MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.tutorialspoint.com/mobile_computing/index.htm
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2	https://www.javatpoint.com/mobile-computing
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3	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/
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Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	M	L	L	M	S	M	M	M	M
CO2	S	S	S	M	M	S	M	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	BLOCKCHAIN TECHNOLOGY		L	T	P	C
Core/Elective/Supportive	Elective		4			4
Pre-requisite	Basics of Block Chain & Crypto Currency					
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Understand the fundamentals of block chain and crypto currency. 2. Understand the influence and role of block chain in various other fields. 3. Learn security features and its significance. 4. Identify problems & challenges posed by Block Chain. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Demonstrate block chain technology and crypto currency				K1,K2	
2	Understand the mining mechanism in block chain				K2	
3	Apply and identify security measures, and various types of services that allow people to trade and transact with bit coins				K3,K4	
4	Apply and analyze Block chain in health care industry				K4,K5	
5	Analyze security, privacy, and efficiency of a given Block chain system				K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1	INTRODUCTION				12 hours	
Introduction to Block chain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Crypto currencies versus Block chain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Block chain platforms, regulators, application providers. The major application: currency, identity, chain of custody.						
Unit:2	NETWORKAND SECURITY				12 hours	
Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain.						
Unit:3	CRYPTOCURRENCY				12 hours	
Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain						
Unit:4	CRYPTOCURRENCYREGULATION				11 hours	
Crypto currency Regulation-Stake holders, Roots of Bitcoin, Legal views-exchange of crypto currency-Black Market-Global Economy. Cyrpto economics–assets, supply and demand, inflation and deflation – Regulation.						

Unit:5	CHALLENGES IN BLOCKCHAIN	11 hours
Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machine to machine communication –Data management in industry 4.0–future prospects. Block chain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	60 hours
Text Books		
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Gold feder, “Bitcoin and Crypto currency Technologies: A Comprehensive Introduction”, Princeton University Press (July 19, 2016).	
2	Antonopoulos, “Mastering Bitcoin: Unlocking Digital Crypto currencies”	
Reference Books		
1	Satoshi Nakamoto, “Bitcoin: A Peer-to-Peer Electronic Cash System”	
2	Rodrigoda Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh, “Blockchain Technology for Industry 4.0” Springer 2020.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.javatpoint.com/blockchain-tutorial	
2	https://www.tutorialspoint.com/blockchain/index.htm	
3	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	WEB SERVICES			L	T	P	C
Core/Elective/Supportive	Elective			4			4
Pre-requisite	Basics of Distributed Computing						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Present the Web Services , Building real world Enterprise applications using Web Services with Technologies XML, SOAP , WSDL , UDDI 2. Get overview of Distributed Computing, XML, and its technologies 3. Update with QoS and its features 4. Develop Standards and future of Web Services 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand web services and its related technologies					K1,K2	
2	Understand XML concepts					K2,K3	
3	Analyze on SOAP and UDDI model					K4,K5	
4	Demonstrate the road map for the standards and future of web services					K5	
5	Analyze QoS enabled applications in web services					K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					12 hours	
Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms.							
Unit:2	XMLFUNDAMENTALS					12 hours	
XMLFundamentals–XMLdocuments-XMLNamespaces-XMLSchema–ProcessingXML.							
Unit:3	SOAP MODEL					12 hours	
SOAP: The SOAP model- SOAP messages-SOAP encoding- WSDL: WSDL structure-interface definitions-bindings-services-Using SOAP and WSDL-UDDI: About UDDI-UDDI registry Specification- Core data structures-Accessing UDDI							
Unit:4	TECHNOLOGIESANDSTANDARDS					12 hours	
Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. Workflow: business process management- workflows and workflow management systems Security: Basics-data handling and forwarding- data storage-errors-Web services security issues.							

