M.Sc. (Computer Science)

Curriculum and Syllabus

for the
AFFILIATED COLLEGES
of

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI-12

Learning Outcome-based Curriculum Framework (LOCF)
based on the TANSCHE Curriculum

With effect from 2024-2025 onwards

VISION AND MISSION OF THE UNIVERSITY

Vision
"To provide quality education to reach the un-reached"

Mission
- To conduct research, teaching and outreach programs to improve conditions of human living
- To create an academic environment that honors women and men of all races, castes, creeds, and cultures and an atmosphere that values intellectual curiosity, the 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 partnerships with industries and government to improve the quality of the workplace and to serve as the 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-abled

M.Sc. COMPUTER SCIENCE PROGRAMME

Preamble
The M.Sc. The Computer Science Programme is introduced to develop postgraduates in **Computer Science** with a deep knowledge of theoretical Computer Science who can be employed in research and development units of industries and academic institutions and could pursue higher studies.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To prepare the students to understand the core concepts in **Computer Science**
2. Enable students to develop problem-solving and programming skills in the recent technologies thereby developing strong employability
3. Empower students to prepare themselves to engage in active research
4. Enable students to pursue competitive exams at the National and state levels such as NET/SLET/GATE

Name of the Programme	M.Sc., Computer Science
Programme Code	
Duration	PG - Two Years
Programme Outcomes (POs)	**Programme Outcomes (POs) for M. Sc Computer Science are as follows** At the end of the course, Students will be able to perform the following **PO1: Computational Knowledge** Understand the basic foundations of Computer Science, Computing Fundamentals with Basic Mathematics. **PO2: Problem Analysis** Analyze and identify customer requirements in multidisciplinary domains, create high-level designs and implement robust software applications using the latest technological skills. **PO3: Design and Development** Design and develop solutions for complex problems in various domains. Serve as the Programmers or the Software Engineers with sound knowledge of practical and theoretical concepts for developing software. **PO4: Research Activity** Understand the fundamentals of research and inculcate the ability to undertake original research at the cutting edge of computer science & its related areas. Produce researchers who can investigate problems in different application domains and creatively develop, and evaluate computational solutions.

	PO5: Software tool usage Adapt and apply modern computing skills and tools to resolve problems with software development tools, software systems, and modern computing platforms. **PO6: Professional ethics** Understand professional ethics and Cyber regulations and develop systems with social commitments. **PO7: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO8: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO9: Social Responsibility** Access Social and Environmental issues for local and global needs and give relevant solutions to them. **PO10: Entrepreneurship** Identify opportunities for entrepreneurship by creating and adding value for the betterment of an individual and society at large.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, and beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur**

	To create effective entrepreneurs by enhancing their critical thinking, problem-solving, decision making and leadership skills that will facilitate startups and high-potential organizations. **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. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of society by collaborating with stakeholders for mutual benefit.

REGULATIONS of the PROGRAMME

Duration of the Programme: Two years (4 Semesters)

Eligibility: Students with a three-year Bachelor's degree in Computer Science / Computer Applications / Information Technology/Software Engineering/AI/Computer Science with AI/Data Science/Cyber Security or any other degree accepted by the Syndicate of Manonmaniam Sundaranar University as equivalent in the 10+2+3 pattern

Credit Distribution for the PG Programme

Semester–I	Credit	Semester-II	Credit	Semester-III	Credit	Semester–IV	Credit
1.1. Core-I	4	2.1. Core-IV	4	3.1. Core-VI	4	4.1 Project with Viva-Voce	16
1.2 Core-II	4	2.2 Core-V	4	3.2 Core-VII	4	4.2 Extension Activity	1
1.3 Core – III	4	2.3 Elective (Generic / Discipline Centric) – III	3	3.3 Core – VIII	4		
1.4 Elective (Generic / Discipline Centric)- I	3	2.4 Elective (Generic / Discipline Centric)-IV	3	3.4 Elective (Generic / Discipline Centric) – V	3		
1.5 Elective (Generic / Discipline Centric)-II	3	2.5 Core Practical 3	3	3.5 Mini Project	6		
1.6 Core Practical 1	3	2.6 Core Practical 4	3	3.6 Core Practical 5	3		
1.7 Core Practical2	3	2.7 Skill Enhancement Course SEC 1	2	3.7 Skill Enhancement Course – SEC 2	2		
				3.8 Internship/ Industrial Activity	2		
	24		22		28		17
						Total Credit Points	91

Component-wise Credit Distribution

Credits	Sem I	Sem-II	Sem III	Sem IV	Total
Core/Core LAB/Mini Project/ Major Project	18	14	15+6	16	69
Electives (i)Discipline– Centric	6	6	3		15
(ii Skill Enhancement		2	2		4
(iii)Summer Internship / Industrial Training/ Project			2		
Extension Activities				1	3
Total Credits	24	22	28	17	91

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test (15)	**25 Marks**
	Assignments / Snap Test / Quiz (5)	
	Seminars (5)	
External Evaluation	End Semester Examination	**75 Marks**
	Total	**100 Marks**
METHODS OF ASSESSMENT		
Remembering (K1)	• 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)	• Understanding of facts and idea s 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)	• Students will be able to solve problems by using/applying a concept learned in the classroom. • Students must use their knowledge to determine a exact response.	
Analyze (K4)	• Analyzing the question that asks the students to break down something in to its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.	
Evaluate (K5)	• 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)	• 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

Scheme of Examination / Question Paper Pattern I - Theory Course:

(Total Marks: 100 (Internal: 25 Marks, External: 75 Marks)

Parameters Students shall secure passes in both internal and external and also obtain 50 marks together to get a pass	
CIA- Internal Marks	**End semester Examination - External Marks**
i. Average of best two tests from three: 15 Marks ii. Seminar: 05 Marks iii. Assignment: 05 Marks Total : 25 Marks	Total: 75 Marks
Passing a minimum of 40% i.e. 10 marks	Passing a minimum of 50% i.e. 38 marks

Practical Courses: Assessment Components (External: Internal (CIA) – 50: 50)

Passing Criteria for Practical Examinations:

There is **no Passing Minimum for the Continuous Internal Assessment (CIA)** component. But overall (CIA+ External), a student shall secure a minimum of 50% or more to get a pass.

End Semester Practical Examinations

Practical examinations will be conducted at the end of each semester. The scheme of valuation is to be decided by the respective board of Question setters before the commencement of Practical exams.

