PERIYAR UNIVERSITY

NAAC A^{++}Grade - State University - NIRF Rank 59, NIRF Innovation Band of 11 to 50

Salem – 636 011

DEPARTMENT OF COMPUTER SCIENCE

M. Sc., COMPUTER SCIENCE

CHOICE BASED CREDIT SYSTEM (CBCS)

TANSCHE Based

OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2023-2024 and thereafter)

CONTENTS

TANSCHE REGULATIONS ON 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 researches 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.

Master of Computer Science
(2023-24)
Semester – I

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC2C01	Core I	Analysis and Design of Algorithms	4	4
23UPCSC2C02	Core II	Object Oriented Analysis and Design and C++	4	4
23UPCSC2C03	Core III	Python Programming	4	4
23UPCSC2L01	Core IV - Lab	Algorithm and OOPS Lab	2	3
23UPCSC2L02	Core V - Lab	Python Programming Lab	2	4
Discipline Centric Elective -I	Elective I	Elective Course -Theory	3	3
Discipline Centric Elective - I Lab	Elective I - Lab	Elective Course- Lab	1	2
Generic Elective – I 23UPCSC2S01	Elective – II	Soft Skill Development Lab	1	2
		Total	**21**	**26**

Semester - II

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC2C04	Core VI	Data Science and Analytics	4	4
23UPCSC2C05	Core VII	Advanced Operating Systems	4	4
23UPCSC2C06	Core VIII	Advanced Java Programming	4	4
23UPCSC2L03	Core IX - Lab	Data Science and Analytics Lab	2	4
23UPCSC2L04	Core X - Lab	Advanced Java Programming Lab	2	4
23UPCSC2P01	Core XI	Professional Competency Skill - Mini Project	2	2
23UPCSC2X01	Extension Activity	Extension Activity	1	-
NME - I	Non-Major Elective (Online Courses)	Online Courses	2	2
Discipline Centric Elective – II	Elective III	Elective Course –Theory	3	3

Discipline Centric Elective – II Lab	Elective III – Lab	Elective Course- Lab	1	2
Generic Elective - II 23UPPGC1H01	Elective-IV	Fundamentals of Human Rights	1	1
		Total	**26**	**30**

Semester - III

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC2C07	Core XII	Mobile Computing	4	4
23UPCSC2C08	Core XIII	Cloud Computing	4	4
23UPCSC2C09	Core XIV	Soft Computing	4	4
23UPCSC2C10	Core XV	Artificial Intelligence and Machine Learning	4	4
23UPCSC2L05	Core XVI - Lab	Mobile Application Development Lab	2	2
23UPCSC2L06	Core XVII - Lab	Cloud Computing Lab	2	3
23UPCSC2C19	Core XVIII-Lab	Web Application Development and Hosting Lab	2	2
23UPCSC2I01	Core XIX	Internship/ Industrial Activity	2	-
NME-II	Non Major Elective	-	2	2
Discipline Centric Elective - III	Elective V	Elective Course –Theory	3	3
Discipline Centric Elective – III Lab	Elective V - Lab	Elective Course- Lab	1	2
		Total	**30**	**30**

Semester IV

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC2P02	Core XX	Project with viva voce	13	-
23UPCSC2I02	Elective VI	Credit Seminar (Industry / Entrepreneurship)	2	4
		Total	**15**	**4**
		Total Credits	**92**	4

Type of Courses	Component	No. of Courses	Credits	Total Credits
Core	Theory courses	10	04	40
	Lab courses	07	02	14
	Professional Competency Skill - Mini project	01	02	02
	Major Project	01	13	13
	Internship/Industrial activity	01	02	02
Elective	Discipline Centric -Theory courses	03	03	09
	Discipline Centric - Lab courses	03	01	03
	Generic Centric courses (Soft Skill Development Lab)	01	01	01
	Generic Centric courses (Fundamental of Human Rights)	01	01	01
	Credit Seminar	01	02	02
NME-I	Skill enhancement courses / Online courses (SWAYAM / Naan Mudhalvan)/NME-I	01	02	02
NME-II	NME-II (Supportive course)	01	02	02
Extension Activity		01	01	01
			Total Credits	**92**

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

CANDIDATE ELIGIBILITY FOR M.Sc. PROGRAMME ADMISSION

A candidate who has passed B.Sc. Computer Science / B.C.A / B.Sc. Computer Technology / B.Sc. Information Science / Technology / B.Sc. Computer Science with Artificial Intelligence / B.Sc. Computer Science with Cyber Security degree of this University or any of the degree of any other University accepted by the syndicate as equivalent thereto subject to such conditions as may be prescribed therefore shall be permitted to appear and qualify for the M.Sc. Computer Science degree examination of this University after a course of study of two academic years.

