

# **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 TANSCHÉ Curriculum**

**With effect from 2023-2024 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. 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

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

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

	<p>To create effective entrepreneurs by enhancing their critical thinking, problem-solving, decision making and leadership skills that will facilitate startups and high-potential organizations.</p> <p><b>PSO3 – Research and Development</b> Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.</p> <p><b>PSO4 – Contribution to Business World</b> To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p><b>PSO 5 – Contribution to the Society</b> To contribute to the development of society by collaborating with stakeholders for mutual benefit.</p>
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### **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	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester-IV	Credit	Hours
<b>1.1. Core-I</b>	4	4	<b>2.1. Core-IV</b>	4	4	3.1. Core-VII	4	5	4.1 Project with Viva-Voce	14	30
<b>1.2 Core-II</b>	4	4	<b>2.2 Core-V</b>	4	4	3.2 Core-VII	4	4	4.2 Extension Activity	1	
<b>1.3 Core – III</b>	4	4	<b>2.3 Core – VI</b>	4	4	3.3 Core – IX	4	4			
<b>1.4 Elective-I</b>	3	3	<b>2.4 Elective – III</b>	3	3	3.4 Elective (Generic / Discipline Centric) – V	3	4			
<b>1.5 Elective-II</b>	3	3	<b>2.5 Elective-IV</b>	3	3	3.5 Core Practical V	3	4			
<b>1.6 Core LAB-I</b>	2	4	<b>2.6 Core LAB-III</b>	2	4	3.6 Mini Project	6	6			
<b>1.7 Core LAB-II</b>	2	4	<b>2.7 Core LAB-IV</b>	2	4	3.7 Skill Enhancement Course –SEC 3	2	3			
1.8 Ability Enhancement Course	1	2	2.8 Ability Enhancement	1	2	3.8 Internship/ Industrial Activity/Research Updation Activity	2	-			
1.9 Skill Enhancement SEC-1	1	2	2.9 Skill Enhancement Course SEC 2	1	2						
	24	30		24	30		28	30		15	30
<b>Total Credits</b>										<b>91</b>	

### Component-wise Credit Distribution

Credits	Sem I	Sem-II	Sem III	Sem IV	Total
Core/Core LAB/Mini Project/ Major Project	16	16	15+6	14	67
Electives	6	6	3		15
(i)Discipline– Centric					
(ii Skill Enhancement	1	1	2		6
(iii)Summer Internship / Industrial Training/ Project			2		
Ability Enhancement / Extension	1	1		1	3
<b>Total Credits</b>	<b>24</b>	<b>24</b>	<b>28</b>	<b>15</b>	<b>91</b>

<b>METHODS OF EVALUATION</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test (15)	<b>25 Marks</b>
	Assignments / Snap Test / Quiz (5)	
	Seminars (5)	
<b>External Evaluation</b>	End Semester Examination	<b>75 Marks</b>
<b>Total</b>		<b>100 Marks</b>
<b>METHODS OF ASSESSMENT</b>		
<b>Remembering (K1)</b>	<ul style="list-style-type: none"> <li>• The lowest level of questions require student store call information from the course content</li> <li>• Knowledge questions usually require students to identify information in the text book.</li> </ul>	
<b>Understanding (K2)</b>	<ul style="list-style-type: none"> <li>• Understanding of facts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words.</li> <li>• The questions go beyond simple recall and require students to combine data together</li> </ul>	
<b>Application (K3)</b>	<ul style="list-style-type: none"> <li>• Students will be able to solve problems by using/applying a concept learned in the classroom.</li> <li>• Students must use their knowledge to determine a exact response.</li> </ul>	
<b>Analyze (K4)</b>	<ul style="list-style-type: none"> <li>• Analyzing the question that asks the students to break down something in to its component parts.</li> <li>• Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.</li> </ul>	
<b>Evaluate (K5)</b>	<ul style="list-style-type: none"> <li>• Evaluation requires an individual to make judgment on something.</li> <li>• Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem.</li> <li>• Students are engaged in decision-making and problem-solving.</li> <li>• Evaluation questions do not have single right answers.</li> </ul>	
<b>Create (K6)</b>	<ul style="list-style-type: none"> <li>• The questions of this category challenge students to get engaged in creative and original thinking. Developing original ideas and problem solving skills</li> </ul>	

## 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))

<b>Parameters</b>	
<b>Students shall secure passes in both internal and external and also obtain 50 marks together to get a pass</b>	
<b>CIA- Internal Marks</b>	<b>End semester Examination - External Marks</b>
i. Average of best two tests from three: 15 Marks	Total: 75 Marks
ii. Seminar: 05 Marks	
iii. Assignment: 05 Marks -----	
Total : 25 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

### First Semester

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
Core – I	Analysis & Design of Algorithms	4	4		25	75	100
Core – II	Object Oriented Analysis and Design & C++	4	4		25	75	100
Core – III	Python Programming	4	4		25	75	100
Elective – I	Advanced Software Engineering	3	3		25	75	100
Elective – II	Advanced Computer Networks	3	3				
Lab I	Algorithm and OOPS Lab	2		4	50	50	100
Lab II	Python Programming Lab	2		4	50	50	100
Ability Enhancement Course AEC-I	Effective Communication in English	1	2		25	75	100
Skill Enhancement Course– SEC I	Basics of Web Design	1	2		25	75	100
<b>Total</b>		24	22	8			

## I – SEMESTER

Course code	ANALYSIS & DESIGN OF ALGORITHMS			L	T	P	C
Core/Elective/Supportive	Core -I			4			4
Pre-requisite	Basic Data Structures & Algorithms						
<b>Course Objectives:</b>							
The main objectives of this course are to:							
<ol style="list-style-type: none"> <li>1. Enable the students to learn the Elementary Data Structures and algorithms.</li> <li>2. Presents an introduction to the algorithms, their analysis and design</li> <li>3. Discuss various methods like Basic Traversal and Search Techniques, divide and conquer method, Dynamic programming, backtracking</li> <li>4. Understood the various design and analysis of the algorithms.</li> </ol>							
<b>Expected Course Outcomes:</b>							
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 the 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	
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>							
<b>Unit:1</b>	<b>INTRODUCTION</b>					<b>15hours</b>	
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.							
<b>Unit:2</b>	<b>TRAVERSALANDSEARCHTECHNIQUES</b>					<b>15hours</b>	
Basic Traversal and Search Techniques: Techniques for Binary Trees-Techniques for Graphs - Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.							
<b>Unit:3</b>	<b>GREEDY METHOD</b>					<b>15hours</b>	
The Greedy Method: -General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path.							
<b>Unit:4</b>	<b>DYNAMIC PROGRAMMING</b>					<b>15hours</b>	

Dynamic Programming-General Method–Multistage Graphs–All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.		
<b>Unit:5</b>	<b>BACKTRACKING</b>	<b>13hours</b>
<b>version</b>		
Backtracking: -General Method–8-QueensProblem–Sum Of Subsets–Graph Coloring– Hamiltonian Cycles – Branch and Bound: - The Method – Traveling Salesperson.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars– webinars		
<b>Total Lecture hours</b>		<b>75hours</b>
<b>Text Books</b>		
1	Ellis Horowitz, “Computer Algorithms”, Galgotia Publications.	
2	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms".	
<b>Reference Books</b>		
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.	
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>		
1	<a href="https://nptel.ac.in/courses/106/106/106106131/">https://nptel.ac.in/courses/106/106/106106131/</a>	
2	<a href="https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm">https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm</a>	
3	<a href="https://www.javatpoint.com/daa-tutorial">https://www.javatpoint.com/daa-tutorial</a>	