External (End Semester) examination question pattern:

Time: 3 Hours   Max. Marks: 75

Part – A

(15*1=15)

Answer all the questions

15 Questions, three objective type questions from each unit.

Part – B

(5*4=20)

Answer all the questions

Five Questions, two short answer type questions from each unit with internal choice

(Either ...Or... type)

Part – C

(5*8=40)

Answer all the questions

Five Questions, two descriptive/Analytical type questions from each unit with internal choice

(Either ...Or... type)

M.Sc., Computer Science

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
Core - I	Analysis & Design of Algorithms	4	5		25	75	100
Core – II	Object Oriented Analysis and Design & C++	4	5		25	75	100
Core – III	Python Programming	4	4		25	75	100
Elective - I	Advanced Software Engineering / Web Services /Multimedia and its Applications	3	4		25	75	100
Elective – II	Advanced Operating System/Advanced Computer Network/ Mobile Computing	3	4		25	75	100
Core Practical1	Algorithm Lab	3		4	50	50	100
Core Practical 2	Python Lab	3		4	50	50	100
	Total	24	22	8			
SECOND SEMESTER							
Core - IV	Data Mining and Warehousing	4	5		25	75	100
Core – V	Advanced Java Programming	4	5		25	75	100
Elective – III	Artificial Intelligence &Machine Learning/ Robotics Process Automation for Business/Cloud Computing	3	4		25	75	100
Elective – IV	IoT/Embedded System/Block Chain Technology	3	4		25	75	100
Core Practical 3	Data Mining Lab using R	3		4	50	50	100
Core Practical 4	Advanced Java Lab	3		4	50	50	100
SEC 1	Statistical Tools	2	4		25	75	100
	Total	22	22	8			

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
THIRD SEMESTER							
Core - VI	Digital Image Processing	4	5		25	75	100
Core – VII	Network Security and Cryptography	4	4		25	75	100
Core – VIII	Data Science & Analytics	4	4		25	75	100
Elective - V	Big Data Analytics/ Deep Learning /Critical thinking, Design Thinking & Problem Solving	3	4		25	75	100
Core Practical 5	Digital Image Processing Using MatLab	3		4	50	50	100
Mini Project	Web Application Development& Hosting	6		6	50	50	100
SEC 2	Cloud Computing Tools	2	3		25	75	100
Internship/ Industrial Activity/ Research Updation Activity		2	-				
	Total	28	20	10			
FOURTH SEMESTER							
Core Project	Project work and Viva-voce	16		30	50	50	100
	Extension Activity	1	-				
	Total	17		30			

Course code		ANALYSIS & DESIGN OF ALGORITHMS	L	T	P	C
Core/Elective/Supportive		**Core -I**	5			4
Pre-requisite		Basic Data Structures & Algorithms				

Course Objectives:

The main objectives of this course are to:

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, students will be able to:

1	Get knowledge about algorithms and determine their time complexity. Demonstrate specific search and sort algorithms using t h e divide and conquer technique.	K1, K2
2	Gain a good understanding of the Greedy method and its algorithm.	K2, K3
3	Able to describe graphs using dynamic programming techniques.	K3, K4
4	Demonstrate the concept of backtracking & branch and bound technique.	K5, K6
5	Explore the traversal and searching technique and apply it to trees and graphs.	K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	15hours

Introduction: - Algorithm Definition and Specification – Space Complexity- Time Complexity- Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heapsort- Graph.

Unit:2	TRAVERSALANDSEARCHTECHNIQUES	15hours

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	15hours

The Greedy Method: -General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path.

Unit:4	DYNAMIC PROGRAMMING	15hours

Dynamic Programming-General Method–Multistage Graphs–All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.			
Unit:5	**BACKTRACKING**		**13hours**
Backtracking: -General Method–8-QueensProblem–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	**75hours**
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	Goodrich, "Data Structures& Algorithms in Java", Wiley3rd 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 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://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

Course code		OBJECT-ORIENTED ANALYSIS AND DESIGN & C++	L	T	P	C
Core/Elective/Supportive		Core -II	5			4
Pre-requisite		Basics of C++ and Object-Oriented Concepts				

Course Objectives:

The main objectives of this course are to:

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 concerning OOAD

Expected Course Outcomes:

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

1	Understand the concept of Object-Oriented development and modelling 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 students with writing C++ program	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	**OBJECT MODEL**	**15hours**

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	**CLASSES AND OBJECTS**	**15hours**

Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects – Key Abstractions and Mechanism.

Unit:3	**C++ INTRODUCTION**	**15hours**

Introduction to C++-Input and output statements in C++-Declarations-control structures– Functions in C++.

Unit:4	**INHERITANCE AND OVERLOADING**	**13hours**

Classes and Objects–Constructors and Destructors–operators overloading–Type Conversion-Inheritance – Pointers and Arrays.

Unit:5	POLYMORPHISM AND FILES	15hours

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	75hours

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, SecondEdition,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

Course code		PYTHON PROGRAMMING	L	T	P	C
Core/Elective/Supportive		**Core – III**	4			4
Pre-requisite		Basics of any OO Programming Language				

Course Objectives:

The main objectives of this course are to:

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, students will be able to:

1	Understand the basic concepts 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**	**15hours**

Python: Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets–Comparison.

Unit:2		**CODE STRUCTURES**	**15hours**

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, PACKAGES AND CLASSES**	**15hours**

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–Inself Defense –Get and Set Attribute Values with Properties –Name Mangling for Privacy – Method Types – Duck Typing – Special Methods –Composition.

Unit:4		**DATA TYPES AND WEB**	**13hours**

Datatypes: Text Strings–Binary Data, **Storing and Retrieving Data:** File Input/Output–Structured Text Files – Structured Binary Files - Relational Databases – NoSQL Data Stores.

Web: Web Clients –Web Servers–Web Services and Automation

Unit:5	SYSTEMS AND NETWORKS	15hours

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 MapReduce – Working in the Clouds.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars –webinars

	Total Lecture hours	75hours

Text Books

1   BillLubanovic, "Introducing Python", O'Reilly, FirstEdition-SecondRelease,2014.

2   Mark Lutz, "Learning Python", O'Reilly, Fifth Edition, 2013.

Reference Books

1   David M. Beazley, "Python Essential Reference", Developer's Library, Fourth Edition,2009.

2   Sheetal Taneja, Naveen Kumar, "Python Programming-A Modular Approach", Pearson Publications.

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

Course code		CORE LAB I: ALGORITHM AND OOPS LAB	L	T	P	C
Core/Elective/Supportive		**Lab – I**			4	3
Pre-requisite		Basic Programming of C++ language				

Course Objectives:

The main objectives of this course are to:

1. This course covers the basic data structures like Stack, Queue, Tree, and List.
2. This course enables the students to learn the applications of the data structures using various techniques
3. It also enables the students to understand C ++ language concerning OOAD concepts
4. Application of OOPS concepts.

Expected Course Outcomes:

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

1	Understand the concepts of object-oriented concerning C++	K1, K2
2	Able to understand and implement OOPS concepts	K3, K4
3	Implementation of data structures like Stack, Queue, Tree, and List using C++	K4, K5
4	Application of the data structures for Sorting and searching using different techniques.	K5, K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS	75hours

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.

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 knap sack 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	**75hours**

Text Books

1	Goodrich, "Data Structures& Algorithms in Java", Wiley 3rd 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, Web sites 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		CORE LAB II: PYTHON PROGRAMMING LAB	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Lab – II**			4	3
Pre-requisite		Basics of any OO Programming Language				

Course Objectives:

The main objectives of this course are to:

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, students 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

LIST OF PROGRAMS	**75hours**

Implement the following in Python:

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 file operations.