Unit:5	QUALITYOFSERVICE	10 hours
Quality of Service: Importance of QoS for web services-QoS metrics-holes-design patterns-QoS enabled web services-QoS enabled applications. Web services management-web services standards and future trends.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	60 hours
Text Books		
1	Sandeep Chatterjee, James Webber, “Developing Enterprise Web Services: An Architects Guide”, Prentice Hall, Nov 2003.	
2	Keith Ballinger, “NET Web services: Architecture and Implementation with .Net”, Pearson Education, First Edition, Feb 2003.	
Reference Books		
1	RameshNagappan,“DevelopingJavaWebServices:Architectinganddevelopingsecure Web Services Using Java”, John Wiley and Sons, first Edition Feb 2003.	
2	EricAMarksandMarkJWerrell,“ExecutiveGuidetoWebservices”,JohnWileyand sons, March 2003.	
3	AnneThomasManes,“WebServices:AmanagersGuide”,AddisonWesley,June2003.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Website setc.]		
1	https://www.tutorialspoint.com/webservices/index.htm	
2	https://www.javatpoint.com/web-services-tutorial	
3	https://www.btechguru.com/training--programming--xml--web-services--web-services-part-1-video-lecture--11801--24--147.html	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	M	M	M	S
CO2	S	S	S	M	M	S	M	S	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	ROBOTICPROCESSAUTOMATION FOR BUSINESS			L	T	P	C
Core/Elective/Supportive	Elective			4			4
Pre-requisite	Basics of Robots & its Applications						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Learn the concepts of RPA, its benefits, types and models. 2. Gain the knowledge in application of RPA in Business Scenarios. 3. Identify measures and skills required for RPA 							
Expected Course Outcomes:							
On the successful completion of the course, student twill be able to:							
1	Demonstrate the benefits and ethics of RPA					K1,K2	
2	Understand the Automation cycle and its techniques					K2	
3	Draw inferences and information processing of RPA					K3,K4	
4	Implement & Apply RPA in Business Scenarios					K5	
5	Analyze on Robots & leveraging automation					K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					12 hours	
Introduction to RPA –Overview of RPA –Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA –Centre of Excellence –Types and their applications –Building an RPA team -Approach for implementing RPA initiatives.							
Unit:2	AUTOMATION					12 hours	
RoleofaBusinessManagerinAutomationinitiatives-SkillsrequiredbyaBusinessManagerfor successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people.							
Unit:3	AUTOMATIONIMPLEMENTATION					12 hours	
Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows.							
Unit:4	ROBOT					12 hours	

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.		
Unit:5	ROBOT SKILL	10 hours
Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	60 hours
Text Books		
1	Alok Mani Tripathi” Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool” Packt Publishing Limited March 2018.	
2	TomTauli“TheRoboticProcessAutomationHandbook”Apress,February2020.	
Reference Books		
1	Steve Kaelble, ”Robotic Process Automation” John Wiley & Sons, Ltd., 2018	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/uiopath/uiopath_robotic_process_automation_introduction.htm	
2	https://www.javatpoint.com/rpa	
3	https://onlinecourses.nptel.ac.in/noc19_me74/preview	
Course Designed By:		

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I.A	ESE	Total
Semester - III						
Core Theory Advanced Java Programming	4	4	3	25	75	100
Core Theory Web Technologies	4	4	3	25	75	100
Core Theory Advanced Machine Learning Technologies	4	4	3	25	75	100
Core Lab Advanced Java Programming-Lab	2	3	3	40	60	100
Core Lab Web Technologies Lab	2	3	3	40	60	100
Core Lab Advanced Machine Learning Lab	1	2	3	40	60	100
Supportive Course	4	4	3	25	75	100
Elective-04 Theory	3	3	3	25	75	100
Elective-04 lab	1	2	3	40	60	100
	25	30				900

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I.A	ESE	Total
Semester - IV						
Option - 1						
Core (Option 1) Credit Seminar	2	2	-	100		100
Core (Option 1) Major Project and Viva-Voce	12	-	-	50	150	200
Total	14	2				300
	92					3100
Option - 2						
Core (Option 2) Credit Seminar	2	2	-	100		100
Core Theory (Option 2) Natural Language Processing	4	4	3	25	75	100
Core (Option 2) Project and Viva-Voce	08	14	-	50	150	200
	14	20				400
Total	92					3200

