

MADURAI KAMARAJ UNIVERSITY

(University with Potential for Excellence)

M.Sc. Computer Science (Semester)

(With effect from 2023-24 onwards)

**CHOICE BASED CREDIT SYSTEM REVISED SYLLABUS
REGULATIONS SCHEME OF EXAMINATIONS AND SYLLABUS**

1. Course Objective:

- To prepare the students to manage the software components in a computer independently and to be a Programmer/Project Leader.
- To motivate the students to take up Academic Research in Computer Science and other streams.

2. Eligibility for Admission: Students who studied B.Sc.(CS), B.Sc. (IT) and BCA with +2 Level Mathematics.

3. Duration of the Course: The students shall undergo the prescribed course of study for a period of not less than two -academic years (Four semesters).

4. Medium of Instruction:English.

5. Eligibility for the Degree:

- I. A Candidate shall be eligible for the award of the degree on completion of the prescribed course of study and passing all the prescribed external examinations.
- II. Attendance progress, internal examinations, conduct certificate from the Head of the Institution shall be required for taking the external examination.
- III. The passing minimum and the ranking are as per the existing rule of the Choice Based Credit System for the affiliated college of the University.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	M.Sc., Computer Science
Programme Code	
Duration	PG - Two Years
Programme Outcomes (Pos)	PO1: Problem Solving Skill Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. PO2: Decision Making Skill Foster analytical and critical thinking abilities for data-based decision-making. PO3: Ethical Value Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. PO4: Communication Skill Ability to develop communication, managerial and interpersonal skills. PO5: Individual and Team Leadership Skill Capability to lead themselves and the team to achieve organizational goals. PO6: Employability Skill Inculcate contemporary business practices to enhance employability skills in the competitive environment. PO7: Entrepreneurial Skill Equip with skills and competencies to become an entrepreneur. PO8: Contribution to Society Succeed in career endeavors and contribute significantly to society. PO 9 Multicultural competence Possess knowledge of the values and beliefs of multiple cultures and a global perspective. PO 10: Moral and ethical awareness/reasoning Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	PSO1 – Placement To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. PSO 2 - Entrepreneur To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will

	facilitate startups and high potential organizations. PSO3 – Research and Development Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. PSO4 – Contribution to Business World To produce employable, ethical and innovative professionals to sustain in the dynamic business world. PSO 5 – Contribution to the Society To contribute to the development of the society by collaborating with stakeholders for mutual benefit.
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Credit Distribution for PG Programme

Semester-I	Credit	Semester-II	Credit	Semester-III	Credit	Semester-IV	Credit
1.1. Core-I	4	2.1. Core-IV	4	3.1. Core-VII	4	4.1. Core-X	4
1.2 Core-II	4	2.2 Core-V	4	3.2 Core-VII	4	4.2 Core-XI	4
1.3 Core – III	4	2.3 Core – VI	4	3.3 Core – IX	4	4.3 Core – XII	4
1.4 Elective (Generic / Discipline Centric)- I	3	2.4 Elective (Generic / Discipline Centric) – III	3	3.4 Elective (Generic / Discipline Centric) – V	3	4.4 Elective (Generic / Discipline Centric) – VI	3
1.5 Elective (Generic / Discipline Centric)-II	3	2.5 Elective (Generic / Discipline Centric)-IV	3	3.5 Core Industry Module	3	4.5 Project with Viva-Voce	3
1.6Ability Enhancement Course- Soft Skill -1	2	2.6 Ability Enhancement Course - Soft Skill -2	2	3.6 Ability Enhancement Course- Soft Skill -3	2	4.6 Ability Enhancement Course- Soft Skill -4	2
Skill Enhancement Course SEC 1	2	2.7 Skill Enhancement Course SEC 2	2	3.7 Skill Enhancement Course – Term Paper and Seminar Presentation SEC 3	2	4.7 Skill Enhancement Course - Professional Competency Skill	2
				3.8 Internship/ Industrial Activity	2	4.8 Extension Activity	1
	22		22		24		23
	Total Credit Points						91

Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	18	18	18	18	72
Part B					
(i) Discipline– Centric/Generic Skill	2	2	2	2	8
(ii) Soft Skill	2	2	2	2	10
(iii) Summer Internship/Industrial Training			2		
Part C				1	1
Total	22	22	24	23	91

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
METHODS OF ASSESSMENT		
Remembering (K1)	• The lowest level of questions require students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook.	
Understanding (K2)	• Understanding of facts and ideas by comprehending, organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond simple recall and require students to combine data together	
Application (K3)	• Students have to solve problems by using/applying a concept learned in the classroom. • Students must use their knowledge to determine an exact response.	
Analyze (K4)	• Analyzing the question is one that asks the student to break down something into its component parts. • Analyzing requires students to identify reasons, causes or motives and reach conclusions or generalizations.	
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem-solving. • Evaluation questions do not have a single right answer.	
Create (K6)	• The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem-solving skills	

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

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

Level of Correlation between PO's and PSO's

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

Assign the value

1 – Low

2 – Medium

3 – High

0 – No Correlation

M.Sc., Computer Science

Course Code	Title of the Course	Credits	Hours	Maximum Marks		
				CIA	ESE	Total
FIRST SEMESTER						
Core - I	Paper I: Analysis& Design of Algorithms	4	5	25	75	100
Core – II	Paper II: Object Oriented Analysis and Design & C++	4	5	25	75	100
Core – III	Paper III: Python Programming	4	5	25	75	100
Elective - I	Elective - I Paper IV: Advanced Software Engineering	3	5	25	75	100
Elective – II	Elective – II Practical I:Algorithms And OOPS Lab	3	5	40	60	100
AECSS 1	Ability Enhancement Course- Soft Skill -1	2	2	25	75	100
SEC 1	Skill Enhancement Course SEC 1 Practical II- Python Programming Lab	2	3	40	60	100
Total		22	30	-	-	-

Course Code	Title of the Course	Credits	Hours	Maximum Marks		
				CIA	ESE	Total
SECOND SEMESTER						
Core - IV	Paper V: Data Mining And Warehousing	4	5	25	75	100
Core – V	Paper VI Advanced Operating Systems	4	5	25	75	100
Core - VI	Paper VII Advanced Java Programming	4	5	25	75	100
Elective – III	Elective – III Practical III: Data Mining With WEKA and R Lab	3	5	40	60	100
Elective –IV	Elective –IV Practical IVAdvancedJava Programming Lab	3	5	40	60	100
AECSS 2	Ability Enhancement Course - Soft Skill -2	2	2	25	75	100
Skill Enhancement Course SEC 2	Skill Enhancement Course: Paper VIIIMultimedia and its	2	3	25	75	100

NME – I	Applications					
Total		22	30	-	-	-

Course Code	Title of the Course	Credits	Hours	Maximum Marks		
				CIA	ESE	Total
THIRD SEMESTER						
Core - VII	Paper IX: Digital Image Processing	4	5	25	75	100
Core – VIII	Paper X: Cloud Computing	4	5	25	75	100
Core – IX	Paper XI: Network Security and Cryptography	4	5	25	75	100
Elective – V	Elective – V Practical V :Digital Image Processing Lab using MATLAB	3	5	40	60	100
Core industry Module	Paper XII:Statistical Computing	3	5	25	75	100
AECSS 3	Ability Enhancement Course - Soft Skill -3	2	2	25	75	100
Skill Enhancement Course – Term Paper and Seminar Presentation SEC 3	Practical VI: Cloud Computing Lab	2	3	40	60	100
Internship Industrial Activity		2	-	40	60	100
Total		24	30	-	-	-

Course Code	Title of the Course	Credits	Hours	Maximum Marks		
				CIA	ESA	Total
FOURTH SEMESTER						
Core - X	Paper XIII: Big Data Analytics	4	5	25	75	100
Core – XI	Paper XIV: Internet of Things	4	5	25	75	100
Core – XII	Practical VIIWeb Application development & hosting Practical	4	5	40	60	100
Elective- VI	Elective (Generic / Discipline Centric) – VI Paper XV: Artificial Intelligence & Machine Learning	3	5	25	75	100
	Project work and Viva-voce	3	4	40	60	100
AECSS 4	Ability Enhancement Course- Soft Skill -4	2	2	25	75	100
	Skill Enhancement Course - Professional Competency Skill Training for competitive exam UGC NET	2	4	25	75	100
	Extension Activity	1	-	-	-	-
Total		23	30	-	-	-
Grand Total		91				

I – SEMESTER

Coursecode	Core - I	ANALYSIS&DESIGN OF ALGORITHMS	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basic Data Structures & Algorithms	CIA 25		ESE 75	
Course Objectives:						
The main objectives of this course are to:						
1. Enable the student to learn the Elementary Data Structures and algorithms.						
2. Present an introduction to the algorithms, their analysis and design						
3. Discuss various methods like Basic Traversal And Search Techniques, divide and conquer method, Dynamic programming, backtracking						
4. Understand the various design and analysis of the algorithms.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Get knowledge about algorithms and determine their time complexity. Demonstrate specific search and sort algorithms using divide and conquer technique.					K1,K2
2	Gain good understanding of Greedy method and its algorithm.					K2,K3
3	Able to describe about graphs using dynamic programming technique.					K3,K4
4	Demonstrate the concept of backtracking & branch and bound technique.					K5,K6
5	Explore the traversal and searching technique and apply it for trees and graphs.					K6
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
Unit:1						
INTRODUCTION			15 hours			
Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity- Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heapsort- Graph.						
Unit:2						
TRAVERSAL AND SEARCH TECHNIQUES			15 hours			
Basic Traversal And Search Techniques: Techniques for Binary Trees-Techniques for Graphs - Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.						
Unit:3						
GREEDY METHOD			15 hours			
The Greedy Method:-General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path.						
Unit:4						
DYNAMIC PROGRAMMING			15 hours			