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

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

### I – SEMESTER

Course code	<b>OBJECT-ORIENTED ANALYSIS AND DESIGN &amp; C++</b>	L	T	P	C
<b>Core/Elective/Supportive</b>	<b>Core -II</b>	4			4
<b>Pre-requisite</b>	Basics of C++ and Object-Oriented Concepts				
<b>Course Objectives:</b>					
The main objectives of this course are to:					
<ol style="list-style-type: none"> <li>1. Present the object model, classes and objects, object orientation, machine view and model management view.</li> <li>2. Enables the students to learn the basic functions, principles and concepts of object-oriented analysis and design.</li> <li>3. Enable the students to understand C++ language concerning OOAD</li> </ol>					
<b>Expected Course Outcomes:</b>					
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
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>					
<b>Unit:1</b>	<b>OBJECT MODEL</b>				<b>15hours</b>
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.					
<b>Unit:2</b>	<b>CLASSES AND OBJECTS</b>				<b>15hours</b>
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.					
<b>Unit:3</b>	<b>C++ INTRODUCTION</b>				<b>15hours</b>
Introduction to C++-Input and output statements in C++-Declarations-control structures– Functions in C++.					
<b>Unit:4</b>	<b>INHERITANCE AND OVERLOADING</b>				<b>13hours</b>

Classes and Objects–Constructors and Destructors–operators overloading–Type Conversion–Inheritance – Pointers and Arrays.		
<b>Unit:5</b>	<b>POLYMORPHISM AND FILES</b>	<b>15hours</b>
Memory Management Operators–Polymorphism–Virtual Functions–Files–Exception Handling – String Handling –Templates.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars – webinars		
<b>Total Lecture hours</b>		<b>75hours</b>
<b>Text Books</b>		
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.	
<b>Reference Books</b>		
1	Balagurusamy “Object Oriented Programming with C++”, TMH, SecondEdition,2003.	
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>		
1	<a href="https://onlinecourses.nptel.ac.in/noc19_cs48/preview">https://onlinecourses.nptel.ac.in/noc19_cs48/preview</a>	
2	<a href="https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/">https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/</a>	
3	<a href="https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm">https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm</a>	

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

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

## I – SEMESTER

Course code	PYTHON PROGRAMMING			L	T	P	C
Core/Elective/Supportive	Core – III			4			4
Pre-requisite	Basics of any OO Programming Language						
<b>Course Objectives:</b>							
The main objectives of this course are to:							
<ol style="list-style-type: none"> <li>1. Presents an introduction to Python, creation of web applications, network applications and working in the clouds</li> <li>2. Use functions for structuring Python programs</li> <li>3. Understand different Data Structures of Python</li> <li>4. Represent compound data using Python lists, tuples and dictionaries</li> </ol>							
<b>Expected Course Outcomes:</b>							
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	
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>							
<b>Unit:1</b>	<b>INTRODUCTION</b>					<b>15hours</b>	
<b>Python:</b> Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets–Comparison.							
<b>Unit:2</b>	<b>CODE STRUCTURES</b>					<b>15hours</b>	
<b>Code Structures:</b> 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.							
<b>Unit:3</b>	<b>MODULES, PACKAGES AND CLASSES</b>					<b>15hours</b>	
<b>Modules, Packages, and Programs:</b> Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. <b>Objects and Classes:</b> 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.							
<b>Unit:4</b>	<b>DATA TYPES AND WEB</b>					<b>13hours</b>	
<b>Datatypes:</b> Text Strings–Binary Data, <b>Storing and Retrieving Data:</b> File Input/Output–Structured Text Files – Structured Binary Files - Relational Databases – NoSQL Data Stores.							
<b>Web:</b> Web Clients –Web Servers–Web Services and Automation							

<b>Unit:5</b>	<b>SYSTEMS AND NETWORKS</b>	<b>15hours</b>
<b>Systems:</b> Files–Directories–Programs and Processes–Calendars and Clocks.		
<b>Concurrency:</b> Queues– Processes–Threads–Green Threads and event–twisted–Redis.		
<b>Networks:</b> 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.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
<b>Total Lecture hours</b>		<b>75hours</b>
<b>Text Books</b>		
1	BillLubanovic, “Introducing Python”, O’Reilly, FirstEdition-SecondRelease,2014.	
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.	
<b>Reference Books</b>		
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.	
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>		
1	<a href="https://www.programiz.com/python-programming/">https://www.programiz.com/python-programming/</a>	
2	<a href="https://www.tutorialspoint.com/python/index.htm">https://www.tutorialspoint.com/python/index.htm</a>	
3	<a href="https://onlinecourses.swayam2.ac.in/aic20_sp33/preview">https://onlinecourses.swayam2.ac.in/aic20_sp33/preview</a>	

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

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

### I – SEMESTER

Course code	<b>CORE LAB I: ALGORITHM AND OOPS LAB</b>	L	T	P	C
<b>Core/Elective/Supportive</b>	<b>Lab – I</b>			4	2
<b>Pre-requisite</b>	Basic Programming of C++ language				
<b>Course Objectives:</b>					
The main objectives of this course are to:					
<ol style="list-style-type: none"> <li>1. This course covers the basic data structures like Stack, Queue, Tree, and List.</li> <li>2. This course enables the students to learn the applications of the data structures using various techniques</li> <li>3. It also enables the students to understand C ++ language concerning OOAD concepts</li> <li>4. Application of OOPS concepts.</li> </ol>					
<b>Expected Course Outcomes:</b>					
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
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>					
<b>LIST OF PROGRAMS</b>					<b>75hours</b>
<ol style="list-style-type: none"> <li>1) Write a program to solve the tower of Hanoi using recursion.</li> <li>2) Write a program to traverse through binary search tree using traversals.</li> <li>3) Write a program to perform various operations on stack using linked list.</li> <li>4) Write a program to perform various operation in circular queue.</li> <li>5) Write a program to sort an array of an elements using quick sort.</li> <li>6) Write a program to solve number of elements in ascending order using heap sort.</li> <li>7) Write a program to solve the knap sack problem using greedy method</li> <li>8) Write a program to search for an element in a tree using divide&amp; conquer strategy.</li> <li>9) Write a program to place the 8 queens on an 8X8 matrix so that no two queens Attack.</li> <li>10) Write a C++ program to perform Virtual Function</li> <li>11) Write a C++ program to perform Parameterized constructor</li> <li>12) Write a C++ program to perform Friend Function</li> <li>13) Write a C++ program to perform Function Overloading</li> <li>14) Write a C++ program to perform Single Inheritance</li> <li>15) Write a C++ program to perform Employee Details using files.</li> </ol>					

Expert lectures, online seminars –webinars	
<b>Total Lecture hours</b>	<b>75hours</b>
<b>Text Books</b>	
1	Goodrich, “Data Structures& Algorithms in Java”, Wiley 3rd edition.
2	Skiena,” The Algorithm Design Manual”, Second Edition, Springer,2008
<b>Reference Books</b>	
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.
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Web sites etc.]</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc19_cs48/preview">https://onlinecourses.nptel.ac.in/noc19_cs48/preview</a>
2	<a href="https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/">https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/</a>
3	<a href="https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm">https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm</a>

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

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

**I – SEMESTER**

<b>Course code</b>	<b>CORE LAB II: PYTHON PROGRAMMING LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>	<b>Lab – II</b>			4	2
<b>Pre-requisite</b>	Basics of any OO Programming Language				
<b>Course Objectives:</b>					
The main objectives of this course are to:					
<ol style="list-style-type: none"> <li>1. This course presents an overview of elementary data items, lists, dictionaries, sets and tuples</li> <li>2. To understand and write simple Python programs</li> <li>3. To Understand the OOPS concepts of Python</li> <li>4. To develop web applications using Python</li> </ol>					
<b>Expected Course Outcomes:</b>					
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
<b>K1-Remember; K2- Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>					
<b>LIST OF PROGRAMS</b>					<b>75hours</b>
Implement the following in Python:					
<ol style="list-style-type: none"> <li>1. Programs using elementary data items, lists, dictionaries and tuples</li> <li>2. Programs using conditional branches,</li> <li>3. Programs using loops.</li> <li>4. Programs using functions</li> <li>5. Programs using exception handling</li> <li>6. Programs using inheritance</li> <li>7. Programs using polymorphism</li> <li>8. Programs to implement file operations.</li> <li>9. Programs using modules.</li> <li>10. Programs for creating dynamic and interactive Web Pages using forms.</li> </ol>					
<b>Total Lecture hours</b>					<b>75hours</b>
<b>Text Books</b>					
1	Bill Lubanovic, “Introducing Python”, O’Reilly, FirstEdition-SecondRelease,2014.				
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.				
<b>Reference Books</b>					