DURATION OF THE PROGRAMME AND MEDIUM

The programme shall be of two years duration spread over four semesters under choice based credit system. The Maximum duration to complete the course shall be two academic years after normal completion of the programme. The medium of instruction/study is English.

SCHEME OF EXAMINTAION FOR EACH SEMESTER - M. Sc. COMPUTER SCIENCE

SEMESTER- I

Course Code	Title of the Course	Credits	Hours		Maximum Marks		Total	Exam Duration hours
			T	P	CIA	ESE		
23UPCSC2C01	Analysis and Design of Algorithms	4	4		25	75	100	3
23UPCSC2C02	Object Oriented Analysis and Design and C++	4	4		25	75	100	3
23UPCSC2C03	Python Programming	4	4		25	75	100	3
23UPCSC2L01	Algorithm and OOPS Lab	2		3	40	60	100	3
23UPCSC2L02	Python Programming Lab	2		4	40	60	100	3
Discipline Centric Elective -I	Elective Course - Theory	3	3		25	75	100	3
Discipline Centric Elective - I Lab	Elective Course- Lab	1		2	40	60	100	3
Generic Elective - I	Soft Skill Development Lab	1		2	100	-	100	3
	Total	**21**	**15**	**11**	**320**	**480**	**800**	**-**

SEMESTER II

Course Code	Title of the Course	Credits	Hours		Maximum Marks		Total	Exam Duration
			T	P	CIA	ESE		
23UPCSC2C04	Data Science and Analytics	4	4		25	75	100	3
23UPCSC2C05	Advanced Operating Systems	4	4		25	75	100	3
23UPCSC2C06	Advanced Java Programming	4	4		25	75	100	3
23UPCSC2L03	Data Science and Analytics Lab	2		4	40	60	100	3
23UPCSC2L04	Advanced Java Programming Lab	2		4	40	60	100	3

Discipline Centric Elective – II	Elective Course - Theory	3	3		25	75	100	3
Discipline Centric Elective – II lab	Elective Course-Lab	1		2	40	60	100	3
23UPCSC2P01	Mini Project	2	-	2	40	60	100	3
NME-I	Non-Major Elective – I (Online Courses)	2		2	-	-	100	3
Generic Elective - II 23UPPGC1H01	Fundamentals of Human Rights	1	1		25	75	100	3
23UPCSC2X01	Extension Activity	1	-	-	-	-	100	3
Total		**26**	**16**	**14**	**285**	**675**	**1100**	**-**

SEMESTER III

Course Code	**Title of the Course**	**Credits**	**Hours**		**Maximum Marks**		**Total**	**Exam**
			T	**P**	**CIA**	**ESE**		**Duration**
23UPCSC2C07	Mobile Computing	4	4		25	75	100	3
23UPCSC2C08	Cloud Computing	4	4		25	75	100	3
23UPCSC2C09	Soft Computing	4	4		25	75	100	3
23UPCSC2C10	Artificial Intelligence and Machine Learning	4	4		25	75	100	3
23UPCSC2L05	Mobile Application Development Lab	2		2	40	60	100	3
23UPCSC2L06	Cloud Computing Lab	2		3	40	60	100	3
23UPCSC2L07	Web Application Development and Hosting	2		2	40	60	100	3
NME-II	Non-Major Elective II	2	2		25	75	100	3
Discipline Centric Elective – III	Elective Course - Theory	3	3		25	75	100	3
Discipline Centric Elective – III Lab	Elective Course-Lab	1		2	40	60	100	3
23UPCSC2I01	Internship/ Industrial Activity	2		-	100		100	3
	Total	**30**	**21**	**9**	**410**	**690**	**1100**	**-**

SEMESTER – IV

Course Code	Title of the Course	Credits	Hours		Maximum Marks		Total	Exam Duration
			T	P	CIA	ESE		
23UPCSC2P01	Project with viva voce	13			50	150	200	3
23UPCSC2I02	Credit Seminar (Industry / Entrepreneurship)	2	4	-	100	-	100	3
Total		**15**			**150**	**150**	**300**	**-**
Grand Total		**92**	**56**	**34**	**1105**	**2055**	**3300**	**-**