9. Programs using modules.

10. Programs for creating dynamic and interactive Web Pages using forms.

Total Lecture hours	**75hours**

Text Books

1	Bill Lubanovic, "Introducing Python", O'Reilly, FirstEdition-SecondRelease,2014.
2	Mark Lutz, "Learning Python", O'Reilly, Fifth Edition, 2013.

Reference Books

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

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	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

Course code		DATA MINING AND WAREHOUSING	L	T	P	C
Core/Elective/Supportive		**Core – IV**	5			4
Pre-requisite		Basics of RDBMS & Algorithms				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.
2. Develop skills in 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, students 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 modelling 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	12hours

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.

Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.

Unit:2	ALGORITHMS	12hours

Classification: Introduction –Statistical–based algorithms -distance–based algorithms-decision tree-based algorithms-neural network-based algorithms–rule-based algorithms–combining techniques.

Unit:3	CLUSTERING AND ASSOCIATION	12hours

Clustering: Introduction–SimilarityandDistanceMeasures–Outliers–HierarchicalAlgorithms -Partitional Algorithms.

Association rules: Introduction - large item sets - basic algorithms – parallel &distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.

Unit:4	DATA WAREHOUSING AND MODELING	11hours

Data warehousing: introduction-characteristics of a data warehouse–data marts–other aspects

Of data mart. Online analytical processing: introduction -OLTP & OLAP systems.Data modelling – star schema for the multidimensional view –data modelling – multi-fact star schema or snowflake 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	60hours

Text Books

1	Margaret.Dunham, "Data Mining: Introductory and Advanced Topics", 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

– SEMESTER

Course code		ADVANCED JAVA PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core – VI	5			4
Pre-requisite		Basics of Java & its Usage				

Course Objectives:

The main objectives of this course are to:

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, students 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 events 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	BASICS OF JAVA	12hours

Java Basics Review: Components and event handling–Threading concepts–Networking features – Media techniques

Unit:2	REMOTE METHOD INVOCATION	12hours

Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons-Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces

Unit:3	DATABASE	10hours

Java in Databases-JDBC principles–database access-Interacting-database search–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-Reading data from a client-Reading HTTP request header-sending data to a client and writing 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	ADVANCED TECHNIQUES	12hours

JAR file format creation–Internationalization–Swing Programming–Advanced java Techniques		

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

	Total Lecture hours	60 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	JimKeogh," TheCompleteReferenceJ2EE", TataMcGrawHillPublishingCompanyLtd,2010.
2	DavidSawyerMcFarland,"JavaScriptAndJQuery-TheMissingManual", Oreilly Publications, 3rd Edition,2011.
3	Deitel and Deitel, "Java How to Program", Third Edition, PHI/Pearson Education Asia.
4	"Java: The Complete Reference" by Herbert Schildt

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		PRACTICAL III: DATA MINING USING R	L	T	P	C
Core/Elective/Supportive		Lab - III			4	3
Pre-requisite		Basics of DM Algorithms & R Programming				

Course Objectives:

The main objectives of this course are to:

1. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, and regression
2. To understand & write programs using the DM algorithms
3. To apply statistical interpretations for the solutions
4. Able to use visualization techniques for interpretations

Expected Course Outcomes:

On the successful completion of the course, students 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 visualization 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

LIST OF PROGRAMS	75hours

- Implement the Apriori algorithm to extract the association rule of data mining.
- Implement k-means clustering technique.
- Implement any Hierarchal Clustering.
- Implement Classification algorithm.
- Implement Decision Tree.
- Linear Regression.
- Data Visualization.

Total Lecture hours	75hours

Text Books

1	Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", 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.

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	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	3
Pre-requisite		Basics in Java Programming				

Course Objectives:

The main objectives of this course are to:

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, students will be able to:

1	Understand 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 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

LIST OF PROGRAMS	75hours

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 an Employee pay slip using JSP.
6. Write a program using JDBC for creating a table, Inserting, deleting records and listing 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 headers it receives along with their associated values.
9. Write a program in JSP by using a session object.
10. Write a program to build a simple Client Server application using RMI.
11. Create an apple 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	**75hours**

	Text Books
1	JamieJaworski,"JavaUnleashed",SAMSTechmediaPublications,1999.
2	Campione, Walrath and Huml,"TheJavaTutorial",AddisonWesley,1999.

	Reference Books
1	JimKeogh,"TheCompleteReferenceJ2EE",Tata Mc Graw Hill Publishing Company Ltd,2010.
2	DavidSawyerMcFarland,"JavaScriptAndJQuery-TheMissingManual",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

Skill Enhancement Course 1: STATISTICAL TOOLS

L	T	P	C
4	0	0	2

Prerequisites:

- Fundamentals of Statistics.

Objectives:

- Understand the difference between descriptive & inferential statistics.
- Understand the importance of sample size calculations and the required input parameters.
- Analyze data more quickly and more accurately.

Outcomes:

- Ability to use the statistical tools for analysis.

UNIT 1

Introduction- Descriptive and Inferential Statistics-Variables and types of data-Data Collection and sampling technique-Uses and Misuses of Statistics

UNIT 2

Organizing data-Histogram, Frequency Polygon and Ogives-other types of graph-Measures of Central Tendency

UNIT 3

Classical Test statistics: Z-test, T-test, F-tests and Goodness of fit test

UNIT 4

Correlation and Regression- Scatter Plots-Analysis of Variance: one-way analysis of variance-Two-way analysis of variance

Unit 5

Statistics Packages : SPSS,MS-EXCEL,SAS,R-Programming, MiniTab

Text Book(s):

1. Allan G. Bluman, Elementary Statistics, 1992.
2. Dr. M.J de Smith, Statistical Analysis Handbook, 2014.
3. ARice, John. Mathematical Statistics and Data Analysis. Duxbury Press, 2006.
4. 4Statistics in a NutShell-Sarab Boslaugh & Paul Andrew Watters

Course code		**DIGITAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core VII**	4			5
Pre-requisite		Basics of Image Processing				

Course Objectives:

The main objectives of this course are to:

1. Learn basic image processing techniques for solving real problems.
2. Gain knowledge in information and image enhancement techniques.
3. Learn Image compression and Segmentation procedures.

Expected Course Outcomes:

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

1	Understand the fundamentals of Digital Image Processing	K1, K2
2	Understandthemathematicalfoundationsfordigitalimagerepresentation, 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	Applytheconceptsoffilteringandsegmentationfordigitalimageretrieval	K4, K5
5	Explore the concepts of the 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 grey 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	RafaelC.Gonzalez, Richard.Woods, "DigitalImageProcessing", SecondEdition,PHI/Pearson Education.
2	B.Chanda,D.DuttaMajumder,"DigitalImageProcessingandAnalysis",PHI, 2003.

ReferenceBooks

1	NickEfford,"DigitalImageProcessingapracticalintroducingusingJava",Pearson Education, 2004.

RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]

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

MappingwithProgrammingOutcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	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

III Semester

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:

1. Enable students to learn the Introduction to Cryptography, Web Security and Case Studies in Cryptography.
2. To gain knowledge of 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, SSL/TLS and email.