DynamicProgramming-GeneralMethod–MultistageGraphs–AllPairShortestPath–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.		
Unit:5	BACKTRACKING	13hours
Backtracking:-GeneralMethod–8-QueensProblem–SumOfSubsets–GraphColoring– Hamiltonian Cycles – Branch And Bound: - The Method – Traveling Salesperson.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars– webinars		
	TotalLecturehours	75hours
Text Books		
1	EllisHorowitz,“ComputerAlgorithms”,GalgotiaPublications.	
2	AlfredV.Aho,JohnE.Hopcroft,JeffreyD.Ullman,"DataStructuresandAlgorithms".	
ReferenceBooks		
1	Goodrich,“DataStructures&AlgorithmsinJava”,Wiley3rd edition.	
2	Skiena,”TheAlgorithmDesignManual”,SecondEdition,Springer,2008	
3	AnanyLevith,”IntroductiontotheDesignandAnalysisofalgorithm”,PearsonEducation Asia, 2003.	
4	RobertSedgewick,PhillipeFlajolet,”AnIntroductiontotheAnalysisofAlgorithms”, Addison-Wesley Publishing Company,1996.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://nptel.ac.in/courses/106/106/106106131/	
2	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm	
3	https://www.javatpoint.com/daa-tutorial	

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

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

I – SEMESTER

Coursecode	Core – II	OBJECTORIENTEDANALYSISAND DESIGN & C++	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of C++ and Object Oriented Concepts	CIA 25		ESE 75	
CourseObjectives:						
Themainobjectivesofthis courseareto:						
1. Presenttheobjectmodel,classesandobjects,objectorientation,machineviewandmodel management view.						
2. Enablethestudentstolearnthebasicfunctions,principlesandconceptsofobjectoriented analysis and design.						
3. EnablethestudentstounderstandC++languagewithrespecttoOOAD						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	UnderstandtheconceptofObject-Orienteddevelopmentandmodelingtechniques					K1,K2
2	Gainknowledgeaboutthevariousstepsperformedduringobjectdesign					K2,K3
3	Abstractobject-basedviewsforgenericsoftwaresystems					K3
4	LinkOOADwithC++ language					K4,K5
5	Applythebasicconcept ofOOPsandfamiliarizetowriteC++ program					K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
Unit:1		OBJECTMODEL	15hours			
The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects.						
Unit:2						
Unit:2		CLASSESANDOBJECTS	15hours			
Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects –Key Abstractions and Mechanism.						
Unit:3						
Unit:3		C++INTRODUCTION	15hours			
IntroductiontoC++-InputandoutputstatementsinC++-Declarations-controlstructures– Functions in C++.						
Unit:4						
Unit:4		INHERITANCEANDOVERLOADING	13hours			

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

Unit:5	POLYMORPHISMANDFILES	15hours
MemoryManagementOperators-Polymorphism–Virtualfunctions–Files–Exception Handling – String Handling -Templates.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	75hours
Text Books		
1	“Object Oriented Analysis and Design with Applications”, Grady Booch, Second Edition, Pearson Education.	
2	“Object-OrientedProgrammingwithANSI&TurboC++”,AshokN.Kamthane,First Indian Print - 2003, Pearson Education.	
ReferenceBooks		
1	Balagurusamy“ObjectOrientedProgrammingwithC++”,TMH,SecondEdition,2003.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview	
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/	
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm	

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

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

I – SEMESTER

Coursecode	Core – III	PYTHONPROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of any OOP Programming Language	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. PresentsanintroductiontoPython,creationofwebapplications,networkapplicationsand working in the clouds						
2. UsefunctionsforstructuringPython programs						
3. UnderstanddifferentDataStructuresofPython						
4. RepresentcompounddatausingPythonlists,tuplesanddictionaries						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	UnderstandthebasicconceptsofPythonProgramming					K1,K2
2	UnderstandFileoperations,Classesand Objects					K2,K3
3	AcquireObject OrientedSkills inPython					K3,K4
4	Developweb applicationsusingPython					K5
5	DevelopClientServerNetworking applications					K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
Unit:1		INTRODUCTION			15hours	
Python:Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets– Comparison.						
Unit:2						
Unit:2		CODESTRUCTURES			15hours	
Code Structures: if, elseif, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions.						
Unit:3						
Unit:3		MODULES,PACKAGESANDCLASSES			15hours	
Modules, Packages, and Programs: Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. Objects and Classes: Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent withsuper–InselfDefense –GetandSetAttributeValueswithProperties –NameManglingfor Privacy – Method Types – Duck Typing – Special Methods –Composition.						
Unit:4						
Unit:4		DATATYPESANDWEB			13hours	
DataTypes:TextStrings–BinaryData.StoringandRetrievingData:FileInput/Output– Structured Text Files – Structured Binary Files - Relational Databases – NoSQL Data Stores.						
Web:WebClients –Web Servers–WebServicesand Automation						

Unit:5	SYSTEMSANDNETWORKS	15hours
Systems: Files–Directories–ProgramsandProcesses–CalendarsandClocks.		
Concurrency: Queues– Processes–Threads–GreenThreadsandgevent–twisted–Redis.		
Networks: Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – ZeroMQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and MapReduce – Working in the Clouds.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	75hours
Text Books		
1	BillLubanovic,“IntroducingPython”,O’Reilly,FirstEdition-SecondRelease,2014.	
2	MarkLutz,“LearningPython”, O’Reilly,FifthEdition, 2013.	
ReferenceBooks		
1	David M. Beazley,“Python Essential Reference”, Developer’s Library, Fourth Edition,2009.	
2	SheetalTaneja,Naveen Kumar, “Python Programming-A Modular Approach”,PearsonPublications.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websites etc.]		
1	https://www.programiz.com/python-programming/	
2	https://www.tutorialspoint.com/python/index.htm	
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview	

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

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

I – SEMESTER

Coursecode	Elective - I	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
Core/Elective/Supportive		Elective	5	-	-	3
Pre-requisite		Basics of Software Engineering &SPM	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. IntroducetoSoftwareEngineering,Design,TestingandMaintenance. 2. EnablethestudentstolearntheconceptsofSoftwareEngineering. 3. LearnaboutSoftwareProjectManagement,SoftwareDesign&Testing.						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	UnderstandaboutSoftwareEngineeringprocess					K1,K2
2	UnderstandaboutSoftwareprojectmanagementskills,designandquality management					K2,K3
3	AnalyzeonSoftwareRequirementsandSpecification					K3,K4
4	AnalyzeonSoftwareTesting, MaintenanceandSoftwareRe-Engineering					K4,K5
5	Designandconductvarioustypesandlevelsofsoftwarequalityforasoftware project					K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
INTRODUCTION			15hours			
Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.						
Unit:2						
SOFTWARE REQUIREMENTS			15hours			
Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Resultmanagementsystem. SoftwareQuality Management –SoftwareQuality, Software Quality Management System, ISO 9000, SEI CMM.						
Unit:3						
PROJECT MANAGEMENT			15hours			
Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead’s software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.						

Unit:4		SOFTWAREDESIGN	15hours
Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.			
Unit:5		SOFTWARETESTING	13hours
Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging–Testingtools-Metrics-ReliabilityEstimation.SoftwareMaintenance -Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.			
Unit:6		ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars			
		TotalLecturehours	75hours
Text Books			
1	AnIntegratedApproachtoSoftwareEngineering–PankajJalote,NarosaPublishingHouse, Delhi, 3rd Edition.		
2	FundamentalsofSoftwareEngineering –RajibMall,PHIPublication,3rdEdition.		
ReferenceBooks			
1	SoftwareEngineering–K.K.AggarwalandYogeshSingh,NewAgeInternational Publishers, 3 rd edition.		
2	APractitionersApproach-SoftwareEngineering,-R.S.Pressman,McGraw Hill.		
3	Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Manodrioli,PHIPublication.		
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]			
1	https://www.javatpoint.com/software-engineering-tutorial		
2	https://onlinecourses.swayam2.ac.in/cec20_cs07/preview		
3	https://onlinecourses.nptel.ac.in/noc19_cs69/preview		

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

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

I – SEMESTER

Coursecode	Elective – II	PRACTICAL I:ALGORITHMSAND OOPS LAB	L	T	P	C
Core/Elective/Supportive		Elective	-	-	5	3
Pre-requisite		BasicProgrammingofC++language	CIA 40		ESE 60	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1.Thiscoursecoversthebasicdatastructureslike Stack,Queue,Tree,List.						
2. Thiscourseenablesthestudentstolearntheapplicationsofthedatastructuresusing various techniques						
3. Italso enablesthestudentstounderstandC++languagewithrespectto OOAD concepts						
4. ApplicationofOOPSconcepts.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	UnderstandtheconceptsofobjectorientedwithrespecttoC++				K1,K2	
2	AbletounderstandandimplementOOPSconcepts				K3,K4	
3	ImplementationofdatastructureslikeStack, Queue,Tree,Listusing C++				K4,K5	
4	ApplicationofthedatastructuresforSorting,Searchingusing different techniques.				K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
LISTOF PROGRAMS						
75hours						
1) Writeaprogram tosolvethetowerofHanoiusing recursion.						
2) Writeaprogramtotraversethroughbinarysearch treeusingtraversals.						
3) Writeaprogramto performvariousoperationson stackusinglinked list.						
4) Writeaprogram toperformvarious operationincircular queue.						
5) Writeaprogram tosortan arrayofan elementsusingquick sort.						
6) Writeaprogramto solvenumberof elementsin ascending orderusing heap sort.						
7) Writeaprogramtosolve theknapsackproblemusinggreedymethod						
8) Writeaprogramto search foran elementin a tree using divide& conquerstrategy.						
9) Writeaprogram toplacethe8 queenson an8X8matrixso thatno twoqueens Attack.						
10) WriteaC++programto performVirtual Function						
11) WriteaC++programtoperformParameterizedconstructor						
12) WriteaC++programtoperform FriendFunction						
13) WriteaC++programtoperform FunctionOverloading						
14) WriteaC++program to performSingleInheritance						
15) WriteaC++program toperform EmployeeDetailsusing files.						
Expertlectures,onlineseminars –webinars						