LIST OF ELECTIVE SUBJECTS

ELECTIVE – 01

23UPCSC2E01	-	Data Engineering and Management
23UPCSC2E02	-	Data Engineering and Management Lab
23UPCSC2E03	-	Architecture and Frameworks
23UPCSC2E04	-	Architecture and Frameworks lab
23UPCSC2E05	-	Network Protocols
23UPCSC2E06	-	Network Protocols Lab
23UPCSC2E07	-	Dot Net Technologies
23UPCSC2E08	-	Dot Net Technologies lab
23UPCSC2E09	-	Software Development Technologies
23UPCSC2E10	-	Software Development Technologies Lab

ELECTIVE – 02

23UPCSC2E11	-	Internet of Things
23UPCSC2E12	-	Internet of Things Lab
23UPCSC2E13	-	Cryptography and Network Security
23UPCSC2E14	-	Cryptography and Network Security Lab
23UPCSC2E15	-	Computer Vision
23UPCSC2E16	-	Computer Vision Lab
23UPCSC2E17	-	Social Networks
23UPCSC2E18	-	Social Networks Lab

ELECTIVE – 03

23UPCSC2E19	-	Cyber Security
23UPCSC2E20	-	Cyber Security Lab
23UPCSC2E21	-	Block chain Technologies
23UPCSC2E22	-	Block chain Technologies Lab
23UPCSC2E23	-	Optimization Techniques
23UPCSC2E24	-	Optimization Techniques Lab
23UPCSC2E25	-	Solution Architecture
23UPCSC2E26	-	Solution Architecture Lab
23UPCSC2E27	-	High Performance Computing
23UPCSC2E28	-	High Performance Computing Lab

NON-MAJOR ELECTIVE – II

23UPCSC1N01	-	Advanced Microsoft Office Lab
23UPCSC1N02	-	Biopython Programming Lab

CREDIT CALCULATION

Method of Teaching	Hours	Credits
Lecture	1	1
Tutorial/Demonstration	2	1
Practical/Internship/self-Learning	2/1	1

ATTAINMENT RUBRICS FOR THEORY COURSES

THEORY EXAMINATION EVALUATION OF INTERNAL ASSESSMENT

Test	:	5 Marks (Best one out of Two Tests)
Model Examination	:	5 Marks
Seminar	:	5 Marks
Assignment	:	5 Marks
Attendance	:	5 Marks
Total	:	25 Marks

***** No Internal Minimum**

EVALUATION OF END SEMESTER EXAMINATIONS

QUESTION PAPER PATTERN (THEORY)

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	One word (Answer all questions)	20×1 = 20 (Multiple Choice Questions)	K1-K2	CO1, CO2, CO3, CO4, CO5
B	100 to 200 words (Answer any three out of five questions)	3×5 = 15 (Analytical type questions)	K3-K6	
C	500 to 1000 words	5×8 = 40 (Essay type questions)	K1-K6	

ATTAINMENT RUBRICS FOR LAB COURSES

PRACTICAL / MINI PROJECT EXAMINATION

EVALUATION OF INTERNAL ASSESSMENT

Test 1	:	20 Marks
Test 2	:	20 Marks (Best one out of Two Tests)
Test 3	:	20 Marks

Total	:	40 Marks

***** No Internal Minimum**

QUESTION PAPER PATTERN

Time duration	:	3 Hours
Max. Marks	:	60 Marks

Two Questions (Without Choice) may be taken from the list of practical problems: 60 Marks

Distribution of the Marks

(i) Practical / Mini Project

- Record Note Book - 10
- Problem Understanding - 10
- Implementation - 20
- Debugging and Modification - 10
- For correct output and viva - 10

(ii) Industrial Training

- Internal Assessment - 40
- Joint Viva-Voce - 60

  (Internal Examiner 30 and External Examiner 30)

(iii) Dissertation

- Internal Assessment - 50
- Report Evaluation by External Examiner - 50
- Joint Viva-Voce - 100

  (Internal Examiner 50 and External Examiner 50)

REGULATIONS FOR DISSERTATION WORK

- Students should attach themselves with well reputed Industry/Company/ Institutions to do their five months dissertation work.
- The Candidate should submit the filled in format to the department for approval during the First week of December during the even semester.
- The review of the dissertation will be carried out periodically.
- The student should submit three copies of their dissertation work.
- The students may use Power Point presentation during their Dissertation Viva-Voce Examinations.

PASSING MINIMUM

The candidate shall be declared to have passed in the Theory/Practical/Dissertation Examination if the candidate secures:

i. 50% marks in the ESE and

ii. 50% in ESE and CIA put together

GRADING SYSTEM

Evaluation of performance of students is based on ten-point scale grading system as given below.