Semester -III

Course code	CLOUD COMPUTING	L	T	P	C
Core/Elective/ Supportive	Core -VII	4			4
Pre-requisite	Basics of Cloud & its Applications				
Course Objectives:					
The main objectives of this course are to: Gain knowledge on cloud computing, cloud services, architectures and applications.					
<ol style="list-style-type: none"> 1. Enable the students to learn the basics of cloud computing with real time usage 2. How to store and share, in and from cloud? 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the concepts of Cloud and its services				K1,K2
2	Collaborate Cloud for Event & Project Management				K3,K4
3	Analyze on cloud in –Word Processing, Spread Sheets, Mail, Calendar, Database				K4,K5
4	Analyze cloud in social networks				K5,K6
5	Explore cloud storage and sharing				K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create					
Unit:1	INTRODUCTION	12hours			
INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.					
Unit:2	CLOUD COMPUTING	12hours			
CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloud computing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.					
Unit:3	CLOUD SERVICES	12hours			
USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.					
Unit:4	OUTSIDE THE CLOUD	12hours			

OUTSIDE THE CLOUD Evaluating web mail services, Evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating online Groupware, collaborating via blogs and wikis.

Unit:5	STORING AND SHARING	10hours
STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
Total Lecture hours		60hours
Text Books		
1	Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009.	
Reference Books		
1	Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata Mc Graw Hill Education Private Limited, 2009.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106/105/106105167/	
2	https://www.tutorialspoint.com/cloud_computing/index.htm	
3	https://www.javatpoint.com/cloud-computing-tutorial	

Mapping with Programming Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	M	S	M	S	M	M	M	S
CO2	M	S	M	S	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Semester -III

Course code	NETWORK SECURITY AND CRYPTOGRAPHY	L	T	P	C
Core/Elective/Supportive	Core - VIII	4			4
Pre-requisite	Basics of Networks & its Security				
Course Objectives:					
The main objectives of this course are to:					
<ol style="list-style-type: none"> 1. Enable students to learn the Introduction to Cryptography, Web Security and Case studies in Cryptography. 2. To gain knowledge on classical encryption techniques and concepts of modular arithmetic and number theory. 3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms. 4. To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email. 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the process of the cryptographic algorithms				K1,K2
2	Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication				K2,K3
3	Apply and analyze appropriate security techniques to solve network security problem				K3,K4
4	Explore suitable cryptographic algorithms				K4,K5
5	Analyze different digital signature algorithms to achieve authentication and design secure applications				K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create					
Unit:1	INTRODUCTION	12hours			
Introduction to Cryptography – Security Goals & Attacks – Security Services – Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA- RC5					
Unit:2	CRYPTO SYSTEM	12hours			
Public-key Crypto system: RSA Algorithm–Rabin Crypto system Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.					

Unit:3	NETWORK SECURITY	12hours
Authentication Applications– Key Management - Kerberos–Diffie-Hellman Key exchange – Public key distribution - X.509Authentication services and Encryption Techniques.		
Unit:4	WEB SECURITY	10hours
Web Security- E-mail Security – PGP – S / MIME – IP Security – Secure Socket Layer– Secure Electronic Transaction.		
Unit:5	SYSTEM SECURITY	12hours
System Security-Intruders and Viruses – Firewalls– Password Security. Network Forensic – Security Audit - Other Security Mechanism: Introduction to: Stenography –Quantum Cryptography – Water Marking - DNA Cryptography		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars–webinars		
Total Lecture hours		60 hours
Text Books		
1	Behrouz A Forouzan,“CryptographyandNetworkSecurity”,3 edition McGrawHill,2015	
2	BruceSchneir, “Applied Cryptography”, CRC Press.	
Reference Books		
1	A.Menezes, P Van Oorschot and S.Vanstone, “Hand Book of Applied Cryptography”, CRC Press, 1997	
2	AnkitFadia,” Network Security”, MacMillan.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106/105/106105031/	
2	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html	
3	https://www.tutorialspoint.com/cryptography/index.htm	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	S	M	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Semester – III