Expected Course Outcomes:

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

1	Understand the process of the cryptographic algorithms	K1,K2
2	Compareandapplydifferentencryptionanddecryptiontechniquestosolveproblems related to confidentiality and authentication	K2,K3
3	Applyandanalyzeappropriatesecuritytechniquestosolvenetworksecurity problem	K3,K4
4	Explore suitable cryptographic algorithms	K4,K5
5	Analyzedifferentdigitalsignaturealgorithmstoachieveauthenticationand 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 Attacks – Security Services –Security Algorithm- Stream cypher and Block cypher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.

Unit:2	CRYPTOSYSTEM	12hours

Public-key cryptosystem: Introduction to Number Theory-RSA algorithm–Key Management -Diffie-Hellman Key exchange–Elliptic Curve Cryptography Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.

Unit:3	NETWORK SECURITY	12hours

Network Security Practice: Authentication Applications–Kerberos–X.509Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.		

Unit:4	**WEB SECURITY**	**10hours**

WebSecurity-SecureSocketLayer–SecureElectronicTransaction.SystemSecurity-Intruders and Viruses – Firewalls– Password Security.

Unit:5	**CASE STUDY**	**12hours**

Case Study: Implementation of Cryptographic Algorithms–RSA–DSA–ECC(C/JAVA Programming).

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	**60hours**

Text Books

1	WilliamStallings,"CryptographyandNetworkSecurity", PHI/PearsonEducation.
2	BruceSchneir,"AppliedCryptography",CRC Press.

ReferenceBooks

1	A.Menezes, P Van Oorschot and S.Vanstone, "Hand Book ofApplied Cryptography", CRC Press, 1997
2	AnkitFadia,"NetworkSecurity",MacMillan.

RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]

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

MappingwithProgrammingOutcomes

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

III Semester

Course code		DATA SCIENCE & ANALYTICS	L	T	P	C
Core/Elective/Supportive		**Core IX**	4			4
Pre-requisite		Basics of Data Science & applications				

Course Objectives:
The main objectives of this course are to:

1. Introduce the students to data science, big data &its ecosystem.
2. Learn data analytics &its life cycle.
3. To explore the programming language, concerning 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, students will be able to:	

1	Understand the concept of data science and its techniques	K1,K2
2	Review data analytics	K2,K3
3	ApplyanddetermineappropriateDataMiningtechniquesusingRtorealtime applications	K3,K4
4	Analyze clustering algorithms	K4,K5
5	Analyze 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

DataAnalyticslifecycle-reviewofdataanalytics-AdvanceddataAnalytics-technologyand 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 DAVY CIELEN ARNO D. B. MEYSMAN MOHAMED ALI
2	Data Science & Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services, WILEY
1	Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools-2016. Pdf
2	Data science in big data analytics-Wiley2015JohnWiley&Sons

ReferenceBooks

1	AsimpleintroductiontoDataScience-LarsNielson2015
2	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication
3	R Programming for Data Science-RogerD.Peng 2015LeanPublication
4	DataScience&BigDataAnalytics:Discovering,Analyzing,VisualizingandPresenting Data
5	O'Reilly Media https://www.oreilly.com › view › machine-learning-and Supervised Learning: Models and Concepts

RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]

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/

MappingwithProgrammingOutcomes

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

III Semester

Course code		PRACTICAL V: DIGITAL IMAGE PROCESSING Using MATLAB	L	T	P	C
Core/Elective/Supportive		**Core**			4	3
Pre-requisite		Basic Programming of Image Processing& an Introduction 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. Toenablethestudentstolearnthefundamentalsofimagecompressionandsegmentation

3. To understand Image Restoration & Filtering Techniques

4. Implementation of the above using MATLAB

Expected Course Outcomes:

On the successful completion of the course, students 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	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	RafaelC.Gonzalez,RichardE.Woods,"Digital ImageProcessing",Second Edition,

	PHI/PearsonEducation.
2	B.Chanda,D.DuttaMajumder,"DigitalImageProcessingandAnalysis",PHI, 2003.
ReferenceBooks	
1	NickEfford,"DigitalImageProcessingapracticalintroducingusingJava",Pearson Education, 2004.
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
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

MappingwithProgrammingOutcomes										
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

Course code		**Mini Project**		**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**				6	6
Pre-requisite		Basic Programming of Software Tools & Introduction to developing Project work					

Course Objectives:

The main objectives of this course are to:
1. to enable the third-semester students to study Project development

2. to undertake a unique project title

3. to get a novel idea for the project

4. to define the problem

5. to design and implement using a n available software development tool /Programming
6. Prepare a report

Expected Course Outcomes:

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

1	To define the problem	K1,K2
2	Design the Project using Software tools	K2,K3
3	Capable of implementing the problem with techniques	K3,K4
4	Report Formation	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

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

Mini Project Guidelines

Mode of Mini Project: Individual Project

Nature of Mini Project: Every student shall undertake a unique project title (Novel Concept/ idea/system or a small research problem, which shall be designed and implemented using W e b A p p l i c a t i o n D e v e l o p m e n t a n d h o s t i n g using open-source software like Python, PHP, HTML,.NET etc., approved by her/his guide.

Guide: Each Student shall be allotted under the Guidance of one Department faculty member by the Programme coordinator/Head

Duration: One semester - (6 hours per week)

Students carry out the Mini Project work in her/his college itself. In the case of a Company project, students are permitted to do the mini-project work in reputed IT companies without affecting the minimum attendance and other classes of the third semester

Continuous Assessment: Based on periodic reviews (Three reviews during the semester. Tentative review dates are decided by the department and will be communicated to the students at the beginning of the third semester.)

Internal (CIA) (50 Marks) (All the three reviews are mandatory)		External (50 Marks)	
Review I (Problem identification, Title & Abstract submission, Novelty of the idea, proposed outcomes, issues in existing methods, tools to be used)	15 Marks	Both the internal and external examiners will evaluate the student at the end of the semester based on the following criteria: an internal examiner, determined by the HOD, such as a faculty member from the Guide or any other department, and an external examiner appointed by the COE.	
Review II System Design / Database Design or Research Methodology / Algorithms and Techniques/ detailed Implementation plan	15 Marks	**Internal Examiner** Project Report	20 Marks
Review III System Implementation status, Testing, demo of working system and completion of report writing	20 Marks	**External Examiner shall evaluate under the following criteria** • Presentation of the Mini Project • Demonstration of the mini-project working • Viva -voce	10 Marks 10 Marks 10 Marks
Total	**50 Marks**		**50 Marks**

Skill Enhancement Course 2:
CLOUD COMPUTING TOOLS

Prerequisites:
- need to know several computer languages such as PHM, JAVA, .NET, and Python.
    Objectives:

- Analyze the components of cloud computing showing how business agility in an organization can be created
- Evaluate the deployment of web services from cloud architecture
- Critique the consistency of services deployed from an architecture
- Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.

Outcomes:

- Ability to use the tools for simulating cloud computing applications.

UNIT I   Introduction

Basic Concepts and Terminology-Goals and Benefits-Risk and Challenges

UNIT II   Fundamental Concepts and Models

Roles and Boundaries-Cloud Characteristics-Cloud Delivery Model: IaaS, PaaS, SaaS, Comparing Cloud Delivery Model, Combining Cloud Delivery Model-Cloud Deployment Model.