Ten Point Scale			
Grade of Marks	Grade points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

CORE COURSES

I – SEMESTER

Course code	**23UPCSC2C01**	**ANALYSIS and DESIGN OF ALGORITHMS**	**L**	**T**	**P**	**C**
Core / Elective		**Core**	4			4
Pre-requisite		Basic of Data Structures and Algorithms				

Course Objectives:

The main objectives of this course are:

1. Enable the students to learn the Elementary Data Structures and algorithms.
2. Presents an introduction 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.
5. Understand the NP and NP-Complete problems

Expected Courses Outcomes:

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

CO1	Understand and apply knowledge of computing and mathematics to find the algorithm efficiency.	K1-K6
CO2	Analyze a problem and identify the computing requirements appropriate for its solution.	
CO3	Create, implement, and evaluate a Dynamic Programming algorithm to meet desired needs.	
CO4	Create, implement, and evaluate a Backtracking and Knapsack to meet desired needs	
CO5	Evaluate the algorithmic principles and efficiency of NP and NP-Complete problems – Approximation algorithms for NP-hard problems – Travelling salesman problem – Knapsack problem.	

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

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

Introduction – Notion of Algorithm - Fundamentals of algorithmic problem solving – Important problem types – Fundamentals of the analysis of algorithm efficiency – analysis frame work – Asymptotic Notations and Basic Efficiency Classes-Mathematical analysis of non-recursive Algorithms – Non-recursive solution to the Matrix Multiplication - Mathematical analysis of recursive algorithms – Recursive solution to the Tower of Hanoi Puzzle.

Unit:2	**DIVIDE AND CONQUER AND GREEDY METHOD**	**15 hours**

Divide and conquer Technique – Multiplication of large integers – Strassen's matrix multiplication– Closest pair and Convex Hull Problems - Greedy method – Prim's algorithm – Kruskal's algorithm – Dijkstra's algorithm.

Unit:3	DYNAMIC PROGRAMMING	15 hours
Dynamic Programming - Computing a binomial coefficient – Warshall's and Floyd' Algorithm – Application of Warshall's Algorithm to the digraph – Floyd's Algorithm for the all pairs shortest paths Problem - The Knapsack problem and Memory function.		

Unit:4	BACKTRACKING	15 hours
Backtracking – N-Queens problem – Hamiltonian circuit problem – Subset sum problem – Branch and bound – Assignment problem – Knapsack problem – Traveling salesman problem.		

Unit:5	P, NP and NP- complete problems	13 hours
P, NP and NP-complete problems – Approximation algorithms for NP-hard problems – Traveling salesman problem – Knapsack problem.		

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

	Total Lecture hours	75 hours

Text Books

1	Anany Levitin "Introduction to the Design and Analysis of Algorithms" Pearson Education 2011. (Chapters 1.1-1.3, 2.1, 2.2, 2.3, 2.4, 4.5, 4.6, 8.2, 8.4, 9.1-9.3, 11. 12.1,12.2, 12.3)

Reference Books

1	Aho, Alfred V., et al. *Data Structures and Algorithms*. Addison-Wesley, 1983.
2	Horowitz, Ellis, et al. *Computer Algorithms*. Galgotia Publications, 1999.
3	Skiena, Steven S. *The Algorithm Design Manual*. Springer, 2012.
4	Levitin, Anany. *Introduction to the Design & Analysis of Algorithms*. Pearson, 2012.
5	Sedgewick, Robert. *An Introduction to the Analysis of Algorithms*. Addison Wesley, 2013.

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

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

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

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

I – SEMESTER

Course code	23UPCSC2C02	OBJECT ORIENTED ANALYSIS AND DESIGN using C++	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of C++ and Object-Oriented Concepts				

Course Objectives:

The main objectives of this course are:

1. Present the object model, classes and objects, object orientation, machine view and model management view.
2. Enables the students to learn the basic functions, principles and concepts of object-oriented analysis and design.
3. Enable the students to understand Modern ANSI ISO C++ language with respect to OOAD
4. To Learn the Link OOAD with C++ language
5. To gain Knowledge about the basic concept of OOPs and familiarize to write C++ program

Expected Course Outcomes:

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

CO1	Understand the concept of Object-Oriented development techniques	K1 - K6
CO2	Gain knowledge about the various steps performed during object design	
CO3	Abstract object-based views for generic software systems	
CO4	Link OOAD with C++ language	
CO5	Apply the basic concept of OOP concepts and familiarize to write C++ program	

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

Unit:1	OBJECT MODEL	15 hours

The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects**.**

Unit:2	CLASSES AND OBJECTS	15 hours

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

Unit:3	C++ INTRODUCTION	15 hours

Introduction to C++ - Expressions and Interactivity - Making Decisions – Loops and Files – Functions.