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.
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>	
1	<a href="https://www.programiz.com/python-programming/">https://www.programiz.com/python-programming/</a>
2	<a href="https://www.tutorialspoint.com/python/index.htm">https://www.tutorialspoint.com/python/index.htm</a>
3	<a href="https://onlinecourses.swayam2.ac.in/aic20_sp33/preview">https://onlinecourses.swayam2.ac.in/aic20_sp33/preview</a>

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

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

**AEC-I: Ability Enhancement Course 1**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
2			1

**EFFECTIVE COMMUNICATION IN ENGLISH**

Course code:

Course Objectives:

- To help the students develop communication skills and self-confidence
- To motivate the students to acquire employability skills
- To introduce various interview techniques to the students
- To motivate the students to become good public speakers
- To develop leadership qualities in the students
- To guide the students on how to tackle interviews
- To help the students to enhance their writing skills
- To teach the students how to write a good CV
- To introduce various articles in writing to the students

**Course Contents**

**Public Speaking**

The power of Public Speaking, • Developing confidence, • Planning • Preparation • Successful and effective delivery of speech

**Group Discussion**

What is group discussion? • Why are group discussions held? • Preparation for a group discussion • Skills for effective participation • Traits tested in a group discussion • Initiating a group discussion • Non-verbal communication in group discussion • Types of group discussions

**Interviews**

Interviewing in the 21st century • Developing an Interview Strategy • Taking Care of the Details • Practicing for the Interview • During the Interview • Stress Interviews • Traditional Interviews

**Writing Skills** • Basics of writing • Writing paragraphs • Writing research articles • Report writing • Writing a CV

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
2			1

## **Skill Enhancement Course (SEC 1)**

### **Basics of Web Design**

#### **UNIT I**

Introduction to Web Design Introduction of Internet, WWW, Website, Working of Websites, Webpages, Front End, Back End, Client and Server Scripting Languages, Responsive Web Designing, Types of Websites (Static and Dynamic Websites).

#### **UNIT II**

HTML Basics HTML: Introduction, Basic Structure of HTML, Head Section and Elements of Head Section, HTML 5 Introduction, HTML5 New Elements: Section, Nav, Article, Aside, Audio Tag, Video Tag, HTML5 Form Validations: Require Attribute. Autofocus Attribute, email, number type, date type, Range type, HTML embed multimedia, HTML Layout, HTML Frame

#### **Unit III**

CSS Introduction to CSS, Types of CSS, CSS Selectors: Universal Selector, ID selector, Tag Selector, Class Selector, Sub Selector, Attribute Selector, Group Selector, CSS Properties: Back Ground properties, Block Properties, Box properties, List properties, Border Properties, Positioning Properties, CSS Lists CSS Tables, CSS Menu Design CSS Image Gallery

#### **Unit IV**

JavaScript and Angular JS Introduction to Client-Side Scripting Language, Variables in Java Script, Operators in JS, Conditions Statements, JS Popup Boxes.

#### **Unit V**

JS Events, Basic Form Validations in JavaScript. Introduction to Angular JS: Expressions, Modules and Directives.

#### **Books for Reference:**

1. HTML5, Black Book, Kagent Learning Solution Inc, 2014
2. Mastering HTML, CSS & JavaScript Web Publishing by Lemay Laura, BPB publications
3. HTML & CSS: The Complete Reference by Thomas Powell

<b>SECOND SEMESTER</b>							
Type of the Course	Course Name	Credits	Hours Theory	PRACTICAL	IN T	E X T	TOT
Core – IV	Data Mining And Warehousing	4	4		25	75	100
Core – V	Advanced Operating Systems	4	4		25	75	100
Core – VI	Advanced Java Programming	4	4		25	75	100
Elective – III	Artificial Intelligence and Machine Learning	3	3		25	75	100
Elective –IV	Internet of Things	3	3		25	75	100
Lab– III	Data Mining using R - Lab	2		4	50	50	100
Lab – IV	Advanced Java Programming Lab	2		4	50	50	100
Ability Enhancement Course AEC-II	English for Competitive Exams	1	2		25	75	100
Skill Enhancement Course – SEC II	Web Development using PHP	1	2		25	75	100
<b>Total</b>		24	22	8			

## II – SEMESTER

Course code	DATA MINING AND WAREHOUSING		L	T	P	C
Core/Elective/Supportive	Core – IV		4			4
Pre-requisite	Basics of RDBMS & Algorithms					
<b>Course Objectives:</b>						
The main objectives of this course are to:						
<ol style="list-style-type: none"> <li>1. Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.</li> <li>2. Develop skills in using recent data mining software for solving practical problems.</li> <li>3. Develop and apply critical thinking, problem-solving, and decision-making skills.</li> </ol>						
<b>Expected Course Outcomes:</b>						
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	
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>						
<b>Unit:1</b>	<b>BASICS AND TECHNIQUES</b>				<b>12hours</b>	
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.						
<b>Unit:2</b>	<b>ALGORITHMS</b>				<b>12hours</b>	
Classification: Introduction –Statistical–based algorithms -distance–based algorithms-decision tree-based algorithms-neural network-based algorithms–rule-based algorithms–combining techniques.						
<b>Unit:3</b>	<b>CLUSTERING AND ASSOCIATION</b>				<b>12hours</b>	
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.						
<b>Unit:4</b>	<b>DATA WAREHOUSING AND MODELING</b>				<b>11hours</b>	
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.		
<b>Unit:5</b>	<b>APPLICATIONS OF DATA WAREHOUSE</b>	<b>11 hours</b>
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.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
	<b>Total Lecture hours</b>	<b>60hours</b>
<b>Text Books</b>		
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.	
<b>Reference Books</b>		
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.	
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>		
1	<a href="https://www.javatpoint.com/data-warehouse">https://www.javatpoint.com/data-warehouse</a>	
2	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/</a>	
3	<a href="https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html">https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html</a>	

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

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

## II – SEMESTER

Course code	<b>ADVANCED OPERATING SYSTEMS</b>	L	T	P	C
<b>Core/Elective/Supportive</b>	<b>Core – V</b>	4			4
<b>Pre-requisite</b>	Basics of OS& its functioning				
<b>Course Objectives:</b>					
The main objectives of this course are to:					
<ol style="list-style-type: none"> <li>1. Enable the students to learn the different types of operating systems and their functioning.</li> <li>2. Gain knowledge of Distributed Operating Systems</li> <li>3. Gain insight into the components and management aspects of real-time and mobile operating systems.</li> <li>4. Learn case studies in Linux Operating Systems</li> </ol>					
<b>Expected Course Outcomes:</b>					
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
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>					
<b>Unit:1</b>	<b>BASICS OF OPERATING SYSTEMS</b>				<b>12hours</b>
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.					
<b>Unit:2</b>	<b>DISTRIBUTED OPERATING SYSTEMS</b>				<b>12hours</b>
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.					
<b>Unit:3</b>	<b>REALTIMEOPERATINGSYSTEM</b>				<b>10hours</b>
Realtime Operating Systems: Introduction – Applications of Real-Time Systems – Basic Model of Real-Time System – Characteristics – Safety and Reliability - Real-Time Task Scheduling					
<b>Unit:4</b>	<b>HANDHELD SYSTEM</b>				<b>12hours</b>