Course code	DATA SCIENCE & ANALYTICS	L	T	P	C
Core/Elective/Supportive	Core - IX	4			4
Pre-requisite	Basics of Data Science & its Applications				
Course Objectives:					
The main objectives of this course are to:					
<ol style="list-style-type: none"> 1. Introduce the students to data science, big data & its ecosystem. 2. Learn data analytics & its life cycle. 3. To explore the programming language R, with respect to the data mining algorithms. 4. Relate the relationship between artificial intelligence, machine learning and data science. 					
Expected Course Outcomes:					
On the successful completion of the course, student will be able to:					
1	Understand the concept of data science and its techniques				K1,K2
2	Review data analytics				K2,K3
3	Apply and determine appropriate Data Mining techniques using R to real time applications				K3,K4
4	Analyze on clustering algorithms				K4,K5
5	Analyze on regression methods in AI				K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5 -Evaluate; K6-Create					
Unit:1	INTRODUCTION				12hours
Introduction of Data Science: data science and big data–facets of data-data science process- Ecosystem- The Data Science process – six steps- Machine Learning.					
Unit:2	BASICS OF DATA ANALYTICS				12hours
Data Analytics life cycle-review of data analytics-Advanced data Analytics-technology and tools.					
Unit:3	DATA ANALYTICS USING R				12hours
Basic Data Analytics using R : R Graphical User Interfaces – Data Import and Export – Attribute and Data Types –Descriptive Statistics – Exploratory Data Analysis – Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables – Data Exploration Versus Presentation.					
Unit:4	CLUSTERING				12hours
Overview of Clustering : K-means – Use Cases – Overview of the Method – Perform a K-means Analysis using R –Classification – Decision Trees – Overview of a Decision Tree – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Tree in R – Bayes’ Theorem – Naïve Bayes Classifier – Smoothing – Naïve Bayes in R.					

Unit:5	ARTIFICIAL INTELLIGENCE	10hours
Artificial intelligence: Machine Learning and deep learning in data science-Clustering, association rules. Linear regression-logistic regression-Additional regression methods.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		60hours
Text Books		
1	Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools-2016. Pdf	
2	Data science in big data analytics-Wiley2015JohnWiley&Sons	
Reference Books		
1	A simple introduction to Data Science-LarsNielson2015	
2	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication	
3	R Programming for Data Science-Roger D.Peng 2015LeanPublication	
4	Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data	
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/python_data_science/index.htm	
2	https://www.javatpoint.com/data-science	
3	https://nptel.ac.in/courses/106/106/106106179/	

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	DIGITAL IMAGE PROCESSING			L	T	P	C
Core/Elective/ Supportive	Elective			4			4
Pre-requisite	Basics of Image Processing						
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Learn basic image processing techniques for solving real problems. 2. Gain knowledge in image transformation and Image enhancement techniques. 3. Learn Image compression and Segmentation procedures. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand the fundamentals of Digital Image Processing						K1,K2
2	Understand the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement						K2,K3
3	Apply, Design and Implement and get solutions for digital image processing problems						K3,K4
4	Apply the concepts of filtering and segmentation for digital image retrieval						K4,K5
5	Explore the concepts of Multi-resolution process and recognize the objects in an efficient manner						K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
Unit:1	INTRODUCTION					12hours	
Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.							
Unit:2	IMAGE ENHANCEMENT					12hours	
Image Enhancement in the spatial domain: - Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods.							
Unit:3	IMAGE RESTORATION					12hours	
Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.							

Unit:4	IMAGE COMPRESSION	11hours
Image Compression: Fundamentals–Image compression models–Elements of Information Theory – Error Free compression – Lossy compression – Image compression standards.		
Unit:5	IMAGE SEGMENTATION	11hours
Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
Total Lecture hours		60hours
Text Books		
1	Rafael C. Gonzalez, Richard E. Woods, “ Digital Image Processing”, Second Edition, PHI/ Pearson Education.	
2	B.Chanda, D.Dutta Majumder, “Digital Image Processing and Analysis”, PHI, 2003.	
Reference Books		
1	Nick Efford, “Digital Image Processing a practical introducing using Java”, Pearson Education, 2004.	
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/117/105/117105135/	
2	https://www.tutorialspoint.com/dip/index.htm	
3	https://www.javatpoint.com/digital-image-processing-tutorial	