Unit:4	INHERITANCE AND OVERLOADING	13 hours
Arrays – Pointers – Characters, C-Strings and More About the string Class – Structured Data – Advanced File Operations.		

Unit:5	POLYMORPHISM AND FILES	15 hours
Introduction to Classes - More About Classes - Inheritance, Polymorphism, and Virtual Functions – Exceptions, Templates.		

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

	Total Lecture hours	75 hours

Text Books

1	Booch, Grady et al. *Object-Oriented Analysis and Design with Applications*. Addison-Wesley Longman, Third Edition, 2007. UNIT I: (Chapters: 2,1.2.3,2.4,3.1,3.2) UNIT II: (Chapters:3.3.3.4,3.5,4.1,4.2,4.3)
2	Tony Gaddis, *Starting out with C++From Control Structures through Objects*, 8th Edition, Pearson Education, 2015. UNIT III: (Chapters: 2, 3, 4, 5, and 6) UNIT IV: (Chapters: 7, 9, 10.1 to 10.4, 11, and 12) UNIT V: (Chapters: 13, 14, 15, 16.1, 16.2, and 16.4)

Reference Books

1	Kamthane Ashok. *Object-Oriented Programming with ANSI and Turbo C++*, Pearson, Education Canada, 2009.
2	Balagurusamy, E. *Object Oriented Programming with C*. Tata McGraw-Hill, 2008.

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

1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Mapping with Programming Outcomes

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

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

I – SEMESTER

Coursecode	23UPCSC2C03	PYTHON PROGRAMMING	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of Object Oriented Programming Concepts / any Object Oriented Programming Language				

Course Objectives:

The main objectives of this course are:

1. To learn the various data types in Python
2. To understand the various structures in Python
3. To learn about Modules and classes
4. To Understand packages in Python
5. To gain Knowledge about web applications using Python

Expected Course Outcomes:

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

CO1	Understand the basic concepts of Python Programming	K1 - K6
CO2	Understand File operations, Classes and Objects	
CO3	Acquire Object Oriented Skills in Python	
CO4	Perform Data visualization and preprocessing usingPython packages	
CO5	Develop web applications using Python	

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

Unit:1	INTRODUCTION	15 hours

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

Unit:2	CODE STRUCTURES	15 hours

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	MODULES AND CLASSES	15 hours

Modules 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	PYTHON PACKAGES	13 hours

Working with Python Packages: NumPy Library-Ndarray – Basic Operations – Indexing, Slicing and Iteration – Array manipulation - Pandas –The Series – The Data Frame - The Index Objects – Data Visualization with Matplotlib – The Matplotlib Architecture – pyplot – The Plotting Window –

Adding Elements to the Chart – Line Charts – Bar Charts – Pie charts		
Unit:5	**WEB DEVELOPMENT: DJANGO**	**15 hours**
Django: Installing Django – Building an Application – Project Creation – Designing the Data Schema - Creating an administration site for models - Working with QuerySets and Managers – Retrieving Objects – Building List and Detail Views		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

	Text Books
1	Banovic, Bill. *Introducing Python: Modern Computing in Simple Packages*. O'Reilly Media, Inc., 2020. UNIT I: (Chapters: 2,3) UNIT II: (Chapters:4) UNIT III: (Chapters: 5,6)
2	Fabio Nelli, "Python Data Analytics: With Pandas, NumPy, and Matplotlib", Second Edition, Kindle Edition, 2018 (Unit - IV)
3	Antonio Mele, "Django 3 By Example", Third Edition, 2020 (Unit - V)
	Reference Books
1	Beazley, David M. *Python: Essential Reference*. Addison-Wesley, 2012.
2	Naveen, Kumar, and Taneja Sheet et al. *Python Programming: A Modular Approach*. Pearson Education India, 2017.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

Mapping with Programming Outcomes

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

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

I – SEMESTER

Coursecode	23UPCSC2L01	ALGORITHM AND OOPS LAB	L	T	P	C
Core / Elective		Core			4	2
Pre-requisite		Basic Programming of C++ language				

Course Objectives:

The main objectives of this course are:

1. This course covers the basic data structures like Stack, Queue, Tree, and List.
2. This course enables the students to learn the applications of the data structures using various techniques
3. To enable the students to understand C++ language with respect to OOAD concepts
4. To understand the applications of OOP concepts.
5. To understand the implementation of virtual function and friend function