UNIT III   Cloud Enabling Technology

Broadband Networks and Internet Architecture-Data Center Technology-Virtualization Technology-Web Technology-Multitenant Technology-Service Technology.

UNIT IV   Developing for Cloud

Cloud Application Design: Introduction-Design Considerations for Cloud Applications-Cloud Application Design Methodologies-Data Storage Approach

UNIT V Service Development

Development environments for service development; Amazon, Azure, Google App.

Text Book(s):

1. Cloud Computing Concepts, Technology & Architecture by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini
2. "Cloud Computing: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti,2014

Reference Book(s):

1. The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice by Derrick Rountree and Ileana Castrillo 2013
2. "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)" by Michael J. Kavis

Course code		**Internship/Industrial Activity/Research Updation Activity**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Supportive**	0	0	0	2
Pre-requisite		a well-written resume, transcripts, and letters of recommendation prepared with their application.				

Course Objectives:
The main objectives of this course are to:
1. to build the necessary skills
2. to gain industry working Experience
3. a high capacity for analysis to solve problems,
4. to achieve a goal
5. adapting easily to changes

Expected Course Outcomes:	
On the successful completion of the course, students will be able to:	
1 to build the necessary skills	K1,K2
2 to gain industry working Experience	K2,K3
3 a high capacity for analysis to solve problems	K3,K4
4 Report Formation	K5,K6
K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create	

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

Guidelines:

1. Internal: 50marks External: 50 marks TOTAL 100 marks

2. A report should be submitted at the end of 3rd semester and evaluated by the external examiners

3. Internship students should submit a certificate of attendance from the industry along with a report.

Course code		Major Project		L	T	P	C
Core/Elective/Supportive		**Core**				30	16
Pre-requisite		Basic Programming of Software Tools & Introduction to developing Project work					

Course Objectives:

The main objectives of this course are to:

1. to enable the students to study Project development

2. to undertake a unique project title

3. to get a novel idea for the project

4. to define the problem

5. to design and implement using a n available software development tool /Programming
6. Prepare a report

Expected Course Outcomes:

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

1	To define the problem	K1,K2
2	Design the Project using Software tools	K2,K3
3	Capable of implementing the problem with techniques	K3,K4
4	Report Formation	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

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

Major Project Guidelines:

Mode of Major Project: Individual Project

Nature of Major Project: Every student must choose a unique project title (novel concept, idea, system, or a small research problem) approved by their guide and then design and implement it using available software development tools or programming languages.

Guide: Each Student shall be allotted under the Guidance of one Department faculty member by the Programme coordinator/Head

Duration :   One semester - (30 hours per week) Major project students may also opt for company projects with prior permission from the Head of the Department/Principal

Continuous Assessment: Based on periodic reviews (Three reviews during the Semester. Tentative review dates are decided by the department and to be intimated to the students at the beginning of the fourth Semester)

Evaluation criteria

Each student is evaluated by the Internal Examiner (Guide) continuously during the respective semester. External Examination will be conducted at the end of the respective semester.

Passing Criteria: Student shall secure a minimum of **50 % marks in the external** evaluation and shall secure a **minimum of 50 % marks in combined Internal and External evaluation**. (There is no passing minimum for the internal evaluation)

Internal (50 Marks) (All the three reviews are mandatory)		External (50 Marks)	
Review I (Problem identification, Title & Abstract submission, The novelty of the idea proposed outcomes, issues in existing methods, tools to be used)	15 Marks	Both Internal and External Examiner Shall evaluate the student based on the following criteria at the end of the semester: (Guide or any other department faculty decided by the HOD shall be internal examiner. External Examiner will be appointed by the COE	
Review II System Design / Database Design / Methodology / Algorithms and Techniques/ detailed Implementation plan	15 Marks	**Internal Examiner** Project Report	20 Marks
Review III System Implementation status, Testing, outcomes and report writing	20 Marks	**External Examiner shall evaluate under the following criteria** • Presentation of the Project • Demonstration of the working project • Viva -voce	10 Marks 10 Marks 10 Marks
Total	**50 Marks**		**50 Marks**

Course code		Extension Activities		L	T	P	C
Core/Elective/Supportive		**Supportive**		-			1
Pre-requisite		high school-level courses like Algebra, Trigonometry, and Pre-Calculus					

Course Objectives:

The main objectives of this course are to:
1. change the outlook of people or develop the individuals.
2. Social and cultural - development of the community.
3. connecting students, faculty
4. institutions with communities, industries,
5. to solve societal needs.

Expected Course Outcomes:

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

1	To define the problem	K1,K2
2	Design the work to be carried	K2,K3
3	Capable of implementing the work	K3,K4
4	Report Formation	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

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

Outreach Activities

1. Awareness of the Internet in Villages
2. Awareness of women's security app in the public
3. Teaching DTP Courses to school teachers.
4. Teaching computers to School Children
5. Awareness of using Mobile Phones for old age people
6. Motivational Videos on Literacy to the village students., etc and not limited to the above

Guidelines:
1. Internal: 50marks External: 50 marks TOTAL 100 marks

2. students should submit a report about their visit and activities individually.

3. External Examination will be conducted in the 4th semester as per the existing pattern for extension Activity
4. No Viva-Voce

LIST OF ELECTIVES

Course code		ADVANCED SOFTWARE ENGINEERING	L	T	P	C
Core/Elective/Supportive		**Elective 1-1**	4			3
Pre-requisite		Basics of Software Engineering & SPM				

Course Objectives:

The main objectives of this course are to:

1. Introduce 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, students 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 Software Requirements and Specification	K3,K4
4	Analyze Software Testing, Maintenance and Software Re-Engineering	K4,K5
5	Design and conduct various types and levels of software quality for software project	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1		**INTRODUCTION**	**15hours**

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**	**15hours**

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	15hours

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	15hours

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	13hours

Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging– Testing Tools- Metrics-Reliability Estimation. Software Maintenance -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, 3rd edition.
2	A Practitioner 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
1	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		WEB SERVICES	L	T	P	C
Core/Elective/Supportive		**Elective 1-2**	4			3
Pre-requisite		Basics of Distributed Computing				

Course Objectives:

The main objectives of this course are to:

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	**12hours**

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**	**12hours**

XMLFundamentals–XMLdocuments-XMLNamespaces-XMLSchema–ProcessingXML.

Unit:3	**SOAP MODEL**	**12hours**

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**	**12hours**

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	Eric A Marks and Mark J Werrell ," Executive Guide to Webservices" ,John Wiley and sons, March 2003.
3	Anne Thomas Manes, "Web Services :A managers Guide", AddisonWesley,June2003.

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

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		MULTIMEDIA AND ITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		**Elective 1-3**	4			3
Pre-requisite		Basics of Multimedia				

Course Objectives:

The main objectives of this course are to:

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	Analyz e the concepts of Sound, Images, Video & Animation	K4
4	Apply and Analyze the role of Multimedia in Internet and realtime applications	K4,K5
5	Analyze multimedia applications using HDTV	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	**INTRODUCTION**	**12hours**

What is Multimedia?–Introduction to making Multimedia–Macintosh and Windows Production platforms – Basic Software tools.