TotalLecturehours	
75hours	
Text Books	
1	Goodrich,“DataStructures&AlgorithmsinJava”,Wiley3rd edition.
2	Skiena,”TheAlgorithmDesignManual”,SecondEdition,Springer,2008
ReferenceBooks	
1	AnanyLevith,”Introductiontothe DesignandAnalysisof algorithm”, Pearson Education Asia, 2003.
2	RobertSedgewick,PhillipeFlajolet,”AnIntroductiontotheAnalysisofAlgorithms”, Addison-Wesley Publishing Company,1996.
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ood_object_oriented_analysis.htm

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

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

I – SEMESTER

Coursecode	SEC 1	PRACTICALII:PYTHON PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Skill Enhancement Course	-	-	3	2
Pre-requisite		Basics of any OOP programming Language	CIA 40		ESE 60	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Thiscoursepresentsanoverviewofelementarydataitems,lists,dictionaries,setsandtuples						
2. Tounderstandand writesimplePythonprograms						
3. ToUnderstandthe OOPSconceptsofPython						
4. Todevelopweb applications usingPython						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	Abletowriteprograms inPythonusingOOPS concepts				K1,K2	
2	TounderstandtheconceptsofFileoperationsandModulesinPython				K2,K3	
3	Implementationoflists,dictionaries,setsandtuplesas programs				K3,K4	
4	Todevelopweb applications usingPython				K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
LISTOF PROGRAMS						
ImplementthefollowinginPython:						
1. Programsusingelementarydataitems,lists,dictionariesandtuples						
2. Programsusingconditionalbranches,						
3. Programsusingloops.						
4. Programsusingfunctions						
5. Programsusingexceptionhandling						
6. Programsusinginheritance						
7. Programsusingpolymorphism						
8. Programstoimplementfile operations.						
9. Programsusingmodules.						
10. Programsforcreatingdynamicandinteractivewebpagesusingforms.						
TotalLecturehours					45hours	
Text Books						
1	BillLubanovic,“Introducing Python”,O’Reilly,FirstEdition-SecondRelease,2014.					
2	MarkLutz,“LearningPython”, O’Reilly,FifthEdition, 2013.					
ReferenceBooks						

1	David M. Beazley, "Python Essential Reference", Developer's Library, Fourth Edition, 2009.
2	SheetalTaneja, Naveen Kumar, "Python Programming-A Modular Approach", Pearson Publications.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

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

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

II – SEMESTER

Coursecode	Core - IV	DATAMININGANDWAREHOUSING	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of RDBMS & Algorithms	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.						
2. Developskillsofusingrecent dataminingsoftwareforsolvingpracticalproblems.						
3. Developandapplycriticalthinking,problem-solving,anddecision-makingskills.						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	Understandthebasicdataminingtechniquesandalgorithms					K1,K2
2	UnderstandtheAssociationrules,ClusteringtechniquesandDatawarehousing contents					K2,K3
3	Compareandevaluatedifferentdataminingtechniqueslikeclassification,prediction, Clustering and association rule mining					K4,K5
4	DesigndatawarehousewithdimensionalmodelingandapplyOLAP operations					K5,K6
5	Identifyappropriatedataminingalgorithmstosolverealworldproblems					K6
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create						
Unit:1		BASICSANDTECHNIQUES			15 hours	
Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.						
Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.						
Unit:2		ALGORITHMS			13 hours	
Classification:Introduction –Statistical –basedalgorithms -distance–basedalgorithms-decision tree-basedalgorithms-neuralnetwork–basedalgorithms–rule-basedalgorithms–combining techniques.						
Unit:3		CLUSTERINGANDASSOCIATION			15 hours	
Clustering:Introduction–SimilarityandDistanceMeasures–Outliers–HierarchicalAlgorithms -PartitionalAlgorithms.						
Association rules: Introduction - large item sets - basic algorithms – parallel &distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.						
Unit:4		DATAWAREHOUSINGANDMODELING			15 hours	
Datawarehousing:introduction-characteristicsofadatawarehouse–datamarts–otheraspects						

Ofdatamart.Online analyticalprocessing:introduction –OLTP&OLAPsystems		
Datamodeling –star schema for multidimensional view –data modeling – multifactstar schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.		
Unit:5	APPLICATIONSOFDATA WAREHOUSE	15 hours
Developing a data WAREHOUSE: why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse.		
Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	75 hours
Text Books		
1	MargarethH.Dunham,“DataMining:IntroductoryandAdvancedTopics”,Pearson education,2003.	
2	C.S.R. Prabhu, “Data Warehousing Concepts,Techniques, Productsand Applications”, PHI, Second Edition.	
ReferenceBooks		
1	ArunK.Pujari,“DataMiningTechniques”,UniversitiesPress(India)Pvt. Ltd.,2003.	
2	AlexBerson,StephenJ.Smith,“DataWarehousing,DataMiningandOLAP”,TMCH, 2001.	
3	JiaweiHan&MichelineKamber, “DataMiningConcepts &Techniques”, 2001, Academicpress.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://www.javatpoint.com/data-warehouse	
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/	
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html	

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

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

II – SEMESTER

Coursecode	Core – V	ADVANCED OPERATING SYSTEMS	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of OS & its functioning	CIA 25		ESE 75	
Course Objectives:						
The main objectives of this course are to:						
1. Enable the student to learn the different types of operating systems and their functioning.						
2. Gain knowledge on Distributed Operating Systems						
3. Gain insight into the components and management aspects of real-time and mobile operating systems.						
4. Learn case studies in Linux Operating Systems						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the design issues associated with operating systems					K1, K2
2	Master various process management concepts including scheduling, deadlocks and distributed file systems					K3, K4
3	Prepare Real Time Task Scheduling					K4, K5
4	Analyze Operating Systems for Handheld Systems					K5
5	Analyze Operating Systems like LINUX and iOS					K5, K6
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
Unit:1						
Unit:1		BASICS OF OPERATING SYSTEMS			18 hours	
Basics of Operating Systems: What is an Operating System? – Main frame Systems – Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems – Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks – Prevention – Avoidance – Detection – Recovery.						
Unit:2						
Unit:2		DISTRIBUTED OPERATING SYSTEMS			15 hours	
Distributed Operating Systems: Issues – Communication Primitives – Lamport’s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems – design issues – Case studies – The Sun Network File System-Coda.						
Unit:3						
Unit:3		REAL TIME OPERATING SYSTEM			15 hours	
Realtime Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling						
Unit:4						
Unit:4		HANDHELD SYSTEM			15 hours	

Operating Systems for Handheld Systems: Requirements – Technology Overview – Handheld Operating Systems – Palm OS – Symbian Operating System – Android – Architecture of android –		
Securing handheld systems		
Unit:5	CASE STUDIES	10 hours
Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	75 hours
Text Books		
1	Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, “Operating System Concepts”, Seventh Edition, John Wiley & Sons, 2004.	
2	Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001.	
Reference Books		
1	Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2006.	
2	Pramod Chandra P. Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.	
3	Daniel P. Bovet & Marco Cesati, “Understanding the Linux kernel”, 3 rd edition, O’Reilly, 2005	
4	Neil Smyth, “iPhone/iOS 4 Development Essentials – Xcode”, Fourth Edition, Payload media, 2011.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.nptel.ac.in/noc20_cs04/preview	
2	https://www.udacity.com/course/advanced-operating-systems--ud189	
3	https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf	

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

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

II – SEMESTER

Coursecode	Core - VI	ADVANCEDJAVAPROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of Java & its Usage	CIA 25		ESE 75	
CourseObjectives:						
The main objectives of this course are to:						
1. Enable the student to learn the basic functions, principles and concepts of advanced java programming.						
2. Provide knowledge on concepts needed for distributed Application Architecture.						
3. Learn JDBC, Servlet packages, JQuery, Java Server Pages and JAR file format						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the advanced concepts of Java Programming					K1,K2
2	Understand JDBC and RMI concepts					K2,K3
3	Apply and analyze Java in Database					K3,K4
4	Handle different event in java using the delegation event model, event listener and class					K5
5	Design interactive applications using Java Servlet, JSP and JDBC					K5,K6
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
Unit:1	BASICS OF JAVA					15 hours
Java Basics Review: Components and event handling – Threading concepts – Networking features – Media techniques						
Unit:2	REMOTE METHOD INVOCATION					15 hours
Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons- Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces						
Unit:3	DATABASE					15 hours
Java in Databases- JDBC principles – database access- Interacting- database search – Creating multimedia databases – Database support in web applications						
Unit:4	SERVLETS					15 hours
Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Reading data from a client-Reading http request header-sending data to a client and writing the http response header-working with cookies						
Java Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page-Expressions-Scriptlets-Directives-Declarations-A complete example						
Unit:5	ADVANCED TECHNIQUES					13 hours