Expected Course Outcomes:

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

CO1	Understand the concepts of object oriented with respect to C++	K1 – K6
CO2	Able to understand and implement OOPS concepts	
CO3	Implementation of data structures like Stack, Queue, Tree, List using C++	
CO4	Application of the data structures for Sorting, Searching using different techniques.	
CO5	Implementation of virtual function and friend function	

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

LIST OF PROGRAMS	60 hours

1) Write a C++ program to perform various operations on stack using linked list.
2) Write a C++ program to traverse through binary search tree using traversals.
3) Write a C++ program to sort an array of an elements using quick sort.
4) Write a C++ program to solve the knapsack problem using greedy method
5) Write a C++ program to search for an element in a tree using divide& conquerstrategy.
6) Write a C++ program to perform Virtual Function
7) Write a C++ program to perform Friend Function
8) Write a C++ program to perform Function Overloading
9) Write a C++ program to perform Multiple Inheritance
10) Write a C++ program to perform Employee Details using Structure.

Expert lectures, online seminars – webinars

Total Lecture hours	60 hours

Text Books	
1	Michael T. Goodrich, *Data Structures and Algorithms in Java*, 3RD ED. India, Wiley India Pvt. Limited, 2008.
2	Skiena,"*The Algorithm Design Manual*", Second Edition, Springer,2008
Reference Books	
1	Anany Levith,"*Introduction to the Design and Analysis of algorithm*", Pearson Education Asia, 2003.
2	Robert Sedgewick, Phillipe Flajolet,"*An Introduction to the Analysis of Algorithms*", Addison-Wesley Publishing Company,1996.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

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

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

I – SEMESTER

Coursecode	23UPCSC2L02	PYTHON PROGRAMMING LAB	L	T	P	C
Core / Elective		Core			4	2
Pre-requisite		Basics of any OOProgramming Language				

Course Objectives:

The main objectives of this course are:

1. To implement the basic operations of elementary data items, lists, dictionaries, sets and tuples
2. To learn the implementation of matrix and vector applications of numpy
3. To understand the OOP concepts of Python
4. To develop web applications using Python
5. To understand and implement various charts using Python packages

Expected Course Outcomes:

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

CO1	Write programs in Python using OOPS concepts	K1-K6
CO2	Understand the concepts of File operations and Modules in Python	
CO3	Implement lists, dictionaries, sets and tuples	
CO4	Develop web applications using Python	
CO5	Implement various charts using Python packages	

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

LIST OF PROGRAMS	60 hours

Implement the following in Python:

1. Program using elementary data items, lists, dictionaries and tuples
2. Program using conditional branches
3. Program using loops
4. Program using functions
5. Program using inheritance
6. Program using polymorphism
7. Program using modules
8. Program using numpy
9. Program using Matplotlib
10. Program using pandas

Total Lecture hours	60 hours

Text Books

1	Lubanovic, Bill. *Introducing Python: Modern Computing in Simple Packages*. O'Reilly Media, Inc., 2020.
2	Lutz, Mark. *Learning Python*. O'Reilly, 2013.

Reference Books	
1	Beazley, David M. *Python: Essential Reference*. Addison-Wesley, 2012.
2	Naveen, Kumar, and Taneja Sheetal. *Python Programming: A Modular Approach*. Pearson Education India, 2017.
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
CO5	S	S	S	S	S	S	S	M	S	S

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

I – SEMESTER

Coursecode	23UPCSC2S01	SOFT SKILL DEVELOPMENT LAB	L	T	P	C
Core / Elective		Core			2	2
Pre-requisite		Basics improvements of English Language Spoken and WrittenSkills				

Course Objectives:

The main objectives of this course are:

1. To enable students to gain basic communication skills in professional and social contexts effectively.
2. To acquire useful words and apply them in situational context.
3. To develop listening and reading skills through comprehension passages
4. To enrich the leadership qualities and interpersonal communication
5. To enhance essential characteristics in writing

Expected Course Outcomes:

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

CO1	Improve the basic communication skills	K1-K6
CO2	Understand the concepts of social context effectively	
CO3	Implement of words and situational context	
CO4	Develop leadership qualities	
CO5	Enhance presentation skill and prepare for facing interview	