Mapping with Programming Outcomes										
Cos	PO1	PO 2	PO3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO10
CO1	S	M	S	S	S	M	S	M	M	S
CO2	S	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

DEEP LEARNING – Elective

a. **Course Code:** -----

b. **Course objectives :**

- To learn the fundamentals of Neural Network.
- To learn components, architectures and applications of CNN.
- To study RNN , LSTM, GPU and Deep RNN.
- To study about different types of Autoencoders and RBM.
- To know about Open-Source Frameworks for Deep Learning.
- To implement Image Classification, Stock Market Prediction and Tamil Handwritten Character Optical Recognition Applications using Deep Learning.

c. **Course Outcomes:**

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

CO1: Explain various components, architectures and applications of CNN.

CO2: Understand RNN, LSTM, GPU and Deep RNN architectures.

CO3: Know about different types of Autoencoders and RBM.

CO4: Explain various Open-Source Frameworks for Deep Learning.

CO5: Implement Image Classification, Stock Market Prediction, Tamil Handwritten Character Optical Recognition Applications using Deep Learning Models.

e. **Course Outline:**

Unit 1:

9 Hours

Fundamentals of Neural Network: Introduction – Types of Machine Learning (Classification Problem, The Regression Problem, Overfitting and Underfitting, Bias and Variance) – Overview of Artificial Neural Networks(Biological neuron, Types of Artificial Neural Networks, Optimization Techniques, Vanishing Gradient problem, Exploding Gradient problem, Weight Initialization, What is Deep Learning).

Unit 2:

9 Hours

Convolutional Neural Network: Introduction – Components of CNN Architecture(Convolution Layer, Pooling or Downsampling Layer, Flattening Layer, Fully Connected Layer) – ReLu Layer(Leaky ReLU and Randomized ReLU) – ELU(Maxout) – Unique Properties of CNN(Weight Sharing, Translation Invariance) – Architectures of CNN(LeNet, AlexNet, ZFNet, GoogLeNet,VGGNet,ResNet,DenseNet) – Applications of CNN(Object Detection, Face Recognition, Scene Labeling, Optical Character Recognition OCR, Handwritten Digit Recognition). **Recurrent Neural Network:** Basic Concepts: Introduction (RNN versus CNN, Feedforward Neural Network versus RNN) – Simple RNN (**Training** an RNN, Backpropagation through Time (BPTT) Illustration,RNN Topology, Challenges with Vanishing Gradients, Bidirectional and Stateful RNNs)- LSTM– LSTM Implementation – Gated Recurrent Unit (GRU) – Deep RNN.

Unit 3:

9 Hours

Autoencoders: Introduction – Features of Autoencoder – Types of Autoencoder(Vanilla AutoEncoder, MultiLayer Autencoder, Stacked Autoencoder, Deep Autoencoder,Denoising Autoencoder, Convolutional autoencoder,Regularization in Autoencoder) **Restricted Boltzmann Machine:** Boltzmann Machine – RBM Architecture(Energy based Model, Gibbs Distribution Model, Gibbs Sampler, Contrastive Divergence) – Example – Types ofRBM.

Unit 4:**9 Hours**

Open-Source Frameworks for Deep Learning: Environment Setup – Deep Learning with Python – Scientific Python (Numerical Python(Numpy), Matplotlib, Pandas) – Frameworks(TensorFlow, Keras, PyTorch).

Unit 5:**9 Hours****Applications of Deep Learning:**

Introduction – Image Classification Using CNN (Problem Description, Language and Framework, Dataset, Code Snippets, Complete Code, Result) – Stock Market Prediction Using RNN (Problem Description, Language and Framework, Dataset, Code Snippets, Complete Code, Result) – Tamil Handwritten Character Optical Recognition Using CRNN(Problem Description, Language and Framework, Dataset, Code Snippets, Complete Code, Result).