Operating Systems for Handheld Systems: Requirements–Technology Overview–Handheld Operating Systems–Palm OS-Symbian Operating System-Android–Architecture of android–		
Securing handheld systems		
<b>Unit:5</b>	<b>CASE STUDIES</b>	<b>12hours</b>
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.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars–webinars		
	<b>Total Lecture hours</b>	<b>60hours</b>
<b>Text Books</b>		
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.	
<b>Reference Books</b>		
1	Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India,2006.	
2	Prmod Chandra P. Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.	
3	Daniel.P. Bovet&MarcoCesati, “UnderstandingtheLinuxkernel”,3 <sup>rd</sup> edition,O’Reilly,2005	
4	Neil Smyth, “iPhone iOS 4Development Essentials–Xcode”, Fourth Edition, Payload media, 2011.	
<b>Related Online Contents [MOOC, SWAYAM,NPTEL, Websites etc.]</b>		
1	<a href="https://onlinecourses.nptel.ac.in/noc20_cs04/preview">https://onlinecourses.nptel.ac.in/noc20_cs04/preview</a>	
2	<a href="https://www.udacity.com/course/advanced-operating-systems--ud189">https://www.udacity.com/course/advanced-operating-systems--ud189</a>	
3	<a href="https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf">https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf</a>	

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

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

## II – SEMESTER

Course code	ADVANCED JAVA PROGRAMMING			L	T	P	C
Core/Elective/Supportive	Core – VI			4			4
Pre-requisite	Basics of Java & its Usage						
<b>Course Objectives:</b>							
The main objectives of this course are to:							
<ol style="list-style-type: none"> <li>1. Enable the students to learn the basic functions, principles and concepts of advanced Java programming.</li> <li>2. Provide knowledge on concepts needed for distributed Application Architecture.</li> <li>3. Learn JDBC, Servlet packages, jQuery, Java Server Pages and JAR file format</li> </ol>							
<b>Expected Course Outcomes:</b>							
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	
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>							
<b>Unit:1</b>	<b>BASICS OF JAVA</b>					<b>12hours</b>	
Java Basics Review: Components and event handling–Threading concepts–Networking features – Media techniques							
<b>Unit:2</b>	<b>REMOTE METHOD INVOCATION</b>					<b>12hours</b>	
Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons-Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces							
<b>Unit:3</b>	<b>DATABASE</b>					<b>10hours</b>	
Java in Databases-JDBC principles–database access-Interacting-database search–Creating multimedia databases – Database support in web applications							
<b>Unit:4</b>	<b>SERVLETS</b>					<b>12hours</b>	
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							
<b>Unit:5</b>	<b>ADVANCED TECHNIQUES</b>					<b>12hours</b>	

JAR file format creation–Internationalization–Swing Programming–Advanced java		
Techniques		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
	<b>Total Lecture hours</b>	<b>60 hours</b>
<b>Text Books</b>		
1	Jamie Jaworski, “Java Unleashed”, SAMS Tech media Publications,1999.	
2	Campione, Walrath and Huml, “The Java Tutorial”, Addison Wesley,1999.	
<b>Reference Books</b>		
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	
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>		
1	<a href="https://www.javatpoint.com/servlet-tutorial">https://www.javatpoint.com/servlet-tutorial</a>	
2	<a href="https://www.tutorialspoint.com/java/index.htm">https://www.tutorialspoint.com/java/index.htm</a>	
3	<a href="https://onlinecourses.nptel.ac.in/noc19_cs84/preview">https://onlinecourses.nptel.ac.in/noc19_cs84/preview</a>	

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

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

<b>Course code</b>		<b>PRACTICAL III: DATA MINING USING R</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>		<b>Lab - III</b>			4	2
<b>Pre-requisite</b>	Basics of DM Algorithms & R Programming					
<b>Course Objectives:</b>						
The main objectives of this course are to:						
<ol style="list-style-type: none"> <li>1. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, and regression</li> <li>2. To understand &amp; write programs using the DM algorithms</li> <li>3. To apply statistical interpretations for the solutions</li> <li>4. Able to use visualization techniques for interpretations</li> </ol>						
<b>Expected Course Outcomes:</b>						
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	
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>						
<b>LIST OF PROGRAMS</b>						<b>75hours</b>
<ul style="list-style-type: none"> <li>• Implement the Apriori algorithm to extract the association rule of data mining.</li> <li>• Implement k-means clustering technique.</li> <li>• Implement any Hierarchal Clustering.</li> <li>• Implement Classification algorithm.</li> <li>• Implement Decision Tree.</li> <li>• Linear Regression.</li> <li>• Data Visualization.</li> </ul>						
<b>Total Lecture hours</b>						<b>75hours</b>
<b>Text Books</b>						
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					
<b>Reference Books</b>						
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.					
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>						

1	<a href="https://www.javatpoint.com/data-warehouse">https://www.javatpoint.com/data-warehouse</a>
2	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/</a>
3	<a href="https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html">https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html</a>

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

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

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

<b>Text Books</b>	
1	JamieJaworski,“JavaUnleashed”,SAMSTechmediaPublications,1999.
2	Campione, Walrath and Huml,“TheJavaTutorial”,AddisonWesley,1999.
<b>Reference Books</b>	
1	JimKeogh,”TheCompleteReferenceJ2EE”,Tata Mc Graw Hill Publishing Company Ltd,2010.
2	DavidSawyerMcFarland,“JavaScriptAndjQuery-TheMissingManual”,Oreilly Publications, 3rd Edition,2011.
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>	
1	<a href="https://www.javatpoint.com/servlet-tutorial">https://www.javatpoint.com/servlet-tutorial</a>
2	<a href="https://www.tutorialspoint.com/java/index.htm">https://www.tutorialspoint.com/java/index.htm</a>
3	<a href="https://onlinecourses.nptel.ac.in/noc19_cs84/preview">https://onlinecourses.nptel.ac.in/noc19_cs84/preview</a>

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

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

## Ability Enhancement Course: AEC 2

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
2			1

## ENGLISH FOR COMPETITIVE EXAMS

### Objectives:

- To help the students prepare for competitive exams
- To enable the students to learn the techniques to ace the tests
- To enable the students to learn English grammar
- To enhance the students' reading skills
- To teach the students how to answer comprehension questions
- To focus on vocabulary and its importance
- To guide the students about IELTS exams
- To discuss various components of vocabulary
- To introduce a variety of reading passages to the students

### Course Contents

#### Reading Comprehension

- Introduction to a variety of reading passages - Key to comprehension - Tackling questions - Techniques for answering comprehension questions

#### Reading Skills

- Skimming - Scanning - Intensive reading - Extensive reading

#### Vocabulary

Synonyms - Antonyms - Analogy - Sentence completion

#### Grammar

Basics of grammar (Parts of speech, tense form, articles, etc.) - Identifying errors

#### Writing

- Importance of writing - Responding to the task - Coherence and cohesion - Lexical resource - Grammatical range and accuracy - Planning and preparation - Using examples - Writing general essays - Descriptive writing.

## Skill Enhancement Course (SEC 2)

L	T	P	C
2			1

### Web Development using PHP

#### UNIT I

Introduction to PHP as a Programming Language: - Advantages of PHP, the server-side architecture Decomposed, an overview of PHP, history, object-oriented support, and benefits of running PHP as a server-side script.

#### UNIT II

The basics of PHP: - data types, variables, constants, operators, Arrays, Conditional statements (if statement, Executing Multiple Statements, else if clause and switch statement), Iterations (for loop, while loop, controlling an array using a while loop, do while statement).

#### UNIT III

Functions, user-defined functions, functions with arguments, built-in functions (print(), includer(), header(), phpinfo() ), Working with Strings.