JARfileformatcreation–Internationalization–SwingProgramming–Advancedjava techniques		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	75 hours
Text Books		
1	JamieJaworski,“JavaUnleashed”,SAMSTechmediaPublications,1999.	
2	Campione,Walrath and Huml,“TheJavaTutorial”,AddisonWesley,1999.	
ReferenceBooks		
1	JimKeogh,”TheCompleteReferenceJ2EE”,TataMcGrawHillPublishingCompanyLtd,2010.	
2	DavidSawyerMcFarland,“JavaScriptAndjQuery-TheMissingManual”,Oreilly Publications, 3rd Edition,2011.	
3	DeitelandDeitel, “JavaHowtoProgram”,ThirdEdition,PHI/PearsonEducationAsia.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://www.javatpoint.com/servlet-tutorial	
2	https://www.tutorialspoint.com/java/index.htm	
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview	

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

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

Coursecode	Elective – III	PRACTICAL III: Data Mining With WEKA and R Lab	L	T	P	C
Core/Elective/Supportive	Elective		-	-	5	3
Pre-requisite	Basics of Data Mining concepts		CIA 40		ESE 60	
CourseObjectives:						
The main objectives of this course are to:						
1. This course presents an overview of concepts of data mining algorithms						
2. To understand the preprocessing concepts in weka programs						
3. To Understand the Association rule mining, classification and clustering using weka						
4. To implement the basic programs of R						
5. To import CSV data into R						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	Able to implement in weka using data mining concepts					K1,K2
2	To understand the concepts of preprocessing.					K2,K3
3	Implementation of association rule mining, classification and clustering using weka					K3,K4
4	To implement the basic programs of R					K4,K5
5	To import CSV data into R					K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
	LIST OF PROGRAMS				75 hours	
Using weka tool						
1. Demonstration of preprocessing on dataset student.arff						
2. Demonstration of preprocessing on dataset labor.arff						
3. Demonstration of Association rule process on dataset contactlenses.arff using apriori algorithm						
4. Demonstration of Association rule process on dataset test.arff using apriori algorithm						
5. Demonstration of classification rule process on dataset student.arff using j48 algorithm						
6. Demonstration of classification rule process on dataset employee.arff using j48 algorithm						
7. Demonstration of classification rule process on dataset employee.arff using id3 algorithm						
8. Demonstration of classification rule process on dataset employee.arff using naïve bayes algorithm						
9. Demonstration of clustering rule process on dataset iris.arff using simple k-means						
10. Demonstration of clustering rule process on dataset student.arff using simple k- means						
Using R-Tool :						

1. Find Sum, Mean and Product of Vector in R
2. R Program to sample from a Population
3. R Program to Sort a Vector.
4. To combine the matrix using rbind and cbind methods.
5. Use seq() to create sequence.
6. Write a program to convert the table data into data frame.
7. Calculate student mark list and output it in data frame.
8. R Program to Check Prime Number
9. R Program to Check for Leap Year.
10. R Program to Check if a Number is Odd or Even in R
11. R Program to Find the Sum of Natural Numbers
12. Convert Decimal into Binary using Recursion in R
13. R program to Find the Factorial of a Number Using Recursion
14. R Program to Make a Simple Calculator
15. Write a R Program to import CSV data into R.
16. Write a R Program to move the result data from R to CSV.
17. Draw the Line Graph for Student Data.
18. Draw the Pie-Chart for Employee Data.
19. Create a Table from the existing data set in R and draw the chart.
20. Apply K-Means Algorithm for IRIS data set and output it in graph
21. Get some input from mtcars data set and perform analysis

Note: The above are sample problems; Instructor can add more exercises based on their requirements and the current technology

	TotalLecturehours	75 hours
ReferenceBooks		
1.	R Programming – An approach to Data Analytics – Dr. Sudhamathy & Dr. Jothi Venkateshwaran, MJP Publishers, 2018	
2.	Statistical Programming in R - K G Srinivasa , G M Siddesh, Chetan Shety, B.J Sowmya, - Oxford University Press, 2017	
3	Design and Implementation of Data Mining Tools – M.Awad, Latifur Khan, Bhavani Thirissingham, Lei Wang – CRC Press, Taylor & Francis Group, 2015.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://cobweb.cs.uga.edu/~khaled/DMcourse/Weka-Tutorial-Exercises.pdf	
2	https://ppawar.github.io/Spring2020/CSE351-S20/Exercises/Weka%20activity%20-%201%20April%202020.pdf	
3	http://datamininglabexercises.blogspot.com/p/exercises-from-weka-textbook.html	

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

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

Coursecode	Elective – IV	PRACTICAL IV: ADVANCED JAVA PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Elective	-	-	5	3
Pre-requisite		Basics in Java Programming	CIA 40		ESE 60	
Course Objectives:						
The main objectives of this course are to:						
1. To enable the students to implement the simple programs using JSP, JAR						
2. To provide knowledge on using Servlets, Applets						
3. To introduce JDBC and navigation of records						
4. To understand RMI & its implementation						
5. To introduce to Socket programming						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand to implement concepts of Java using HTML forms, JSP & JAR				K1, K2	
2	Must be capable of implementing JDBC and RMI concepts				K3, K4	
3	Able to write Applets with Event handling mechanism				K4, K5	
4	To Create interactive web based applications using servlets and jsp				K5, K6	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
LIST OF PROGRAMS						
75 hours						
1. Display a welcome message using Servlet.						
2. Design a Purchase Order form using Html form and Servlet.						
3. Develop a program for calculating the percentage of marks of a student using JSP.						
4. Design a Purchase Order form using Html form and JSP.						
5. Prepare an Employee payslip using JSP.						
6. Write a program using JDBC for creating a table, Inserting, Deleting records and list out the records.						
7. Write a program using Java servlet to handle form data.						
8. Write a simple Servlet program to create a table of all the headers it receives along with their associated values.						
9. Write a program in JSP by using session object.						
10. Write a program to build a simple Client Server application using RMI.						
11. Create an applet for a calculator application.						
12. Program to send a text message to another system and receive the text message from the system (use socket programming).						
Expert lectures, online seminars – webinars						
Total Lecture hours						
75 hours						

Text Books	
1	JamieJaworski,“JavaUnleashed”,SAMSTechmediaPublications,1999.
2	Campione,Walrath and Huml,“TheJavaTutorial”,AddisonWesley,1999.
ReferenceBooks	
1	JimKeogh,”TheCompleteReferenceJ2EE”,TataMcGrawHillPublishingCompany Ltd,2010.
2	DavidSawyerMcFarland,“JavaScriptAndjQuery-TheMissingManual”,Oreilly Publications, 3rd Edition,2011.
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

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

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

Coursecode	SEC 2 NME – I	MULTIMEDIAANDITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		Elective	3	-	-	2
Pre-requisite		Basics of Multimedia	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Tointroducethestudents theconceptsofMultimedia,Images&Animation.						
2. TointroduceMultimediaauthoring tools						
3. Tounderstandtheroleof Multimediain Internet						
4. ToknowaboutHighDefinitionTelevisionandDesktopComputing–Knowledgebased Multimedia systems						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	UnderstandthebasicconceptsofMultimedia					K1,K2
2	DemonstrateMultimediaauthoringtools					K2,K3

3	Analyze the concepts of Sound, Images, Video & Animation	K4
4	Apply and Analyze the role of Multimedia in Internet and real time applications	K4, K5
5	Analyze multimedia applications using HDTV	K5, K6
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		
Unit:1	INTRODUCTION	6 hours
What is Multimedia? – Introduction to making Multimedia – Macintosh and Windows Production platforms – Basic Software tools.		
Unit:2	MULTIMEDIA TOOLS	6 hours
Making Instant Multimedia – Multimedia authoring tools – Multimedia building blocks – Text – Sound.		
Unit:3	ANIMATION	6 hours
Images – Animation – Video.		
Unit:4	INTERNET	6 hours
Multimedia and the Internet – The Internet and how it works – Tools for World Wide Web – Designing for the World Wide Web.		
Unit:5	MULTIMEDIA SYSTEMS	4 hours
High Definition Television and Desktop Computing – Knowledge based Multimedia systems.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	30 hours
Text Books		
1	Tay Vaughan, “Multimedia making it work”, Fifth Edition, Tata McGraw Hill.	
2	John F. Koegel Bufford, “Multimedia Systems”, Pearson Education.	
Reference Books		
1	Judith Jeffloat, “Multimedia in Practice (Technology and Applications)”, PHI, 2003.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/multimedia/index.htm	
2	https://www.tutorialspoint.com/basics_of_computer_science/basics_of_computer_science_multimedia.htm	

3	https://nptel.ac.in/courses/117/105/117105083/

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

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

III SEMESTER

Coursecode	Core - VII	DIGITALIMAGEPROCESSING	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of Image Processing	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Learnbasicimageprocessingtechniquesforsolvingreal problems.						
2. Gainknowledgeinimagetransformationand Imageenhancementtechniques.						
3. LearnImagecompressionandSegmentation procedures.						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	UnderstandthefundamentalsofDigitalImage Processing					K1,K2
2	Understandthematematicalfoundationsfordigitalimagerepresentation, image acquisition, image transformation, and image enhancement					K2,K3
3	Apply, Design and Implement and get solutions for digital image processingproblems					K3,K4
4	Applytheconceptsoffilteringandsegmentationfordigitalimageretrieval					K4,K5
5	Explore the concepts of Multi-resolution process and recognize the objects in an efficient manner					K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
Unit:1		INTRODUCTION			15 hours	
Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.						
Unit:2						
Unit:2		IMAGEENHANCEMENT			17 hours	
Image Enhancement in the spatial domain:- Background – some basic Gray levelTransformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods.						
Unit:3						
Unit:3		IMAGERESTORATION			18 hours	

Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.