Unit:2	**MULTIMEDIATOOLS**	**12hours**

Making Instant Multimedia–Multimedia authoring tools–Multimedia building blocks–Text– Sound.

Unit:3	**ANIMATION**	**10hours**

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	MULTIMEDIASYSTEMS	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	60hours

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	Judith Jef floate, "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		ADVANCED OPERATING SYSTEMS	L	T	P	C
Core/Elective/Supportive		**Elective 2-1**	4			3
Pre-requisite		Basics of OS& its functioning				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the different types of operating systems and their functioning.
2. Gain knowledge of 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, students 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**		**12hours**

Basics of Operating Systems: What is an Operating System? – Mainframe 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**		**12hours**

Distributed Operating Systems: Issues – Communication Primitives – Lamports 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		**REALTIMEOPERATINGSYSTEM**		**10hours**

Realtime 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**		**12hours**

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	12hours

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	60hours

Text Books

1	Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", 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: Theory and Practice", Pearson Education India,2006.
2	Pramod Chandra P. Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.
3	Daniel.P. Bovet&MarcoCesati, "UnderstandingtheLinuxkernel",3rdedition,O"Reilly,2005
4	Neil Smyth, "iPhone iOS 4Development Essentials–Xcode", Fourth Edition, 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

Course code		ADVANCED COMPUTER NETWORKS	L	T	P	C
Core/Elective/Supportive		Elective 2-2	4			3
Pre-requisite		Basic Knowledge of mathematics and networking				

Course Objectives:

The main objectives of this course are to:
1. Have a detailed knowledge of the concept of networks
2. Know the idea of protocols, OSI layers and their functions.
3. Get knowledge of protocols used in different layers.
4. Know about the function of the 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	12hours

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	12hours

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	12hours

Network layer – IP V4 addressing – IPV6 addressing – ICMP – IGMP –Network layer delivery – forwarding – unicast and multicast routing protocols

Unit:4	TRANSPORT LAYER	12hours

Transport layer – Process to process delivery – UDP -TCP -Congestion – congestion control – QOS – Techniques to improve QOS

Unit:5	APPLICATION LAYER	12hours

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	60hours

Text Books

1 Data communications and networking – Behrouz A Forouzan McGraw Hill 4th 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		MOBILE COMPUTING	L	T	P	C
Core/Elective/Supportive		Elective 2-3	4			3
Pre-requisite		Basics of Mobile Communication				

Course Objectives:

The main objectives of this course are to:

1. Present the overview of Mobile Computing, Applications and Architecture.
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, students will be able to:

1	Understand the needs 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 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	12hours

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	12hours

Introduction to Cellular Mobile Communication – Mobile Communication Standards –Mobility Management – Frequency Management – Cordless Mobile Communication Systems.

Unit:3	MOBILE COMPUTING	12hours

Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Change over from one satellite to another – Global Mobile Communication – Interferences in Cellular Mobile Communication.

Unit:4	MOBILE COMMUNICATION SYSTEM	11hours

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	11hours

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	60hours

Text Books

1	T.G. Palani velu, R. Nakkeeran, "Wireless and Mobile Communication", PHI Limited, 2009.
2	Jochen Schiller, "Mobile Communications," Second Edition, Pearson Education, 2007.

Reference Books

1	Asoke K Talukder, Hasan Ahmed, Roopa Yavagal, "Mobile Computing", TMH,2010.

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

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

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		ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	L	T	P	C
Core/Elective/Supportive		**Elective 3-1**	4			3
Pre-requisite		Basics of AI & An Introduction to ML				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the basic functions of AI and Heuristic Search Techniques.
2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic.
3. Introduce Machine Learning to Data Mining, Big Data and Cloud.
4. Study about Applications & Impact of ML.

Expected Course Outcomes:

	On the successful completion of the course, students 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 designing are all world problems for implementation and understanding the dynamic behaviour of a system	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search State space search - Production Systems - Problem Characteristics - Issues in the design of Search.

Unit:2	SEARCH TECHNIQUES	12hours

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	PREDICATE LOGIC	12hours

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. backwards reasoning -Matching-Control knowledge.

Unit:4	MACHINE LEARNING	12hours

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

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	60hours

Text Books

1	Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Publishers Company Pvt Ltd, Second Edition, 1991.
2	George F Luger, "Artificial Intelligence", 4th edition, Pearson Education Publ,2002.

Reference Books

1	Machine Learning For Dummies ®, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch.

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		ROBOTIC PROCESS AUTOMATION FOR BUSINESS	L	T	P	C
Core/Elective/Supportive		**Elective 3-2**	4			3
Pre-requisite		Basics of Robots & its applications				

Course Objectives:

The main objectives of this course are to:

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 will 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**		**12hours**

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**		**12hours**

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for 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		**AUTOMATION IMPLEMENTATION**		**12hours**

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**		**12hours**

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	ROBOTSKILL	10hours

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, online seminars – webinars

	Total Lecture hours	60hours

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	Tom Taulli "The Robotic Process Automation Handbook" Apress, February2020.

Reference Books

1	Steve Kaelble ”Robotic Process Automation” John Wiley & Sons, Ltd., 2018

Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]

1	https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2	https://www.javatpoint.com/rpa
3	https://onlinecourses.nptel.ac.in/noc19_me74/preview

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 code		CLOUD COMPUTING	L	T	P	C
Core/Elective/Supportive	**Elective 3-3**		4			3
Pre-requisite		Basics of Cloud & its Applications				

Course Objectives:

The main objectives of this course are to:

1. Gain knowledge on cloud computing, cloud services, architectures and applications.
2. Enable the students to learn the basics of cloud computing with real-time usage
3. How to store and share in and from the cloud?

Expected Course Outcomes:	

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

1	Understand the concepts of the 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 the community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporations, mapping, schedules, managing projects, and presenting on the road.

Unit:3	**CLOUD SERVICES**	**12hours**

USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring online 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**

Evaluating webmail 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 online file storage, exploring online bookmarking services, exploring online photo editing applications, exploring photo sharing communities, and controlling it with web-based desktops.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars –webinars

	Total Lecture hours	60hours

Text Books

1	MichaelMiller, "Cloud Computing", PearsonEducation, NewDelhi, 2009.

ReferenceBooks

1	Anthony T. Velte, "Cloud Computing: A Practical Approach", 1st Edition, Tata McGraw-Hill Education Private Limited, 2009.

RelatedOnlineContents[MOOC, SWAYAM, NPTEL, Websitesetc.]

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

course code		INTERNET OF THINGS	L	T	P	C
Core/Elective/Supportive		**Elective 4-1**	4			3
Pre-requisite		Basics of Sensors & their Applications				

Course Objectives:
The main objectives of this course are to:

- To get familiar with the evolution of IOT with its design principles.
- To outline the functionalities and protocols of Internet communication.
- To analyze the hardware and software components needed to construct IOT applications.
- To identify the appropriate protocol for API construction and writing embedded code.
- To realize various business models and ethics in the Internet of Things.