#### UNIT IV

Working with forms, form elements (Text Box, Text Area, Password, Radio Button, Checkbox, The Combo Box, Hidden Field and image), adding elements to a form

#### UNIT V

Database connectivity using PHP (MySQL, ODBC, ORACLE, SQL) Performing, and executing Commands, and different types of Data Base Operations like Insertion, deletion, update and query on date

Books for Reference:

1. Mastering PHP, WebTech Solutions, Khanna Publishing House
2. Learning PHP, Ramesh Bangia, Khanna Publishing House

Third Semester							
Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
Core - VII	Digital Image Processing	4	5		25	75	100
Core – VIII	Network Security and Cryptography	4	4		25	75	100
Core – IX	Data Science & Analytics	4	4		25	75	100
Elective - V	Deep Learning/ Big Data Analytics /Critical thinking, Design Thinking & Problem Solving	3	4		25	75	100
Core Practical V	Digital Image Processing Using MatLab	3		4	50	50	100
Mini Project	Web Application Development& Hosting using Open-source software like PHP, Python, HTML, or .NET based, etc.,	6		6	50	50	100
SEC 3	Cloud Computing Tools	2	3		25	75	100
Internship/ Industrial Activity/Research Updating Activity		2	-		50	50	100
<b>Total</b>		28	20	10			
<b>FOURTH SEMESTER</b>							
Core Project	Project work and Viva-voce	14		30	50	50	100
	Extension Activity	1	-		50	50	100
<b>Total</b>		15		30			
<b>Total</b>		91					

<b>Course code</b>		<b>DIGITAL IMAGE PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>		<b>Core VII</b>	4			5
<b>Pre-requisite</b>	Basics of Image Processing					
<b>Course Objectives:</b>						
The main objectives of this course are to:						
<ol style="list-style-type: none"> <li>1. Learn basic image processing techniques for solving real problems.</li> <li>2. Gain knowledge in information and image enhancement techniques.</li> <li>3. Learn Image compression and Segmentation procedures.</li> </ol>						
<b>Expected Course Outcomes:</b>						
On the successful completion of the course, students will be able to:						
1	Understand the fundamentals of Digital Image Processing					K1, K2
2	Understand the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement					K2, K3
3	Apply, Design and Implement and get solutions for digital image processing problems					K3, K4
4	Apply the concepts of filtering and segmentation for digital image retrieval					K4, K5
5	Explore the concepts of the Multi-resolution process and recognize the objects in an efficient manner					K5, K6
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>						
<b>Unit:1</b>	<b>INTRODUCTION</b>					<b>12hours</b>
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.						
<b>Unit:2</b>	<b>IMAGE ENHANCEMENT</b>					<b>12hours</b>
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.						
<b>Unit:3</b>	<b>IMAGE RESTORATION</b>					<b>12hours</b>
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.						

<b>Unit:4</b>	<b>IMAGE COMPRESSION</b>	<b>11hours</b>
Image Compression: Fundamentals–Image compression models–Elements of Information Theory – Error Free compression – Lossy compression – Image compression standards.		
<b>Unit:5</b>	<b>IMAGE SEGMENTATION</b>	<b>11hours</b>
Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary Deduction – Thresholding – Region-Based Segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
<b>Total Lecture hours</b>		<b>60hours</b>
<b>Text Books</b>		
1	RafaelC.Gonzalez, Richard.Woods, “DigitalImageProcessing”, SecondEdition,PHI/Pearson Education.	
2	B.Chanda,D.DuttaMajumder,“DigitalImageProcessingandAnalysis”,PHI, 2003.	
<b>ReferenceBooks</b>		
1	NickEfford,“DigitalImageProcessingapracticalintroducingusingJava”,Pearson Education, 2004.	
<b>RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]</b>		
1	<a href="https://nptel.ac.in/courses/117/105/117105135/">https://nptel.ac.in/courses/117/105/117105135/</a>	
2	<a href="https://www.tutorialspoint.com/dip/index.htm">https://www.tutorialspoint.com/dip/index.htm</a>	
3	<a href="https://www.javatpoint.com/digital-image-processing-tutorial">https://www.javatpoint.com/digital-image-processing-tutorial</a>	

<b>MappingwithProgrammingOutcomes</b>										
<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	S	M	S	S	S	M	S	M	M	S
<b>CO2</b>	S	S	S	S	S	M	S	M	S	S
<b>CO3</b>	S	S	S	S	S	S	S	M	S	S
<b>CO4</b>	S	S	S	S	S	S	S	M	S	S
<b>CO5</b>	S	S	S	S	S	S	S	M	S	S

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

Course code	NETWORK SECURITY AND CRYPTOGRAPHY			L	T	P	C
Core/Elective/Supportive	Core VIII			4			4
Pre-requisite	Basics of Networks & its Security						
<b>Course Objectives:</b>							
The main objectives of this course are to:							
<ol style="list-style-type: none"> <li>1. Enable students to learn the Introduction to Cryptography, Web Security and Case Studies in Cryptography.</li> <li>2. To gain knowledge of classical encryption techniques and concepts of modular arithmetic and number theory.</li> <li>3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.</li> <li>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.</li> </ol>							
<b>Expected Course Outcomes:</b>							
On the successful completion of the course, students will be able to:							
1	Understand the process of the cryptographic algorithms					K1,K2	
2	Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication					K2,K3	
3	Apply and analyze appropriate security techniques to solve network security problem					K3,K4	
4	Explore suitable cryptographic algorithms					K4,K5	
5	Analyze different digital signature algorithms to achieve authentication and design secure applications					K5,K6	
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>							
<b>Unit:1</b>	<b>INTRODUCTION</b>					<b>12hours</b>	
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.							
<b>Unit:2</b>	<b>CRYPTOSYSTEM</b>					<b>12hours</b>	
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.							
<b>Unit:3</b>	<b>NETWORK SECURITY</b>					<b>12hours</b>	
Network Security Practice: Authentication Applications–Kerberos–X.509 Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.							

<b>Unit:4</b>	<b>WEB SECURITY</b>	<b>10hours</b>
WebSecurity-SecureSocketLayer–SecureElectronicTransaction.SystemSecurity-Intruders and Viruses – Firewalls– Password Security.		
<b>Unit:5</b>	<b>CASE STUDY</b>	<b>12hours</b>
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		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars–webinars		
<b>Total Lecture hours</b>		<b>60hours</b>
<b>Text Books</b>		
1	WilliamStallings,“CryptographyandNetworkSecurity”, PHI/PearsonEducation.	
2	BruceSchneir,“AppliedCryptography”,CRC Press.	
<b>ReferenceBooks</b>		
1	A.Menezes, P Van Oorschot and S.Vanstone, “Hand Book ofApplied Cryptography”, CRC Press, 1997	
2	AnkitFadia, ”NetworkSecurity”,MacMillan.	
<b>RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]</b>		
1	<a href="https://nptel.ac.in/courses/106/105/106105031/">https://nptel.ac.in/courses/106/105/106105031/</a>	
2	<a href="http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html">http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html</a>	
3	<a href="https://www.tutorialspoint.com/cryptography/index.htm">https://www.tutorialspoint.com/cryptography/index.htm</a>	

<b>MappingwithProgrammingOutcomes</b>										
<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	S	M	S	M	L	S	M	S	M	S
<b>CO2</b>	S	S	S	S	S	S	S	S	S	S
<b>CO3</b>	S	S	S	S	S	S	S	S	S	S
<b>CO4</b>	S	S	S	S	S	S	S	S	S	S
<b>CO5</b>	S	S	S	S	S	S	S	S	S	S

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

Course code	DATA SCIENCE&ANALYTICS			L	T	P	C
Core/Elective/Supportive	Core IX			4			4
Pre-requisite	Basics of Data Science & applications						
<b>Course Objectives:</b>							
The main objectives of this course are to:							
<ol style="list-style-type: none"> <li>1. Introduce the students to data science, big data &amp; its ecosystem.</li> <li>2. Learn data analytics &amp; its life cycle.</li> <li>3. To explore the programming language, concerning the data mining algorithms.</li> <li>4. Relate the relationship between artificial intelligence, machine learning and data science.</li> </ol>							
<b>Expected Course Outcomes:</b>							
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	Apply and determine appropriate Data Mining techniques using R to real time applications					K3,K4	
4	Analyze clustering algorithms					K4,K5	
5	Analyze regression methods in AI					K6	
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5 -Evaluate; K6-Create</b>							
<b>Unit:1</b>	<b>INTRODUCTION</b>					<b>12hours</b>	
Introduction of Data Science: data science and big data – facets of data-data science process- Ecosystem- The Data Science process – six steps- Machine Learning.							
<b>Unit:2</b>	<b>BASICS OF DATA ANALYTICS</b>					<b>12hours</b>	
Data Analytics lifecycle- review of data analytics- Advanced data Analytics- technology and tools.							
<b>Unit:3</b>	<b>DATA ANALYTICS USING R</b>					<b>12hours</b>	
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.							
<b>Unit:4</b>	<b>CLUSTERING</b>					<b>12hours</b>	
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.							