Unit:4	IMAGECOMPRESSION	10 hours
ImageCompression:Fundamentals–Imagecompressionmodels–ElementsofInformation Theory – Error Free compression – Lossy compression – Image compression standards.		
Unit:5	IMAGESEGMENTATION	13 hours
Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	75 hours
Text Books		
1	RafaelC.Gonzalez,RichardE. Woods,“DigitalImageProcessing”,SecondEdition,PHI/Pearson Education.	
2	B.Chanda,D.DuttaMajumder,“DigitalImageProcessingandAnalysis”,PHI, 2003.	
ReferenceBooks		
1	NickEfford,“DigitalImageProcessingapraacticalintroducingusingJava”,Pearson Education, 2004.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://nptel.ac.in/courses/117/105/117105135/	
2	https://www.tutorialspoint.com/dip/index.htm	
3	https://www.javatpoint.com/digital-image-processing-tutorial	

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

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

Coursecode	Core – VIII	CLOUDCOMPUTING	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of Cloud & its Applications	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Gainknowledgeon cloudcomputing,cloudservices,architecturesandapplications.						
2. Enablethestudentstolearnthebasicsofcloudcomputingwithrealtime usage						
3. Howtostoreandshare,inandfromcloud?						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understandthe conceptsofCloudanditsservices				K1,K2	
2	CollaborateCloudforEvent&ProjectManagement				K3,K4	
3	Analyzeon cloudin –WordProcessing,SpreadSheets,Mail,Calendar, Database				K4,K5	
4	Analyzecloudinsocial networks				K5,K6	
5	Explorecloud storageand sharing				K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
INTRODUCTION			15 hours			
INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.						
Unit:2						
CLOUDCOMPUTING			15 hours			
CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloudcomputing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.						
Unit:3						
CLOUDSERVICES			15 hours			
USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.						
Unit:4						
OUTSIDETHECLOUD			15 hours			
OUTSIDETHECLOUDEvaluatingwebmailservices,Evaluatinginstantmessaging, Evaluatingwebconferencetools,creatinggroupsonsocialnetworks,Evaluatingonline						

groupware,collaboratingviablogsandwikis.		
Unit:5	STORINGAND SHARING	13 hours
STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	75 hours
Text Books		
1	MichaelMiller,“Cloud Computing”,PearsonEducation,NewDelhi, 2009.	
ReferenceBooks		
1	Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata McGrawHill Education Private Limited, 2009.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://nptel.ac.in/courses/106/105/106105167/	
2	https://www.tutorialspoint.com/cloud_computing/index.htm	
3	https://www.javatpoint.com/cloud-computing-tutorial	

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

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

Coursecode	Core – IX	NETWORK SECURITY AND CRYPTOGRAPHY	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of Networks & its Security	CIA 25		ESE 75	
Course Objectives:						
The main objectives of this course are to:						
1. Enable students to learn the Introduction to Cryptography, Web Security and Case studies in Cryptography.						
2. To gain knowledge on classical encryption techniques and concepts of modular arithmetic and number theory.						
3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.						
4. To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the process of the cryptographic algorithms					K1,K2
2	Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication					K2,K3
3	Apply and analyze appropriate security techniques to solve network security problem					K3,K4
4	Explore suitable cryptographic algorithms					K4,K5
5	Analyze different digital signature algorithms to achieve authentication and design secure applications					K5,K6
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
Unit:1		INTRODUCTION			15 hours	
Introduction to Cryptography – Security Attacks – Security Services – Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.						
Unit:2		CRYPTOSYSTEM			18 hours	
Public-key Cryptosystem: Introduction to Number Theory-RSA Algorithm–Key Management -Diffie-Hellman Key exchange–Elliptic Curve Cryptography Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.						
Unit:3		NETWORK SECURITY			15 hours	
Network Security Practice: Authentication Applications–Kerberos–X.509 Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.						

Unit:4	WEB SECURITY	10hours
WebSecurity-SecureSocketLayer–SecureElectronicTransaction.SystemSecurity-Intruders and Viruses – Firewalls– Password Security.		
Unit:5	CASE STUDY	15 hours
CaseStudy:ImplementationofCryptographicAlgorithms–RSA–DSA–ECC(C/JAVA Programming).Network Forensic – Security Audit - Other Security Mechanism: Introduction to: Stenography –Quantum Cryptography – Water Marking - DNA Cryptography		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars–webinars		
	TotalLecturehours	75 hours
Text Books		
1	WilliamStallings,“CryptographyandNetworkSecurity”, PHI/PearsonEducation.	
2	BruceSchneir,“AppliedCryptography”,CRC Press.	
ReferenceBooks		
1	A.Menezes, P Van Oorschot and S.Vanstone, “Hand Book ofApplied Cryptography”, CRC Press, 1997	
2	AnkitFadia,”NetworkSecurity”,MacMillan.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://nptel.ac.in/courses/106/105/106105031/	
2	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html	
3	https://www.tutorialspoint.com/cryptography/index.htm	

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

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

Coursecode	Elective – V	PRACTICAL V: DIGITAL IMAGE PROCESSING Using MATLAB	L	T	P	C
Core/Elective/Supportive		Elective	-	-	5	3
Pre-requisite		Basic Programming of Image Processing & an intro to MATLAB	CIA 40		ESE 60	
Course Objectives:						
The main objectives of this course are to:						
1. To understand the basics of Digital Image Processing fundamentals, image enhancement and image restoration techniques						
2. 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						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To write programs in MATLAB for image processing using the techniques				K1, K2	
2	To be able to implement Image Enhancements & Restoration techniques				K2, K3	
3	Capable of using Compression techniques in an Image				K3, K4	
4	Must be able to manipulate the image and Segment it				K5, K6	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
LIST OF PROGRAMS				75 hours		
1. Implement Image enhancement Technique.						
2. Histogram Equalization						
3. Image Restoration.						
4. Implement Image Filtering.						
5. Edge detection using Operators (Roberts, Prewitts and Sobel operators)						
6. Implement image compression.						
7. Image Subtraction						
8. Boundary Extraction using morphology.						
9. Image Segmentation						
Total Lecture hours				75 hours		
Text Books						
1	Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Second Edition,					

	PHI/Pearson Education.
2	B.Chanda,D.DuttaMajumder,“DigitalImageProcessingandAnalysis”,PHI, 2003.
ReferenceBooks	
1	NickEfford,“DigitalImageProcessingapacticalintroducingusingJava”,Pearson Education, 2004.
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial

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

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

Coursecode	Core industry Module	Statistical Computing	L	T	P	C
Core/Elective/Supportive		Core industry Module	5	-	-	3
Pre-requisite		Basic knowledge of statistical concepts	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto: 1. To understand the applications of various correlation methods 2. To study and model the sampling concepts 3. To acquire knowledge on Hypotheses test						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	To understand the concepts of Correlation					K1,K2
2	To able to know the Regression Analysis					K2,K3
3	To make understand the Probability Distribution and mathematical Expectation					K3,K4
4	To know the Sampling and Sampling Distributions					K4,K5
5	To understand the Statistical Inference					K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5 -Evaluate; K6-Create						

Unit:1		15 hours
Correlation - Definition of Correlation- Scatter Diagram- Kari Pearson’s Coefficient of Linear Correlation- Coefficient of Correlation and Probable Error of r- Coefficient of Determination - Merits and Limitations of Coefficient of Correlation- Spearman’s Rank Correlation(7.1-7.9.4).		
Unit:2		15 hours
Regression Analysis - Regression and Correlation(Intro)- Difference between Correlation and Regression Analysis- Linear Regression Equations -Least Square Method- Regression Lines- Properties of Regression Coefficients- Standard Error of Estimate.(8.1-8.8)		
Unit:3		15 hours
Probability Distribution and mathematical Expectation- Random Variable- Defined - Probability Distribution a Random VariableExpectation of Random Variable- Properties of Expected Value and Variance(12.2-12.4).		
Unit:4		15 hours
Sampling and Sampling Distributions - Data Collection- Sampling and Non-Sampling Errors – Principles of Sampling-- Merits and Limitations of Sampling- Methods of Sampling- Parameter and Statistic- Sampling Distribution of a Statistic- Examples of Sampling Distributions- Standard Normal, Student’s t, Chi-Square (x2) and Snedecor’s F- Distributions(14.1-14.16).		
Unit:5		13 hours
Statistical Inference- Estimation and Testing of Hypothesis - Statistical Inference- Estimation- Point and interval- Confidence interval using normal, t and x2Distributions- Testing of HypothesisSignificance of a mean - Using t Distribution(15.1-15.10.2).		
Unit:6		ContemporaryIssues
		2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	75 hours
Text Books		
1	K.L. Sehgal, “Quantitative Techniques and Statistics”, First Edition, Himalaya Publishing House, 2011.	
ReferenceBooks		
1	N. P. Bali, P. N. Gupta, C. P. Gandhi, “A Textbook of Quantitative Techniques”, First Edition, Laxmi Publications, 2008.	
2	U. K. Srivastava, G. V. Shenoy, S. C. Sharma, “Quantitative Techniques for Managerial Decisions”, Second Edition, New Age International Publishers, 2005.	
3	David Makinson, “Sets, Logic and Maths for Computing”, Springer, 2011.	
4	Christopher Chatfield,”Statistics for Technology- A Course in Applied Statistics, Third	

	Edition”, CRC Press, 2015.
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	Web resources from NDL Library, E-content from open-source libraries