e. Mapping of COs to POs and PSOs

Course Outcome	PO Addressed PO1 to PO7		Correlation Level L/M/H		PSO Addressed dPSO1 to PSO7		Correlation Level L/M/H		Cognitive Level K1 to K6
							M	H	
CO1	PO1		M		PSO1	PSO5	M	H	K1
CO2	PO2	PO3	M	H	PSO2	PSO3	M	H	K2, K3, K6
CO3	PO4		M		PSO4		M		K2, K3
CO4	PO5		M		PSO5		M		K2, K4, K5, K6
CO5	PO2	PO6	M	H	PSO2	PSO6	M	H	K3, K4, K5,

(L – Low, M – Medium, H – High; K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5–Evaluate, K6 – Create)

f. Reference Books:

1. Deep Learning using Python - Lovelyn, S., Rose, L. Ashok kumar, D. Karthika Renuka, Wiley India Pvt. Ltd., First Edition, 2019.
2. Deep Learning with TensorFlow 2 and Keras - Antonio Gulli, Amita Kapoor, Sujit Pal, Packt Publishing, Second Edition, 2019.
3. Advanced Deep Learning with TensorFlow 2 and Keras - Rowel Atienza, , Packt Publishing, Second Edition, 2020.
4. On Deep Learning Algorithms with Python- Hands,- Packt Publishing, 2019

Course code	WEB APPLICATION DEVELOPMENT AND HOSTING			L	T	P	C
Core/Elective/ Supportive	Elective – Semester III					2	2
Pre-requisite	Basic Programming using HTML tags						
Course Objectives:							
The main objectives of this course are to:							
1. Able to design a web page using HTML tags							
2. To enable the students to use Framesets, hyper links and different formatting features of HTML tags							
3. Enable the students to use Forms & other controls in a webpage							
4. To create interactive applications using PHP							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand & implement the basic HTML tags to create static web pages					K1,K2	
2	Capable of using hyper links, frames, images, tables, in a webpage					K2,K3	
3	Able to write dynamic web applications using HTML forms					K4,K5	
4	Must be able to write dynamic web applications in PHP & HTML tags using XAMPP.					K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create							
LIST OF PROGRAMS						30hours	
1. Develop a website for your college using advanced tags of HTML. 2. Write names of several countries in a paragraph and store it as an HTML document, world.html. Each country name must be a hot text. When you click India (for example), it must open india.html and it should provide a brief introduction about India. 3. Develop a HTML document to i)display Text with Bullets / Numbers - Using Lists ii) to display the Table Format Data 4. Develop a Complete Web Page using Frames and Framesets which gives the Information about a Hospital using HTML. 5. Write a HTML document to print your Bio-Data in a neat format using several components. 6. Develop a HTML document to display a Registration Form for an inter-collegiate function. 7. Using HTML form accept Customer details like Name, City, Pin code, Phone number and Email address and validate the data and display appropriate messages for violations using PHP (Eg. Name is Mandatory field ; Pin code must be 6 digits, etc.). 8. Write a program to accept two numbers n1 and n2 using HTML form and display the Prime Numbers between n1 and n2 using PHP.							
Total Lecture hours						30 hours	

Text Books	
1	Ivan Bayross, “Web Enabled Commercial Applications Development Using HTML, JavaScript, DHTML and PHP”, BPB Publications, 4th Revised Edition, 2010.
Reference Books	
2	A.K. Saini and Sumint Tuli, “Mastering XML”, First Edition, New Delhi, 2002.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/xml/index.htm
2	https://www.tutorialspoint.com/internet_technologies/websites_development.htm
3	https://www.youtube.com/watch?v=PlxWf493en4

Mapping with Programming Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Semester - III
MOBILE APPLICATION DEVELOPMENT – Elective

a. **Course code:**

b. **Course Objectives:**

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

c. **Course Outcome:**

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

- CO1:** Describe the requirements for mobile applications
- CO2:** Explain the challenges in mobile application design and development
- CO3:** Develop design for mobile applications for specific requirements
- CO4:** Implement the design using Android SDK
- CO5:** Implement the design using Objective C and iOS
- CO6:** Deploy mobile applications in Android and iPhone market place for distribution

d. **Course Prerequisite:**

Should have knowledge of Android Application, and wireless networks

e. **Course Outline:**

UNIT I:

9 Hours

Introduction: Introduction to Mobile Computing – Introduction to – Android Development Environment -Factors in Developing Mobile Applications: Mobile Software Engineering – Frameworks and Tools – Generic UI Development – Android User.