Expected Course Outcomes:	
On the successful completion of the course, students will be able to:	
1	Understand about IoT, its Architecture and its Applications	K1,K2
2	Comprehend the IoT evolution with its architecture and sensors	K2,K3
3	Assess the embedded technologies and develop prototypes for the IoT products	K4
4	Evaluate the use of Application Programming Interface and design an API for IoT in real-time	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	12hours

Internet of Things: An Overview: IoT Conceptual Framework - IoT Architectural View - Technology Behind IoT - Sources of IoT - M2M Communication - Examples of IoT - Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization - Communication Technologies - Data Enrichment, Data Consolidation and Device Management at Gateway

Unit:2	**Design Principles for Web Connectivity:**	**12hours**

Communication Protocols for Connected Devices – Message Communication Protocols for Connected Devices – Web Connectivity for Connected Devices – Network Using Gateway, SOAP, REST, HTTP, RESTful and Web Sockets -   Internet Connectivity Principles: Internet Connectivity - Internet Based Communication – IP Addressing in the IoT – Media Access Control – Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others

Unit:3	**Data Acquiring, Organizing, Processing and Analytics** :	**12hours**

Data Acquiring and Storage – Organizing the Data – Transactions, Business Processes, Integration and Enterprise Systems – Analytics – Knowledge Acquiring, Managing and Storing Processes - Data Collection, Storage and Computing Using a Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing – Everything as a Service and Cloud Service Models.

Unit:4	SENSORS AND ACTUATORS	10hours

Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks: Sensor Technology – Wireless Sensor Networks Technology - Prototyping the Embedded Devices for loT and M2M : Embedded Computing Basics – Embedded Platforms for Prototyping.

Unit:5	Prototyping and Designing the Software for IoT Applications	12hours

Prototyping Embedded Device Software - Devices, Gateways, Internet and Web/Cloud Services Software Development – Prototyping online Component APIs and Web APIs – Security for IoT: Vulnerabilities, Security Requirements and Threat Analysis – IoT Security Tomography and Layered Attacker Model – Security Models, Profiles and Protocols for IoT – IoT Application Case Study: Design Layers, Design Complexity and Designing using Cloud PaaS – IoT / IoT Applications in the premises, Supply – Chain and Customer Monitoring – Connected Car and its Applications and Services.

Unit:6	Contemporary Issues	2 hours
	Expert lectures, online seminars –webinars	
	Total Lecture hours	60 hours

Text Book

1 Raj Kamal, " Internet of Things Architecture and Design Principles", McGraw Hill, 2017

Reference Books

1 Ovidiu Vermesan and Peter Friess, "Internet of Things – From Research and Innovation to Mark Deployment", River Publishers, 2014.

2 Peter Waher, "Learning Internet of Things" , Packt Publishing, 2015.

3 Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black", Mc Graw Hill, 2015

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		EMBEDDED SYSTEMS	L	T	P	C
Core/Elective/Supportive		Elective 4-2	4			3
Pre-requisite		Basics of Micro Controller				

Course Objectives:

The main objectives of this course are to:

1. Present theintroductionto8051 the Microcontroller Instruction Set and concepts on RTOS & Software tools.
2. Gain knowledge about embedded software development.
3. Learn about microcontrollers and software tools in embedded systems.

Expected Course Outcomes:

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

1	Understand the concept of the 8051 microcontrollers	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 MICROCONTROLLERS	12Hours

8051 Microcontroller: Introduction-8051Architecture-Input/Output Pins, Ports and Circuits-External Memory - Counters / Timers - Serial Data Input / Output –Interrupts

Unit:2		PROGRAMMINGBASICS	12Hours

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	12Hours

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 - Memory management routines in an RTOS Environment.

Unit:4		DESIGN USING RTOS	10Hours

Basic Design using an 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	60Hours

Text Books

1	David E. Simon, "An Embedded Software Primer" Pearson Education Asia, 2003.
2	Kenneth J Ayala, "The8051 Microcontroller and Architecture programming and application", Second Edition, Penram International.

Reference Books

1	RajKamal, "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		**BLOCKCHAIN TECHNOLOGY**	L	T	P	C
Core/Elective/Supportive		**Elective 4-3**	4			3
Pre-requisite		Basics of Block Chain & Crypto Currency				

Course Objectives:

The main objectives of this course are to:

1. Understand the fundamentals of blockchain and cryptocurrency.
2. Understand the influence and role of blockchain in various other fields.
3. Learn security features and their significance.
4. Identify problems & challenges posed by blockchain.

Expected Course Outcomes:

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

1	Demonstrate blockchain technology and cryptocurrency	K1,K2
2	Understand the mining mechanism in blockchain	K2
3	Apply and identify security measures and various types of services that allow people to trade and transact with bitcoins	K3,K4
4	Apply and analyze Blockchain in the healthcare industry	K4,K5
5	Analyze the security, privacy, and efficiency of a given Blockchain system	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	**INTRODUCTION**	**12hours**

Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major applications are Currency, identity, and chain of custody.

Unit:2	**NETWORK AND SECURITY**	**12hours**

Advantage over conventional distributed database, Blockchain 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**	**12hours**

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	**CRYPTOCURRENCY REGULATION**	**11hours**

Cryptocurrency Regulation-Stake holders, Roots of Bitcoin, Legal views-exchange of crypto currency-Black Market- Global Economy. Crypto economics–assets, supply and Demand,

inflation and deflation – Regulation.

Unit:5	CHALLENGES IN BLOCKCHAIN	11hours

Opportunities and challenges in blockchain – Application of blockchain: Industry 4.0 – machine to machine communication –Data management in industry4.0–prospects. Blockchain 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 Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press (July 19, 2016).
2	Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies"

Reference Books

1	Satoshi Nakamoto, "Bitcoin: A peer-to-peer Electronic Cash System"
2	Rodrigo da 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		**DEEP LEARNING**	L	T	P	C
Core/Elective/Supportive		**Elective 5-1**	4			3
Pre-requisite		Basics of Cloud &its Applications				

Course Objectives:

The main objectives of this course are to:

1. To introduce the fundamental techniques and principles of Neural Networks
2. To familiarize fundamental concepts in Deep Learning

Expected Course Outcomes:

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

1	Become familiar with the fundamental concepts in Deep Learning	K1,K2
2	Explore the use of Deep Learning Technology in computer vision, speech analysis, healthcare, agriculture, and understanding climate change.	K3,K4
3	Apply Deep Learning technology in computer vision, speech analysis, Health care, agriculture, and understanding climate change	K4,K5
4	Analyze Deep Reinforcement Learning	K5,K6
5	Evaluate the Practical Challenges in Deep Learning	K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1		**INTRODUCTION**	**12hours**

Introduction to Neural Networks – Introduction – Basic Architecture of Neural Networks – Training and Neural Network with Backpropagation – Practical Issues in Neural Network Training – The Secrets to the Power of Function Composition – Common Neural Architectures – Advanced Topics.