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

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

Coursecode	SEC 3	PRACTICAL VI: CLOUD COMPUTING LAB	L	T	P	C
Core/Elective/Supportive		Skill Enhancement Course	-	-	3	2
Pre-requisite		Basic Programming using Cloud	CIA 40		ESE 60	
Course Objectives:						
The main objectives of this course are to:						
1. This course covers the basic data structures like Stack, Queue, Tree, List.						
2. This course enables the student to learn the applications of the data structures using various techniques						
3. It also enables the student to understand C++ language with respect to OOAD concepts						
4. Application of OOPS concepts						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the concepts of object-oriented with respect to C++				K1, K2	
2	Able to understand and implement OOPS concepts				K3, K4	
3	Implementation of data structures like Stack, Queue, Tree, List using C++				K4, K5	
4	Application of the data structures for Sorting, Searching using different techniques.				K5, K6	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
LIST OF PROGRAMS					45 hours	
1. Working with Google Drive to make spreadsheet and notes.						
2. Launch a Linux Virtual Machine.						
3. To host a static website						
4. Exploring Google cloud for the following a) Storage b) Sharing of data c) manage your calendar, to-do lists, d) a document editing tool						
5. Working and installation of Google App Engine						
6. Working and installation of Microsoft Azure						
7. To Connect Amazon Redshift with S3 bucket						
8. To Create and Query a NoSQL Table						
Expert lectures, online seminars – webinars						
Total Lecture hours					45 hours	
Text Books						
1	Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009.					
Reference Books						

1	Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata McGrawHill Education Private Limited, 2009.
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

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

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

Course code	Core - X	Big Data Analytics	L	T	P	C
Core/Elective/Supportive		Core	5	-	-	4
Pre-requisite		Basics of Data Analytics& its Applications	CIA 25		ESE 75	
Course Objectives:						
The main objectives of this course are to: 1. To study the basic technologies that forms the foundations of Big Data. 2. To study the programming aspects of cloud computing with a view to rapid prototyping of complex applications. 3. To understand the specialized aspects of big data including big data application, and big data analytics. 4. To study different types Case studies on the current research and applications of the Hadoop and big data in industry.						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	understand the building blocks of Big Data					K1,K2
2	articulate the programming aspects of cloud computing(map Reduce etc)					K2,K3
3	understand the specialized aspects of big data with the help of different big data applications					K3,K4
4	represent the analytical aspects of Big Data					K4,K5
5	know the recent research trends related to Hadoop File System, MapReduce and Google File System etc					K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5 -Evaluate; K6-Create						
Unit:1						
Unit:1		Data Explosion and Big Data Analytics	15 hours			
An Overview: Introduction, Evolution of Database Technology and Big Data, Elements of Big Data, Big Data System Components, Big Data Analytics – Data Analytics. Types of Big Data Analytics, Applications of Big Data Technology, Challenges and Skills required with Big Data Technology. Introduction about Classification Algorithms, Regression Techniques, Domain Specific Analytic Techniques: Time Series Analysis, In Database Analytics, Text Analytics. Case Study: An Application of Analytics in Agriculture field, Anticipating the Market Price.						
Unit:2						
Unit:2		Real – Time Analysis	15 hours			
Introduction: Real-time System, Types of Real-time System, Types of Popular Real-time Operating systems - Advantages and Disadvantages of Real-time Operating Systems, Characteristics of Real-time Systems, Real-time Processing Systems for Big Data: Data Processing and Analytics, Big Data Engine-Hadoop, Real-time System Architecture, Real-time Platforms for Processing Big Data, Real-time Data Analytics. Big Data: Hardware, Technology Foundations: Introduction, Big Data Stack, Virtualization and Big Data.						

Understanding NoSQL and Hadoop Ecosystem: Introduction, NoSQL:CouchDB, MongoDB, Hadoop Ecosystem – HDFS, HBase, Yarn.		
Unit:3	High Dimensional Data and Information Retrieval	15 hours
High Dimensional Data: A Big Data Perspective: Introduction – What is Dimensionality?, Challenges in High Dimensional Data Handling – Curse of Dimensionality, Large Scale Optimization, Spurious Correlation – Endogeneity, Dimensionality Reduction – Approaches for Dimensionality Reduction, Dimensionality Reduction Techniques. Information Retrieval: Big Data Integration and Processing: Big Data Integration and Processing: Introduction, Components of Information Retrieval System, User Interface and Visualization – Desirable Properties, Visualization Techniques, Text Operations, Query Operations, Indexing and Ranking.		
Unit:4	R Programming and Case Study	15 hours
R Programming: Introduction, Data Types, Data Structures and Operators – Basic Data Types in R, R Operators, Vectors, List, Factor, Arrays and Matrix, Data Frame, R Programming Structure – Control statements of R: if, if-else, if-else ladder, switch-case, return, Loops and Loop Control Statements, Input / Output: Import and Export Data, Handling Missing Values, Statistical Functions and Models of R, R Graphics and Data Visualization. Case Study: Association Rule Mining Algorithm Implementations, K Means Clustering Algorithm Implementations, Decision Tree Algorithm Implementations, Naïve Bayes Classification Algorithm Implementation, Build the Regression Models, Construct Directed Graph using Adjacency Matrix.		
Unit:5	Mongo/DB with R Programming and Case Study	13 hours
Mongo/DB with R Programming: Introduction – Document, Collections / Views / On-Demand Materialized Views, Key Features, Document Structure of MongoDB, Datatypes in MogoDB, MongoDB Curd Operations – Basics of MongoDB CURD Operations, Detailed Discussion of MongoDB CURD Operations with examples, MongoDB with R – Import/Export SCV/JSON file at MongoDB, Interfacing R and MongoDB, GridFS. Case Study: Access GridFS files and show them using any front end support, Develop a solution using MongoDB and R for any application domain of your choice, Develop the coding to retrieve the content from GridFS.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
TotalLecturehours		75 hours
Text Books		
1	Big Data Analytics – Concepts, Techniques, Tools and Technologies – First Edition, M. Thangaraj, S. Suguna, G. Sudha, PHI Learning Private Limited, Delhi,2022. Unit I : Chapter 1, Chapter 2 (2.2.2. 2.2.4, 2.3) Unit II : Chapter 3 (3.1 – 3.4)	

	Chapter 4 (4.1 – 4.3) Chapter 5 (5.1, 5.2, 5.3.1 - 5.3.3) Unit III : Chapter 6 & Chapter 7 Unit IV : Chapter 8 Unit V : Chapter 9
ReferenceBooks	
1	Data Mining Concepts and Techniques – Jiawei Han, MichelineKamber& Jain Pei, Morgan Kaufmann Publishers, Third edition 2012.
2	Introduction to Data Mining with Case Studies, G. K. Gupta, Easter Economy Edition, Prentice Hall of India, 2006.
3	DT Editorial Services, <i>Big Data Black Book: Covers Hadoop 2, MapReduce, Hive, Yarn, Pig, R and Data Visualization</i> , Publisher: Dreamtech Press India Pvt. Ltd, January 2016
4	Ricardo Baeza – Yates, BerthierRiberio-Neto, <i>Modern Information Retrieval</i> , 1 st Edition, Publisher: ACM Press, New York, Addison-Wesley, 1999.
5	Christopher D. Manning, PrabhakarRaghavan, HinrichSchutze, <i>An Introduction to Information Retrieval</i> , 1 st Edition, Publisher: Cambridge University Press, Cambridge, England, April 1, 2009.
6	Peter Ingwersen, <i>Information Retrieval Interaction</i> [www.db.dk/pi/iri], 1 st Edition, Publisher: Taylor Graham Publishing, United Kingdom, USA (ISBN: 0 947568549), November 1992.
7	The MongoDB 4.2 Manual - https://docs.mongodb.com › manual .
8	Krishna Rungta (R-tutorial), <i>Learn R Programming in 1 Day (Complete Guide for Beginners)</i> , 1 st Edition, 2019.
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
Web resources from NDL Library, E-content from open-source libraries	

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

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

Coursecode	Core – XI	INTERNETOF THINGS	L	T	P	C
Core/Elective/Supportive		Elective	5	-	-	4
Pre-requisite		Basics of Sensors & its Applications	CIA 25		ESE 75	
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. AboutInternetofThingswherevariouscommunicatingentitiesarecontrolledandmanaged for decision making in the application domain.						
2. EnablestudentstolearntheArchitectureof IoTandIoTTechnologies						
3. DevelopingIoTApplicationsandSecurityinIoT,BasicElectronicsforIoT,ArduinoIDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.						
ExpectedCourseOutcomes:						
Onthesuccessfulcompletionofthecourse,studentwillbeableto:						
1	UnderstandaboutIoT,itsArchitectureandits Applications					K1,K2
2	UnderstandbasicelectronicsusedinIoT&itsrole					K2,K3
3	DevelopapplicationswithCusingArduinoIDE					K4
4	Analyzeaboutsensorsandactuators					K5,K6
5	DesignIoTinrealtimeapplicationsusingtoday’sinternet&wireless technologies					K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
INTRODUCTION			15 hours			
Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT– Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT						
Unit:2						
BASICELECTRONICSFORIoT			15 hours			
Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – BinaryCalculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation.						
Unit:3						
PROGRAMMINGUSINGARDUINO			18 hours			
Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions.						
Unit:4						
SENSORSANDACTUATORS			12 hours			
SensorsandActuators:AnalogandDigitalSensors–Interfacingtemperaturesensor,ultrasound						