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

LIST OF EXERCISES	30 hours

1. Characteristics of Technical Writing
2. Development of Employability Skills
3. Vocabulary Development
4. Sentence Completion
5. Error Spotting
6. Interpretation of Verbal Analogy
7. Interpretation of Reading (Comprehension -Conception)
8. Interpretation of Reading (Comprehension -Reasoning)
9. Practice for writing E-mails/Technical Blogs/Forums
10. PPT Preparation / Demonstration of Technical Presentation
11. Preparation of Resume
12. Preparation for Job Interviews / Mock Interview Section
13. Group Discussion Skills
14. Developing Listening Skill(Comprehension)
15. Practice for Short Speeches / Situational Conversation
16. English through Mass Media
17. Essential Grammar
18. Communicating and collaborating with peer members

19. Team Empowerment 20. Persuasive Communication	
Total Lecture hours	**30 hours**

Text Books	
1	Uma Narula, "Development Communication: Theory and Practice", Revised Edition, Har-Aanad Publication, 2019.
2	Annette Capel and Wendy Sharp, "Cambridge English: Objective First", Fourth Edition, Cambridge University Press, 2013.
3	Emma Sue-Prince, "The Advantage: The 7 Soft Skills You Need to Stay One Step Ahead", First Edition, FT Press, 2013.
4	Guy Brook-Hart, "Cambridge English: Business Benchmark", Second Edition, Cambridge University Press, 2014.
5	Norman Lewis, "How to Read Better & Faster", Binny Publishing House, New Delhi, 1978.
Reference Books	
1	Michael McCarthy and Felicity O'Dell, "English Vocabulary in Use:100 Units of Vocabulary Reference and Practice", Cambridge UniversityPress,1996.
2	Murphy, Raymond, "Intermediate English Grammar", SecondEdition, Cambridge University Press, 1999.

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
CO5	S	S	S	S	S	S	S	M	S	S

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

II – SEMESTER

Course code	23UPCSC2C04	DATA SCIENCE AND ANALYTICS	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of Data Science and its Applications				

Course Objectives:

The main objectives of this course are:

1. Introduce the students to data science, big data and its eco system.
2. Learn data analytics and its life cycle.
3. To explore the programming language R, with respect to the data mining algorithms.
4. Relate the relationship between artificial intelligence, machine learning and data science.
5. Learn clustering and regression

Expected Course Outcomes:

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

CO1	Understand the concept of data science and its techniques	K1- K6
CO2	Review data analytics	
CO3	Apply and determine appropriate Data Mining techniques using R to real time applications	
CO4	Analyze on clustering algorithms	
CO5	Analyze on regression methods in AI	

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

Unit:1	INTRODUCTION	15 hours

Introduction of Data Science: data science and big data – facets of data – data science process- Eco system - The Data Science process – six steps - Machine Learning.

Unit:2	BASICS OF DATA ANALYTICS	15 hours

Data Analytics life cycle – review of data analytics – Advanced data Analytics – technology and tools.

Unit:3	DATA ANALYTICS USING R	15 hours

Basic Data Analytics using R : R Graphical User Interfaces – Data Import and Export – Attribute and Data Types –Descriptive Statistics – Exploratory Data Analysis –Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables – Data Exploration Versus Presentation.

Unit:4	CLUSTERING	15 hours
Overview of Clustering : K-means – Use Cases – Overview of the Method – Perform a K-means Analysis using R –Classification – Decision Trees – Overview of a Decision Tree – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Tree in R – Bayes' Theorem – Naïve Bayes Classifier – Smoothing – Naïve Bayes in R.		
Unit:5	**ARTIFICIAL INTELLIGENCE**	**13 hours**
Association rules. Linear regression-logistic regression-Additional regression methods-Advanced Analytics-Technology and Tools: Map Reduce and Hadoop **(newly included)**		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Davy Cielen, Arno D. Meysman, Mohamed Ali, Introducing Data Science : Big-Data, Machine Learning, and more, using Python Tools, 2016, Manning Shelter Island, Manning Publications Co., Unit 1- Chapter-1,2,3
2	David Dietrich, Barry Heller, Beibei Yang, Data Science & Big Data Analytics : Discovering, Analyzing, Visualizing and Presenting Data – EMC Education Services, 2015 John Wiley & Sons Inc., Indianapolis, Indiana (https://aitskadapa.ac.in/e-books/AI&DS/BIG%20DATA/Data%20Science%20_%20Big%20Data%20Analytics%20(%20PDFDrive%20).pdf) Unit-2-Chapter-2,10,11 Unit-3-Chapter 3-3.1 and 3.2 Unit-4:Chapter 4-4.2.1,4.2.2,Chapter 7-7.1,7.2 Unit-5: Chapter-5,6,10
Reference Books	
1	A simple introduction to Data Science-Lars Nielson 2015
2	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication
3	R Programming for Data Science-Roger D.Peng 2015Lean Publication
4	Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/python_data_science/index.htm
2	https://www.javatpoint.com/data-science