Unit:2			**12hours**

Machine Learning with Shallow Neural Networks: Introduction – Neural Architectures for Binary Classification Models – Neural Architectures for Multiclass models – Back propagated saliency for Feature Selection – Matrix Factorization with Auto encoders – Simple Neural Architectures for Graph Embedding.

Unit:3			**12hours**

Training Deep Neural Networks: Introduction – Backpropagation – Setup and Initialization issues – The vanishing and exploding gradient problems – Gradient Descent Strategies' –Batch Normalization–Teaching Deep Learners to Generalize: Introduction –The Bias-Variance trade-off – Generalization issues in model tuning and evaluation – Penalty based regularization – Ensemble methods – Early Stopping – Unsupervised pre-training – Continuation and Curriculum learning – Parameter sharing – Regularization in Unsupervised Applications.

Unit:4			**12hours**

Recurrent Neural Networks: Introduction – Architecture of Recurrent Neural Networks –ThechallengesoftrainingrecurrentNetworks–Echo-StateNetworks– Long Short-Term Memory – Gated Recurrent Units – Applications of

Recurrent Neural Networks.

Convolutional Neural Networks: Introduction – The Basic Structure of a Convolutional Network – Training a Convolutional Network – Case studies of Convolutional Architectures – Visualization and Unsupervised Learning – Applications of Convolutional Networks.

Unit:5		12hours

Deep Reinforcement Learning: Introduction – Stateless Algorithms – The basic framework of Reinforcement Learning – Bootstrapping for value function learning– Policy Gradient Methods – Monte Carlo Tree Search – Case Studies – Practical Challenges associated with safety. Advanced Topics associated with Deep Learning: Generative adversarial networks (GAN) – Competitive Learning – Limitations of Neural Networks

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

	Total Lecture hours	60hours

Text Books

1	Charu C. Aggarwal, Neural Networks and Deep Learning, Springer 2018

Reference books

1	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, The MIT Press, 2016
2	Francois Chollet, Deep Learning with Python, Manning Publications Co, 2018
3	Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach 1st Edition, O'Reilly' 2017

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

Course code		BIG DATA ANALYTICS	L	T	P	C
Core/Elective/Supportive		Elective 5-2	4			3
Pre-requisite		Basics of Cloud &its Applications				

Course Objectives:

The main objectives of this course are to:
  1. To understand the fundamental concepts of big data and analytics.
  2. To explore tools and practices for working with big data
  3. To know about the research with the integration of large amounts of data.

Expected Course Outcomes:

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

1	Acquire knowledge of the basics of Big Data	K1,K2
2	Work with big data tools	K3,K4
3	Design efficient algorithms for mining data from large volumes	K4,K5
4	Explore the cutting-edge tools and technologies to analyse Big Data	K5,K6
5	Appreciate Big Data Processing concepts and Data visualization techniques	K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

Introduction to Big Data Analytics: Big Data Overview–Data Structures–Analyst Perspective on Data Repositories - State of the Practice in Analytics – BI Versus Data Science - Current Analytical Architecture – Drivers of Big Data – Big Data Ecosystem – Key Role for the New Big Data Ecosystem.

Unit:2	BIG DATA TECHNOLOGIES & TOOLS	12hours

Advanced Analytics-Technology and Tools: MapReduce and Hadoop: Analytics for Unstructured Data. - Use Cases - MapReduce - Apache Hadoop – The Hadoop Ecosystem – pig – Hive – Hbase – Mahout – NoSQL - Tools in Database Analytics: SQL Essentials – Joins – Set operations – Grouping Extensions – In Database Text Analysis - Advanced SQL – Windows Functions – User Defined Functions and Aggregates – ordered aggregates- MADLib.

Unit 3	CLUSTERING AND CLASSIFICATION	12hours

Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes_ Theorem - Naïve Bayes

Unit:4	Time Series Analysis & Text Analysis	

- Time Series Analysis: Overview –Box–Jenkins Methodology–ARIMA Model – Autocorrelation Function – Autoregressive Models – Moving Average Models – ARMA and ARIMA Models–Building and Evaluating and ARIMA Model-Text Analysis: Text Analysis Steps – Example – Collecting – Representing Term Frequency – Categorizing – Determining Sentiments – Gaining Insights

Unit:5	Machine Learning with BIG DATA & Applications	12hours

MACHINE LEARNING BASICS- Classifying with Nearest Neighbors -SVM - REGRESSION: Logistic-Tree based Regression-A-Priori Algorithm-Principal Component Analysis-Neural Network-spam filtering-Ranking-Multidimensional Scaling-Social Graphing

Application Evolution, Big Data Analysis Fields - Structured Data Analysis, Text Data Analysis,Web Data Analysis, Multimedia Data Analysis, Network Data Analysis, Mobile Traffic Analysis, Key Applications - Application of Big Data in Enterprises, Application of IoT Based Big Data, Application of Online Social Network-Oriented Big Data, Applications of Healthcare and Medical Big Data, CollectiveIntelligence, Smart Grid.

Unit:6	Contemporary Issues	
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60hours**

Text Books

1. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services Published by John Wiley &Sons,
2. Noreen Burlingame, "The Little Book on Big Data", NewStreetpublishers,2012.
3. Anil Maheshwari, "Data Analytics", McGrawHillEducation,2017.
4. Kim S.Priesand Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.
5.Min Chen, Shiwen Mao, Yin Zhang,Victor C.M. Leung, "Big Data: Related Technologies, challenges and Future Prospects", Springer; 2014 edition

Reference books

1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
3.DietmarJannachandMarkusZanker, "Recommended Systems: An Introduction", Cambridge University Press, 2010.
4.Tom White, "Hadoop- The Definitive Guide", O'reilly, 2nd Edition.
5.VigneshPrajapati,"Big Data Analytics with R and Hadoop", PACKT Publishing,November 2013.

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

Course code		CRITICAL THINKING, DESIGN THINKING AND PROBLEM-SOLVING	L	T	P	C
Core/Elective/Supportive		**Elective 5-3**	4			3
Pre-requisite		Basics of Logical & Reasoning Skills				

Course Objectives:

The main objectives of this course are to:

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, students 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 to problems	K3,K4
4	Decide and take action based on the 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	12hours

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	12hours

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, Stakeholder assessment, design thinking for manufacturers, smart idea to implementation.

Unit:3	CASE STUDY	12hours

Thinking to confidence, fear management, duty Vs passion, Team management, Tools for Thinking, prototype design, Relevance of Design and Design Thinking in engineering, human-centred design, case study: apply design thinking in problem.

Unit:4	PROBLEM-SOLVING	10hours

Problem-solving: problem definition, problem-solving methods, selecting and using information, data processing, solution methods, solving problems by searching, recognizing patterns, spatial

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

Unit:5	REASONING	12hours

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
	Expert lectures, online seminars –webinars	
	Total Lecture hours	60hours

Text Books

1	John Butterworth and Geoff Thwaites, Thinking skills: Critical Thinking and Problem Solving, Cambridge University Press, 2013.
2	H.S. Fogler and S.E. LeBlanc, Strategies for Creative Problem Solving, 2nd 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 Co. press, 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