Sensor and infrared (IR) sensor with Arduino – Interfacing LED and Buzzer with Arduino.		
Unit:5	SENSOR DATA IN INTERNET	13 hours
Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (ThingSpeak).		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	75 hours
Text Books		
1	Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-On Approach”, 2014. ISBN: 978-0996025515	
2	Boris Adryan, Dominik Obermaier, Paul Fremantle, “The Technical Foundations of IoT”, Artech Houser Publishers, 2017.	
Reference Books		
1	Michael Margolis, “Arduino Cookbook”, O’Reilly, 2011	
2	Marco Schwartz, “Internet of Things with ESP8266”, Packt Publishing, 2016.	
3	Dhivya Bala, “ESP8266: Step by Step Tutorial for ESP8266 IoT, Arduino NODEMCU Dev. Kit”, 2018.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.nptel.ac.in/noc20_cs66/preview	
2	https://www.javatpoint.com/iot-internet-of-things	
3	https://www.tutorialspoint.com/internet_of_things/index.htm	

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

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

Coursecode	Core – XII	PRACTICAL VII : WEB APPLICATION DEVELOPMENT AND HOSTING	L	T	P	C
Core/Elective/Supportive		Core	-	-	5	4
Pre-requisite		Basic Programming using HTML tags	CIA 40		ESE 60	
Course Objectives:						
The main objectives of this course are to:						
1. Able to design a webpage using HTML tags						
2. To enable the students to use Framesets, hyperlinks and different formatting features of HTML tags						
3. Enable the students to use Forms & other controls in a webpage						
4. To create interactive applications using PHP						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand & implement the basic HTML tags to create static web pages				K1, K2	
2	Capable of using hyperlinks, frames, images, tables, in a webpage				K2, K3	
3	Able to write dynamic web applications using HTML forms				K4, K5	
4	Must be able to write dynamic web applications in PHP & HTML tags using XAMPP.				K5, K6	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create						
LIST OF PROGRAMS						
75 hours						
1. Develop a website for your college using advanced tags of HTML.						
2. Write names of several countries in a paragraph and store it as an HTML document, world.html. Each country name must be a hot text. When you click India (for example), it must open india.html and it should provide a brief introduction about India.						
3. Develop a HTML document to i) display Text with Bullets / Numbers - Using Lists ii) to display the Table Format Data						
4. Develop a Complete Web Page using Frames and Framesets which gives the Information about a Hospital using HTML.						
5. Write a HTML document to print your Bio-Data in a neat format using several components.						
6. Develop a HTML document to display a Registration Form for an inter-collegiate function.						
7. Using HTML form accept Customer details like Name, City, Pin code, Phone number and Email address and validate the data and display appropriate messages for violations using PHP (Eg. Name is Mandatory field; Pin code must be 6 digits, etc.).						
8. Write a program to accept two numbers n1 and n2 using HTML form and display the Prime						

Numbers between n1 and n2 using PHP.	
Total Lecture hours	
75 hours	
Text Books	
1	Ivan Bayross, "Web Enabled Commercial Applications Development Using HTML, JavaScript, DHTML and PHP", BPB Publications, 4th Revised Edition, 2010.
Reference Books	
2	A.K. Saini and Sumint Tuli, "Mastering XML", First Edition, New Delhi, 2002.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/xml/index.htm
2	https://www.tutorialspoint.com/internet_technologies/websites_development.htm
3	https://www.youtube.com/watch?v=PlxWf493en4

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

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

Course code	Elective – VI	ARTIFICIALINTELLIGENCE& MACHINE LEARNING	L	T	P	C
Core/Elective/Supportive		Elective	5	-	-	3
Pre-requisite		Basics of AI & an Introduction about ML	CIA 25		ESE 75	
Course Objectives:						
The main objectives of this course are to:						
1. Enable the students to learn the basic functions of AI, Heuristic Search Techniques.						
2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic.						
3. Introduce Machine Learning with respect Data Mining, Big Data and Cloud.						
4. Study about Applications & Impact of ML.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Demonstrate AI problems and techniques					K1,K2
2	Understand machine learning concepts					K2,K3
3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning					K3,K4
4	Analyze the impact of machine learning on applications					K4,K5
5	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system					K5,K6

K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		
Unit:1	INTRODUCTION	15 hours
Introduction: AI Problems - AI techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.		
Unit:2	SEARCHTECHNIQUES	15 hours
Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.		
Unit:3	PREDICATELOGIC	15 hours
Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming -Forward Vs Backward reasoning -Matching-Control knowledge.		
Unit:4	MACHINE LEARNING	15 hours
UnderstandingMachineLearning:WhatIsMachineLearning?-DefiningBigData-BigDatain ContextwithMachineLearning-TheImportanceoftheHybridCloud-LeveragingthePowerof Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.		
Unit:5	APPLICATIONS OF MACHINE LEARNING	13 hours
Looking Inside Machine Learning: The Impact of Machine Learning on Applications-Data Preparation-The Machine Learning Cycle.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	75 hours
Text Books		
1	Elaine Richand Kevin Knight," Artificial Intelligence", Tata McGraw Hill Publishers company Pvt Ltd, Second Edition, 1991.	
2	GeorgeFLuger,"ArtificialIntelligence",4 th Edition, Pearson Education Publ,2002.	
Reference Books		
1	Machine Learning For Dummies ®,IBM Limited Edition	by Judith Hurwitz, Daniel Kirsch.

Related Online Contents [MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	https://www.ibm.com/downloads/cas/GB8ZMQZ3
2	https://www.javatpoint.com/artificial-intelligence-tutorial
3	https://nptel.ac.in/courses/106/105/106105077/

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

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

ADDITION LIST OF ELECTIVE COURSES

Coursecode		EMBEDDEDSYSTEMS	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		BasicsofMicro Controller				
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Presenttheintroductionto8051MicrocontrollerInstructionSet,conceptsonRTOS&Software tools.						
2. Gaintheknowledge abouttheembeddedsoftwaredevelopment.						
3. LearnaboutMicrocontrollerandsoftwaretoolsintheembeddedsystems.						
ExpectedCourseOutcomes:						
Onthesuccessfulcompletionofthecourse,studentwillbeable to:						
1	Understandtheconceptof8051microcontroller					K1,K2
2	UnderstandtheInstructionSetandProgramming					K2,K3
3	Analyze the conceptsofRTOS					K3,K4
4	AnalyzeanddesignvariousrealtimeembeddedsystemsusingRTOS					K5
5	Debugthemalfunctioningsystemusingvarious debugging techniques					K5,K6
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6– Create						
Unit:1	8051 MICROCONTROLLER				12Hours	
8051Microcontroller:Introduction-8051Architecture-Input/OutputPins,PortsandCircuits- External Memory - Counters / Timers - Serial Data Input / Output –Interrupts						
Unit:2	PROGRAMMINGBASICS				12Hours	
Instruction Set and Programming Moving Data-Addressing Modes-Logical operations-Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts.						
Unit:3	CONCEPTSONRTOS				12Hours	

CONCEPTS ON RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data- Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions-Events - Memory Management-Interrupt Routines in an RTOS Environment.

Unit:4	DESIGN USING RTOS	10Hours
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Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power- introductions to RTL & QNX.

Unit:5	SOFTWARE TOOLS	12Hours
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SOFTWARE TOOLS: Embedded software Development Tools: Hosts and Target Machines-

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

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

	Total Lecture hours	60Hours
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Text Books

- 1 David E. Simon, "An Embedded Software primer" Pearson Education Asia, 2003.
- 2 Kenneth J Ayala, "The 8051 Microcontroller and Architecture programming and application", Second Edition, Penram International.

Reference Books

- 1 Raj Kamal, "Embedded Systems –Architecture, programming and design", Tata McGraw– Hill, 2003.

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

- 1 https://onlinecourses.nptel.ac.in/noc20_cs14/preview
- 2 <https://www.javatpoint.com/embedded-system-tutorial>
- 3 https://www.tutorialspoint.com/embedded_systems/index.htm

Mapping with Programming Outcomes

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

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

Coursecode		CRITICAL THINKING, DESIGN THINKING AND PROBLEM SOLVING	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		BasicsofLogical&ReasoningSkills				
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Learncriticalthinkinganditsrelated concepts						
2. Learndesignthinkinganditsrelatedconcepts						
3. DevelopThinkingpatterns,Problemsolving&Reasoning						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	Understandtheconcepts ofCriticalthinkinganditsrelatedtechnology					K1,K2
2	Focusontheexplicitdevelopmentofcriticalthinkingandproblemsolvingskills					K2,K3
3	Applydesignthinkinginproblems					K3,K4
4	Makeadecisionandtakeactionsbasedon analysis					K4,K5
5	Analyze the concepts of Thinking patterns, Problem solving & Reasoning inreal time applications					K5,K6
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
Unit:1		CRITICAL THINKING	12hours			
Critical Thinking: Definition, Conclusions and Decisions, Beliefs and Claims, Evidence –finding, evaluation, Inferences, Facts – opinion, probable truth, probably false, Venn diagram. Applied critical thinking: Inference, Explanation, Evidence, Credibility, Two Case Studies, critical thinking and science, critical evaluation, self assessment.						
Unit:2						
Unit:2		DESIGN THINKING	12hours			
Design Thinking: Introduction, Need of Design Thinking, problem to question - design thinking process, Traditional Problem Solving versus Design Thinking, phases of Design Thinking, problem exploration, Stake holder assessment, design thinking for manufacturers, smart Idea to implementation.						
Unit:3						
Unit:3		CASE STUDY	12hours			
Thinking to confidence, fear management, duty Vs passion, Team management, Tools for Thinking, prototype design, Relevance of Design and Design Thinking in engineering, human centered design, case study: apply design thinking in problem.						
Unit:4						
Unit:4		PROBLEMSOLVING	10hours			
Problem solving: problem definition, problem solving methods, selectingand using information, dataprocessing,solutionmethods,solvingproblemsbysearching,recognizingpatterns,spatial						