<b>Unit:5</b>	<b>ARTIFICIAL INTELLIGENCE</b>	<b>10hours</b>
Artificial intelligence: Machine Learning and Deep Learning in data science-clustering, association rules. Linear regression-logistic regression-Additional regression methods.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
<b>Total Lecture hours</b>		<b>60hours</b>
<b>Text Books</b>		
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	
3	Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools-2016. Pdf	
4	Data science in big data analytics-Wiley2015JohnWiley&Sons	
<b>ReferenceBooks</b>		
1	AsimpleintroductiontoDataScience-LarsNielsen2015	
2	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication	
3	RProgrammingforData Science-RogerD.Peng 2015LeanPublication	
4	DataScience&BigDataAnalytics:Discovering,Analyzing,VisualizingandPresenting Data	
5	<a href="https://www.oreilly.com › view › machine-learning-and-Supervised-Learning: Models and Concepts">O'Reilly Media https://www.oreilly.com › view › machine-learning-and-Supervised Learning: Models and Concepts</a>	
<b>RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]</b>		
1	<a href="https://www.tutorialspoint.com/python_data_science/index.htm">https://www.tutorialspoint.com/python_data_science/index.htm</a>	
2	<a href="https://www.javatpoint.com/data-science">https://www.javatpoint.com/data-science</a>	
3	<a href="https://nptel.ac.in/courses/106/106/106106179/">https://nptel.ac.in/courses/106/106/106106179/</a>	

<b>MappingwithProgrammingOutcomes</b>										
<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	S	S	S	S	S	S	S	M	M	S
<b>CO2</b>	S	S	S	S	S	S	S	M	S	S
<b>CO3</b>	S	S	S	S	S	S	S	M	S	S
<b>CO4</b>	S	S	S	S	S	S	S	M	S	S
<b>CO5</b>	S	S	S	S	S	S	S	M	S	S

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

<b>Course code</b>		<b>PRACTICAL V: DIGITAL IMAGE PROCESSING Using MATLAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>	<b>Core</b>				4	3
<b>Pre-requisite</b>	Basic Programming of Image Processing & an Introduction to MATLAB					
<b>Course Objectives:</b>						
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. To enable the student to learn the fundamentals of image compression and segmentation						
3. To understand Image Restoration & Filtering Techniques						
4. Implementation of the above using MATLAB						
<b>Expected Course Outcomes:</b>						
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	
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>						
<b>LIST OF PROGRAMS</b>					<b>60hours</b>	
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						
<b>Total Lecture hours</b>					<b>60hours</b>	
<b>Text Books</b>						

1	RafaelC.Gonzalez,RichardE.Woods,“Digital ImageProcessing”,Second Edition,
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	PHI/PearsonEducation.
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2	B.Chanda,D.DuttaMajumder,“DigitalImageProcessingandAnalysis”,PHI, 2003.
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**ReferenceBooks**

1	NickEfford,“DigitalImageProcessingapacticalintroducingusingJava”,Pearson Education, 2004.
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**RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]**

1	<a href="https://nptel.ac.in/courses/117/105/117105135/">https://nptel.ac.in/courses/117/105/117105135/</a>
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2	<a href="https://www.tutorialspoint.com/dip/index.htm">https://www.tutorialspoint.com/dip/index.htm</a>
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3	<a href="https://www.javatpoint.com/digital-image-processing-tutorial">https://www.javatpoint.com/digital-image-processing-tutorial</a>
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**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

<b>Course code</b>		<b>Mini Project</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>		<b>Core</b>			6	6
<b>Pre-requisite</b>	Basic Programming of Software Tools & Introduction to developing Project work					
<b>Course Objectives:</b>						
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						
<b>Expected Course Outcomes:</b>						
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
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>						

<b>Mapping with Programming Outcomes</b>										
<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	S	S	M	S	S	S	M	M	S	S
<b>CO2</b>	S	S	S	S	S	S	S	M	S	S
<b>CO3</b>	S	S	S	S	S	S	S	M	S	S
<b>CO4</b>	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 Web Application Development and hosting using open-source software like Python, PHP, HTML, or .NET based 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.)

<b>Internal (CIA) (50 Marks)</b> (All the three reviews are mandatory)		<b>External (50 Marks)</b>	
<b>Review I</b> (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.	
<b>Review II</b> System Design / Database Design or Research Methodology / Algorithms and Techniques/ detailed Implementation plan	15 Marks	<b>Internal Examiner</b> Project Report	20 Marks
<b>Review III</b> System Implementation status, Testing, demo of working system and completion of report writing	20 Marks	<b>External Examiner shall evaluate under the following criteria</b> <ul style="list-style-type: none"> <li>• Presentation of the Mini Project</li> <li>• Demonstration of the mini-project working</li> <li>• Viva -voce</li> </ul>	10 Marks 10 Marks 10 Marks
<b>Total</b>	<b>50 Marks</b>		<b>50 Marks</b>

### SEC 3: CLOUD COMPUTING TOOLS

L	T	P	C
3	0	0	2

#### 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.				
<b>Course Objectives:</b>					
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					
<b>Expected Course Outcomes:</b>					
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
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>					

<b>Mapping with Programming Outcomes</b>										
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 3<sup>rd</sup> semester and evaluated by the external examiners
3. Internship students should submit a certificate of attendance from the industry along with a report.

<b>Course code</b>		<b>Major Project</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>		<b>Core</b>			30	14
<b>Pre-requisite</b>	Basic Programming of Software Tools & Introduction to developing Project work					
<b>Course Objectives:</b>						
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						
<b>Expected Course Outcomes:</b>						
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
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>						

<b>Mapping with Programming Outcomes</b>										
<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	S	S	M	S	S	S	M	M	S	S
<b>CO2</b>	S	S	S	S	S	S	S	M	S	S
<b>CO3</b>	S	S	S	S	S	S	S	M	S	S
<b>CO4</b>	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)	
<b>Review I</b> (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)	
<b>Review II</b> System Design / Database Design / Methodology / Algorithms and Techniques/ detailed Implementation plan	15 Marks	<b>Internal Examiner</b>  Project Report	20 Marks
<b>Review III</b> System Implementation status, Testing, outcomes and report writing	20 Marks	<b>External Examiner shall evaluate under the following criteria</b> <ul style="list-style-type: none"> <li>• Presentation of the Project</li> <li>• Demonstration of the working project</li> <li>• Viva -voce</li> </ul>	10 Marks  10 Marks  10 Marks

<b>Total</b>	<b>50 Marks</b>	<b>50 Marks</b>
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Course code	Extension Activities				L	T	P	C		
<b>Core/Elective/Supportive</b>	<b>Supportive</b>							1		
<b>Pre-requisite</b>	high school-level courses like Algebra, Trigonometry, and Pre-Calculus									
<b>Course Objectives:</b>										
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.										
<b>Expected Course Outcomes:</b>										
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			
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>										
<b>Mapping with Programming Outcomes</b>										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>CO1</b>	S	S	M	S	S	S	M	M	S	S
<b>CO2</b>	S	S	S	S	S	S	S	M	S	S
<b>CO3</b>	S	S	S	S	S	S	S	M	S	S
<b>CO4</b>	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.,

#### Guidelines:

1. Internal: 50marks External: 50 marks TOTAL 100 marks
2. students should submit a report about their visit and activities individually.