1. UNIT II

9 Hours

More on UIs: VUIs and Mobile Apps – Text-to-Speech Techniques – Designing the Right UI – Multichannel and Multi modal UIs – Intents and Services: Android Intents and Services – Characteristics of Mobile Applications –Successful Mobile Development.

2. UNIT III

9 Hours

Storing and Retrieving Data: Synchronization and Replication of Mobile Data – Getting the Model Right –Android Storing and Retrieving Data – Working with a Content Provider – Communications Via Network and the Web: State Machine – Correct Communications Model – Android Networking and Web.

4. UNIT IV**9Hours**

Telephony: Deciding Scope of an App – Wireless Connectivity and Mobile Apps – Android Telephony – Notifications and Alarms: Performance – Performance and Memory Management – Android Notifications and Alarms.

5. UNIT V**9 Hours**

Graphics: Performance and Multithreading –Graphics and UI Performance – Android Graphics and - Multimedia: Mobile Agents and Peer-to-Peer Architecture – Android Multimedia – Location: Mobility and Location Based Services.

f. Mapping of COs to POs and PSOs

Course Outcome	PO Addressed PO1 to PO7		Correlation Level L/M/H		PSO Addressed PSO1 to PSO7		Correlation Level L/ M/ H		Cognitive Level K ₁ to K ₆
CO1	PO1		H		PSO3		L		K ₁
CO2	PO2	PO3	M	M	PSO1	PSO4	M	H	K ₂
CO3	PO2	PO4	H	M	PSO1	PSO2	H	H	K ₃
CO4	PO1	PO5	H	M	PSO1		H		K ₄
CO5	PO4		H		PSO6		M		K ₅
CO6	PO6	PO7	H	H	PSO6		H		K ₆

(L – Low, M – Medium, H – High; K₁ – Remember, K₂ Understand, K₃ – Apply, K₄ – Analyze, K₅– Evaluate, K₆– Create)

g. Reference books

1. G. Luger, W. A. Stubblefield, “Artificial Intelligence”, Third Edition, Addison – Wesley Longman, 1998. N. J Nilsson, “Principles of Artificial Int

Course code		PRACTICALV:DIGITAL IMAGE PROCESSING Using MATLAB	L	T	P	C
Core/Elective/Supportive		Lab V – SEMESTER III			4	4
Pre-requisite		Basic Programming of Image Processing & an intro to MATLAB				
Course Objectives:						
The main objectives of this course are to:						
1.To understand the basics of Digital Image Processing fundamentals, image enhancement and image restoration techniques						
2. Toenablethestudentstolearnthefundamentals of image compression and segmentation						
3. To understand Image Restoration & Filtering Techniques						
4. Implementation of the above using MATLAB						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To write programs in MATLAB for image processing using the techniques					K1,K2
2	To able to implement Image Enhancements & Restoration techniques					K2,K3
3	Capable of using Compression techniques in an Image					K3,K4
4	Must be able to manipulate the image and Segment it					K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
LIST OF PROGRAMS					60hours	
1. Implement Image enhancement Technique. 2. Histogram Equalization 3. Image Restoration. 4. Implement Image Filtering. 5. Edge detection using Operators(Roberts, Prewitts and Sobels operators) 6. Implement image compression. 7. Image Subtraction 8. Boundary Extraction using morphology. 9. Image Segmentation						
Total Lecture hours					60hours	
Text Books						
1	Rafael C.Gonzalez, Richard E.Woods,“ Digital Image Processing ”, Second Edition, PHI/Pearson Education.					
2	B.Chanda, D.Dutta Majumder,“ Digital Image Processing and Analysis ”, PHI, 2003.					
Reference Books						
1	NickEfford,“DigitalImageProcessingapracticalintroducingusingJava”,Pearson Education, 2004.					

	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial

Mapping with Programming Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low