reasoning,necessityandsufficiency, choosingandusingmodels,makingchoicesanddecisions.										
Unit:5		REASONING							12hours	
Reasoning: Deductive and hypothetical reasoning, computational problem solving; generating, implementing, and evaluating solutions, interpersonal problem solving. Advanced problem solving: Combining skills – using imagination, developing models, Carrying out investigations, Data analysis and inference. Graphical methods of solution, Probability, tree diagrams and decision trees										
Unit:6		ContemporaryIssues							2 hours	
Expertlectures,onlineseminars –webinars										
		TotalLecturehours							60hours	
Text Books										
1	JohnButterworthandGeoffThwaites,Thinkingskills:CriticalThinkingandProblem Solving, Cambridge University Press, 2013.									
2	H.S.FoglerandS.E.LeBlanc,StrategiesforCreativeProblemSolving,2ndedition, Pearson, Upper Saddle River, NJ, 2008.									
ReferenceBooks										
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	MichaelBaker,TheBasicofCriticalThinking,TheCriticalThinkingCoproress, 2015.									
4	DavidKelleyandTomKelley,CreativeConfidence,2013.									
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]										
1	https://www.tutorialspoint.com/critical_thinking/index.htm									
2	https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm									
3	https://nptel.ac.in/courses/109/104/109104109/									
MappingwithProgrammingOutcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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

Coursecode		MOBILECOMPUTING	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		BasicsofMobile Communication				
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. PresenttheoverviewofMobilecomputing,Applicationsand Architectures.						
2. Describethefuturisticcomputing challenges.						
3. Enablethestudentstolearntheconceptofmobile computing.						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	Understandtheneedandrequirements ofmobile communication					K1,K2
2	Focusonmobilecomputingapplicationsandtechniques					K2,K3
3	Demonstratesatellitecommunicationinmobile computing					K4
4	Analyzeaboutwirelesslocalloop architecture					K5,K6
5	Analyzevariousmobilecommunicationtechnologies					K6
K1-Remember;K2-Understand;K3-Apply; K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
INTRODUCTION						
12hours						
Introduction: Advantages of Digital Information - Introduction to Telephone Systems –Mobile communication: Need for Mobile Communication – Requirements of Mobile Communication – History of Mobile Communication.						
Unit:2						
MOBILECOMMUNICATION						
12hours						
Introduction to Cellular Mobile Communication – Mobile Communication Standards –Mobility Management – Frequency Management – Cordless Mobile Communication Systems.						
Unit:3						
MOBILECOMPUTING						
12hours						
Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Changeover from one satellite to other – Global Mobile Communication – Interferences in Cellular Mobile Communication.						
Unit:4						
MOBILECOMMUNICATIONSYSTEM						
11hours						
Important Parameters of Mobile Communication System – Mobile Internet: Working of Mobile IP – Wireless Network Security – Wireless Local Loop Architecture: Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol.						
Unit:5						
COMMUNICATIONTECHNOLOGY						
11hours						

WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system – Fourth Generation Mobile Communication systems.

Unit:6		ContemporaryIssues	2 hours
Expertlectures,onlineseminars–webinars			
		TotalLecturehours	60hours
Text Books			
1	T.G.Palanivelu,R.Nakkeeran,“WirelessandMobileCommunication”,PHILimited, 2009.		
2	JochenSchiller,“MobileCommunications”,SecondEdition,PearsonEducation, 2007.		
ReferenceBooks			
1	AsokeKTalukder,HasanAhmed,RoopaYavagal,“MobileComputing”,TMH,2010.		
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]			
1	https://www.tutorialspoint.com/mobile_computing/index.htm		
2	https://www.javatpoint.com/mobile-computing		
3	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/		

MappingwithProgrammingOutcomes

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

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

Coursecode		BLOCKCHAIN TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		BasicsofBlockChain&Crypto Currency				
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Understandthe fundamentalsofblockchainand cryptocurrency.						
2. Understandtheinfluence androleofblock chaininvariousother fields.						
3. Learnsecurityfeaturesandits significance.						
4. Identifyproblems&challengesposedbyBlockChain.						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	Demonstrateblockchain technologyandcrypto currency					K1,K2
2	Understandtheminingmechanisminblockchain					K2
3	Applyandidentifysecuritymeasures,andvarioustypesofservicesthataallow people to trade and transact with bitcoins					K3,K4
4	ApplyandanalyzeBlockchaininhealthcareindustry					K4,K5
5	Analyzesecurity,privacy,andefficiencyof agivenBlockchainsystem					K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1		INTRODUCTION			12hours	
Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major application: currency, identity, chain of custody.						
Unit:2		NETWORKAND SECURITY			12hours	
Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain.						
Unit:3		CRYPTOCURRENCY			12hours	
Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain						
Unit:4		CRYPTOCURRENCYREGULATION			11hours	
CryptocurrencyRegulation-Stakeholders,RootsofBitcoin,Legalviews-exchangeof cryptocurrency-BlackMarket-GlobalEconomy.Cyrptoconomics–assets,supplyand						

Demand,inflationanddeflation – Regulation.		
Unit:5	CHALLENGESINBLOCKCHAIN	11hours
Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machinetomachinecommunication –Datamanagementinindustry4.0–futureprospects.Block chain in Health 4.0 – Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	60hours
Text Books		
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press (July 19, 2016).	
2	Antonopoulos,“MasteringBitcoin:UnlockingDigitalCryptocurrencies”	
ReferenceBooks		
1	SatoshiNakamoto,“Bitcoin:APeer-to-PeerElectronicCashSystem”	
2	RodrigodaRosaRighi,AntonioMarcosAlberti,MadhusudanSingh,“Blockchain Technology for Industry 4.0” Springer 2020.	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://www.javatpoint.com/blockchain-tutorial	
2	https://www.tutorialspoint.com/blockchain/index.htm	
3	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/	

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

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

Coursecode		WEB SERVICES	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		BasicsofDistributedComputing				
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Present the Web Services , Building real world Enterprise applications using Web ServiceswithTechnologiesXML, SOAP , WSDL , UDDI						
2. Getoverview ofDistributedComputing,XML,andits technologies						
3. UpdatewithQoSanditsfeatures						
4. DevelopStandards andfutureofWeb Services						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understandwebservices anditsrelated technologies				K1,K2	
2	UnderstandXMLconcepts				K2,K3	
3	AnalyzeonSOAPandUDDImodel				K4,K5	
4	Demonstratetheroad mapforthe standardsandfutureofweb services				K5	
5	AnalyzeQoSenabledapplicationsinwebservices				K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1	INTRODUCTION				12hours	
Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms.						
Unit:2	XMLFUNDAMENTALS				12hours	
XMLFundamentals–XMLdocuments-XMLNamespaces-XMLSchema–ProcessingXML.						
Unit:3	SOAP MODEL				12hours	
SOAP: The SOAP model- SOAP messages-SOAP encoding- WSDL: WSDL structure-interfacedefinitions-bindings-services-Using SOAP and WSDL-UDDI: About UDDI- UDDI registrySpecification- Core data structures-Accessing UDDI						
Unit:4	TECHNOLOGIESANDSTANDARDS				12hours	
Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. Workflow: business process management-workflows and workflow management systems Security: Basics-data handling and forwarding-data storage-errors-Web services security issues.						

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

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

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

Coursecode		ROBOTICPROCESSAUTOMATION FOR BUSINESS	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		BasicsofRobots&its Applications				
CourseObjectives:						
Themain objectivesof thiscourseareto:						
1. Learntheconceptsof RPA,itsbenefits,typesandmodels.						
2. Gaintheknowledgeinapplication ofRPAinBusiness Scenarios.						
3. IdentifymeasuresandskillsrequiredforRPA						
ExpectedCourseOutcomes:						
On the successful completion of the course, student will be able to:						
1	Demonstratethebenefits andethicsofRPA				K1,K2	
2	UnderstandtheAutomationcycleandits techniques				K2	
3	DrawinferencesandinformationprocessingofRPA				K3,K4	
4	Implement&ApplyRPAinBusinessScenarios				K5	
5	AnalyzeonRobots&leveragingautomation				K5,K6	
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create						
Unit:1						
INTRODUCTION			12hours			
IntroductiontoRPA –OverviewofRPA –BenefitsofRPAinabusinessenvironment -Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementingRPA –CentreofExcellence –Typesandtheirapplications –Buildingan RPAteam -ApproachforimplementingRPAinitiatives.						
Unit:2						
AUTOMATION			12hours			
RoleofaBusinessManagerinAutomationinitiatives-SkillsrequiredbyaBusinessManagerfor successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people.						
Unit:3						
AUTOMATIONIMPLEMENTATION			12hours			
Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows.						
Unit:4						
ROBOT			12hours			

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.		
Unit:5	ROBOTSKILL	10hours
Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.		
Unit:6	ContemporaryIssues	2 hours
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	60hours
Text Books		
1	Alok Mani Tripathi” Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool” Packt Publishing Limited March 2018.	
2	TomTaulli“”TheRoboticProcessAutomationHandbook”Apress,February2020.	
ReferenceBooks		
1	SteveKaelble”RoboticProcessAutomation”JohnWiley&Sons,Ltd., 2018	
RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]		
1	https://www.tutorialspoint.com/uiopath/uiopath_robotic_process_automation_introduction.htm	
2	https://www.javatpoint.com/rpa	
3	https://onlinecourses.nptel.ac.in/noc19_me74/preview	
CourseDesigned By:		

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

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