2. External Examination will be conducted in the 4<sup>th</sup> semester as per the existing pattern for extension activity

## LIST OF ELECTIVES

Course code	ADVANCED SOFTWARE ENGINEERING		L	T	P	C
Core/Elective/Supportive	Elective 1		3			3
Pre-requisite	Basics of Software Engineering & SPM					
<b>Course Objectives:</b>						
The main objectives of this course are to:						
<ol style="list-style-type: none"> <li>1. Introduce Software Engineering, Design, Testing and Maintenance.</li> <li>2. Enable the students to learn the concepts of Software Engineering.</li> <li>3. Learn about Software Project Management, Software Design &amp; Testing.</li> </ol>						
<b>Expected Course Outcomes:</b>						
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
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>						
<b>Unit:1</b>	<b>INTRODUCTION</b>				<b>15hours</b>	
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.						
<b>Unit:2</b>	<b>SOFTWARE REQUIREMENTS</b>				<b>15hours</b>	
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.						
<b>Unit:3</b>	<b>PROJECT MANAGEMENT</b>				<b>15hours</b>	

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.		
<b>Unit:4</b>	<b>SOFTWARE DESIGN</b>	<b>15hours</b>
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.		
<b>Unit:5</b>	<b>SOFTWARE TESTING</b>	<b>13hours</b>
Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging–Testingtools-Metrics-ReliabilityEstimation.SoftwareMaintenance -Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
<b>Total Lecture hours</b>		<b>75 hours</b>
<b>Text Books</b>		
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.	
<b>Reference Books</b>		
1	Software Engineering– K.K. Aggarwal and Yogesh Singh, New Age International Publishers, 3 rd edition.	
2	A Practitioners Approach-Software Engineering,- R.S. Pressman, McGraw Hill.	
3	Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Manodrioli, PHI Publication.	
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>		
1	<a href="https://www.javatpoint.com/software-engineering-tutorial">https://www.javatpoint.com/software-engineering-tutorial</a>	
2	<a href="https://onlinecourses.swayam2.ac.in/cec20_cs07/preview">https://onlinecourses.swayam2.ac.in/cec20_cs07/preview</a>	
3	<a href="https://onlinecourses.nptel.ac.in/noc19_cs69/preview">https://onlinecourses.nptel.ac.in/noc19_cs69/preview</a>	

<b>MappingwithProgrammingOutcomes</b>										
<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>1</b>	S	S	M	S	S	S	M	M	M	M
<b>CO2</b>	S	S	S	S	S	S	S	M	S	S
<b>CO3</b>	S	S	S	S	S	S	S	M	S	S
<b>CO4</b>	S	S	S	S	S	S	S	M	S	S
<b>CO5</b>	S	S	S	S	S	S	S	M	S	S

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

Course code		ADVANCED COMPUTER NETWORKS	L	T	P	C
Core/Elective/Supportive		Elective 2	3			3
Pre-requisite		Basic Knowledge of mathematics and networking				
<b>Course Objectives:</b>						
The main objectives of this course are to:						
<ol style="list-style-type: none"> <li>1. Have a detailed knowledge of the concept of networks</li> <li>2. Know the idea of protocols, OSI layers and their functions.</li> <li>3. Get knowledge of protocols used in different layers.</li> <li>4. Know about the function of the Internet</li> </ol>						
<b>Expected Course Outcomes:</b>						
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
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>						
<b>Unit:1</b>	<b>INTRODUCTION</b>					<b>12hours</b>
Introduction- data communications – networks – The internet – Protocols and standards – OSI model – layers in OSI model – TCP/IP protocol suite – addressing – guided media – Unguided media						
<b>Unit:2</b>	<b>DATA LINK LAYER</b>					<b>12hours</b>
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						
<b>Unit:3</b>	<b>NETWORK LAYER</b>					<b>12hours</b>
Network layer – IP V4 addressing – IPV6 addressing – ICMP – IGMP –Network layer delivery – forwarding – unicast and multicast routing protocols						
<b>Unit:4</b>	<b>TRANSPORT LAYER</b>					<b>12hours</b>
Transport layer – Process to process delivery – UDP -TCP -Congestion – congestion control – QOS – Techniques to improve QOS						
<b>Unit:5</b>	<b>APPLICATION LAYER</b>					<b>12hours</b>
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						
<b>Unit:6</b>	<b>Contemporary Issues</b>					<b>2 hours</b>

Expert lectures,online seminars– webinars	
<b>Total Lecture hours</b>	
<b>60hours</b>	
<b>Text Books</b>	
1	Data communications and networking – Behrouz A Forouzan McGraw Hill 4 <sup>th</sup> Edition 2015 Reprint
<b>Reference Books</b>	
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
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>	
1	<a href="https://nptel.ac.in/courses/106105080">https://nptel.ac.in/courses/106105080</a>
2	<a href="https://www.tutorialspoint.com/computer-networks/index.asp">https://www.tutorialspoint.com/computer-networks/index.asp</a>
3	<a href="https://www.javatpoint.com/computer-network-tutorial">https://www.javatpoint.com/computer-network-tutorial</a>

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

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

Course code	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING		L	T	P	C
Core/Elective/Supportive	Elective 3		3			3
Pre-requisite	Basics of AI & An Introduction to ML					
<b>Course Objectives:</b>						
The main objectives of this course are to:						
<ol style="list-style-type: none"> <li>1. Enable the students to learn the basic functions of AI and Heuristic Search Techniques.</li> <li>2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic.</li> <li>3. Introduce Machine Learning to Data Mining, Big Data and Cloud.</li> <li>4. Study about Applications &amp; Impact of ML.</li> </ol>						
<b>Expected Course Outcomes:</b>						
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	
<b>K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create</b>						
<b>Unit:1</b>	<b>INTRODUCTION</b>				<b>12hours</b>	
Introduction: AI Problems - AI techniques - Criteria for success. Problems, Problem Spaces, Search State space search - Production Systems - Problem Characteristics - Issues in the design of Search.						
<b>Unit:2</b>	<b>SEARCH TECHNIQUES</b>				<b>12hours</b>	
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.						
<b>Unit:3</b>	<b>PREDICATE LOGIC</b>				<b>12hours</b>	
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.						
<b>Unit:4</b>	<b>MACHINE LEARNING</b>				<b>12hours</b>	

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.

<b>Unit:5</b>	<b>APPLICATIONS OF MACHINE LEARNING</b>	<b>10 hours</b>
Looking Inside Machine Learning: The Impact of Machine Learning on Applications - Data Preparation -The Machine Learning Cycle.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
<b>Total Lecture hours</b>		<b>60hours</b>

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

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

**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

<b>Course code</b>		<b>INTERNET OF THINGS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>		<b>Elective 4</b>	3			3
<b>Pre-requisite</b>	Basics of Sensors & their Applications					
<b>Course Objectives:</b>						
The main objectives of this course are to:						
<ul style="list-style-type: none"> <li>● To get familiar with the evolution of IOT with its design principles.</li> <li>● To outline the functionalities and protocols of Internet communication.</li> <li>● To analyse the hardware and software components needed to construct IOT applications.</li> <li>● To identify the appropriate protocol for API construction and writing embedded code.</li> <li>● To realise various business models and ethics in the Internet of Things.</li> </ul>						
<b>Expected Course Outcomes:</b>						
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
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>						
<b>Unit:1</b>	<b>INTRODUCTION</b>				<b>12hours</b>	
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						
<b>Unit:2</b>	<b>Design Principles for Web Connectivity:</b>				<b>12hours</b>	
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						
<b>Unit:3</b>	<b>Data Acquiring, Organizing, Processing and Analytics :</b>				<b>12hours</b>	

Data Acquiring and Storage – Organising 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.

<b>Unit:4</b>	<b>SENSORS AND ACTUATORS</b>	<b>10hours</b>
Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks: Sensor Technology – Wireless Sensor Networks Technology - Prototyping the Embedded Devices for IoT and M2M : Embedded Computing Basics – Embedded Platforms for Prototyping.		
<b>Unit:5</b>	<b>Prototyping and Designing the Software for IoT Applications</b>	<b>12hours</b>
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.		
<b>Unit:6</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
Expert lectures, online seminars –webinars		
<b>Total Lecture hours</b>		<b>60 hours</b>

<b>Text Book</b>	
1	Raj Kamal , “ Internet of Things Architecture and Design Principles”, McGraw Hill, 2017
<b>Reference Books</b>	
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
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc20_cs66/preview">https://onlinecourses.nptel.ac.in/noc20_cs66/preview</a>
2	<a href="https://www.javatpoint.com/iot-internet-of-things">https://www.javatpoint.com/iot-internet-of-things</a>
3	<a href="https://www.tutorialspoint.com/internet_of_things/index.htm">https://www.tutorialspoint.com/internet_of_things/index.htm</a>

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

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

<b>Course code</b>		<b>DEEP LEARNING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Core/Elective/Supportive</b>		<b>Elective 5-1</b>	4			3
<b>Pre-requisite</b>		Basics of Cloud & its Applications				
<b>Course Objectives:</b>						
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						
<b>Expected Course Outcomes:</b>						
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
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>						
<b>Unit:1</b>	<b>INTRODUCTION</b>					<b>12hours</b>
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.						
<b>Unit:2</b>						<b>12hours</b>
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.						
<b>Unit:3</b>						<b>12hours</b>
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.						

<b>Unit:4</b>		<b>12hours</b>								
<p>Recurrent Neural Networks: Introduction – Architecture of Recurrent Neural Networks – The challenges of training recurrent networks – Echo-State Networks – Long Short-Term Memory – Gated Recurrent Units – Applications of Recurrent Neural Networks.</p> <p>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.</p>										
<b>Unit:5</b>		<b>12hours</b>								
<p>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</p>										
<b>Unit:6</b>	<b>Contemporary Issues</b>									
Expert lectures, online seminars –webinars										
	<b>Total Lecture hours</b>	<b>60hours</b>								
<b>Text Books</b>										
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 1 <sup>st</sup> Edition, O’Reilly’ 2017									
<b>Mapping with Programming Outcomes</b>										
<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	L	S	M	S	M	S	M	M	M	S
<b>CO2</b>	M	S	M	S	S	S	M	M	M	S
<b>CO3</b>	S	S	S	S	S	S	S	S	S	S
<b>CO4</b>	S	S	S	S	S	S	S	S	S	S
<b>CO5</b>	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							
<b>Course Objectives:</b>								
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.								
<b>Expected Course Outcomes:</b>								
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	
<b>K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create</b>								
<b>Unit:1</b>	<b>INTRODUCTION</b>						<b>12hours</b>	
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.								
<b>Unit:2</b>	<b>BIG DATA TECHNOLOGIES &amp; TOOLS</b>						<b>12hours</b>	
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.								
<b>Unit 3</b>	<b>CLUSTERING AND CLASSIFICATION</b>						<b>12hours</b>	
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								
<b>Unit:4</b>	<b>Time Series Analysis &amp; Text Analysis</b>							
- 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										
<b>Unit:5</b>		<b>Machine Learning with BIG DATA &amp; Applications</b>							<b>12hours</b>	
<p>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</p> <p>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.</p>										
<b>Unit:6</b>		<b>Contemporary Issues</b>								
Expert lectures, online seminars –webinars										
<b>Total Lecture hours</b>								<b>60hours</b>		
<b>Text Books</b>										
<ol style="list-style-type: none"> <li>1. Data Science &amp; Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services Published by John Wiley &amp; Sons,</li> <li>2. Noreen Burlingame, “The Little Book on Big Data”, NewStreetpublishers,2012.</li> <li>3. Anil Maheshwari, “Data Analytics”, McGrawHillEducation,2017.</li> <li>4. Kim S.Priesand Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.</li> <li>5. Min Chen, Shiwen Mao, Yin Zhang, Victor C.M. Leung, “Big Data: Related Technologies, Challenges and Future Prospects”, Springer; 2014 edition</li> </ol>										
Reference books										
<ol style="list-style-type: none"> <li>1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.</li> <li>2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.</li> <li>3. Dietmar Jannach and Markus Zanker, "Recommended Systems: An Introduction", Cambridge University Press, 2010.</li> <li>4. Tom White, “Hadoop- The Definitive Guide”, O’Reilly, 2<sup>nd</sup> Edition.</li> <li>5. Vignesh Prajapati,” Big Data Analytics with R and Hadoop”, PACKT Publishing, November 2013.</li> </ol>										
<b>Mapping with Programming Outcomes</b>										
<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	L	S	M	S	M	S	M	M	M	S
<b>CO2</b>	M	S	M	S	S	S	M	M	M	S
<b>CO3</b>	S	S	S	S	S	S	S	S	S	S
<b>CO4</b>	S	S	S	S	S	S	S	S	S	S
<b>CO5</b>	M	S	S	S	S	S	S	S	S	S

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

Course code	CRITICAL THINKING, DESIGN THINKING AND PROBLEM-SOLVING			L	T	P	C
Core/Elective/Supportive	Elective 5-3			4			3
Pre-requisite	Basics of Logical & Reasoning Skills						
<b>Course Objectives:</b>							
The main objectives of this course are to:							
<ol style="list-style-type: none"> <li>1. Learn critical thinking and its related concepts</li> <li>2. Learn design thinking and its related concepts</li> <li>3. Develop Thinking patterns, Problem solving &amp; Reasoning</li> </ol>							
<b>Expected Course Outcomes:</b>							
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	
<b>K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create</b>							
<b>Unit:1</b>	<b>CRITICAL THINKING</b>					<b>12hours</b>	
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.							
<b>Unit:2</b>	<b>DESIGN THINKING</b>					<b>12hours</b>	
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.							
<b>Unit:3</b>	<b>CASE STUDY</b>					<b>12hours</b>	
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.							

<b>Unit:4</b>	<b>PROBLEM-SOLVING</b>								<b>10hours</b>	
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.										
<b>Unit:5</b>	<b>REASONING</b>								<b>12hours</b>	
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										
<b>Unit:6</b>	<b>Contemporary Issues</b>								<b>2 hours</b>	
Expert lectures, online seminars –webinars										
								<b>Total Lecture hours</b>	<b>60hours</b>	
<b>Text Books</b>										
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, 2 <sup>nd</sup> edition, Pearson, Upper Saddle River, NJ, 2008.									
<b>Reference Books</b>										
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.									
<b>Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]</b>										
1	<a href="https://www.tutorialspoint.com/critical_thinking/index.htm">https://www.tutorialspoint.com/critical_thinking/index.htm</a>									
2	<a href="https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm">https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm</a>									
3	<a href="https://nptel.ac.in/courses/109/104/109104109/">https://nptel.ac.in/courses/109/104/109104109/</a>									
<b>Mapping with Programming Outcomes</b>										
<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	S	S	M	S	S	S	M	S	S	S
<b>CO2</b>	S	S	M	S	S	S	M	S	S	S
<b>CO3</b>	S	S	M	S	S	S	S	S	S	S
<b>CO4</b>	S	S	S	S	S	S	S	S	S	S
<b>CO5</b>	S	S	S	S	S	S	S	S	S	S

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