3	https://nptel.ac.in/courses/106/106/106106179/

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

S-Strong; M-Medium; L-Low

II – SEMESTER

Course code	23UPCSC2C05	ADVANCED OPERATING SYSTEMS	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of OS and its functioning				

Course Objectives:

The main objectives of this course are:

1. Enable the students to learn the different types of operating systems and their functioning.
2. Gain knowledge on Distributed Operating Systems
3. Gain insight into the components and management aspects of real time and mobile operating systems.
4. Learn case studies in Linux Operating Systems
5. Understand the various types of scheduling

Expected Course Outcomes:

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

CO1	Understand the design issues associated with operating systems	K1- K6
CO2	Master various process management concepts including scheduling, deadlocks and distributed file systems	
CO3	Prepare Real Time Task Scheduling	
CO4	Analyze Operating Systems for Handheld Systems	
CO5	Analyze Operating Systems like LINUX and iOS	

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

Unit:1	BASICS OF OPERATING SYSTEMS	15 hours

Basics of Operating Systems: Main frame Systems –Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems –Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery.

Unit:2	DISTRIBUTED OPERATING SYSTEMS	15 hours

Distributed Operating Systems: Types of Distributed OS – Network Structure and Topology – Communication Primitives – Robustness – Design Issues - 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	SPECIAL PURPOSE SYSTEMS	15 hours

Real-Time Systems- Overview- System Characteristics - Features of Real -Time Kernels- Implementing Real - Time Operating Systems- Real-Time CPU Scheduling- **Multimedia Systems-** What Is Multimedia- Compression- Requirements of Multimedia Kernels- CPU Scheduling- Disk Scheduling- Network Management.

Unit:4	HANDHELD SYSTEM	15 hours

Operating Systems for Handheld Systems: Requirements – Technology Overview – Handheld Operating Systems – PalmOS - Symbian Operating System- Android –Architecture of android – Securing handheld systems.

Unit:5	CASE STUDIES	13 hours

The Linux System-Linux History-Design Principles-Kernel Modules-Process Management-Scheduling-Memory Management-File Systems-Input and Output 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	Silberschatz, Abraham, Peter Baer Galvin, and Greg Gagne, "*Operating system Concepts"*. 7th Edition (2004) and 9th Edition (2012), John Wiley & Sons. Unit – I (Chapter 1,3,7,20) Unit – II (Chapter 17) Unit – III (Chapter 19,20 7th edition) Unit – V (Chapter 18)
2	Singhal, Mukesh, and Niranjan G. Shivaratri, *"Advanced concepts in operating systems",* McGraw-Hill, Inc., 2011. Unit – II (Chapter 5,7,9)
3	Smyth, Neil, "iPhone iOS 4 Development Essentials–Xcode", *Payload media* (2014). Unit V (Chapter – 3).

Reference Books

1	Mall, Rajib, "*Real-time systems: theory and practice",* Pearson Education India, 2009.
2	Bhatt, Pramod Chandra P. *An Introduction to Operating Systems: Concepts and Practice*. Prentice-Hall of India Pvt. Ltd, 2019.
3	Bovet, Daniel P and Marco Cesati, "*Understanding the Linux Kernel: from I/O ports to process management* ",O'Reilly Media, Inc.", 2005.

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

1	https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2	https://www.udacity.com/course/advanced-operating-systems--ud189
3	https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf

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

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

II – SEMESTER

Course code	23UPCSC2C06	ADVANCED JAVA PROGRAMMING	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of Java and its Usage				

Course Objectives:

The main objectives of this course are:

1. To gain knowledge of Object Oriented Programming Concept in Java
2. To understand usages of String functions in Java
3. To familiarize with the applet and swing
4. To grasp the concepts on Java Beans
5. To comprehend the connection between Relational Database and Java.

Expected Course Outcomes:

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

CO1	Understand the Object Oriented Program including classes andmethods; inheritance and exception handling	K1- K6
CO2	Complete comprehension of String functions and I/O Streams	
CO3	Creation of graphical representation using Swing	
CO4	Application of Servlets for designing Web based applications	
CO5	Usage of JDBC connectivity and implementation of the concept toget desired results from database	

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

Unit:1	BASICS OF JAVA	15 hours

An Overview of Java: Object Oriented Programming- Data Types, Variables, and Arrays: Primitive Types-Literals Variables - Type Conversion and Casting- Arrays- Operators: Control Statements-Classes and Methods – Inheritance- ExceptionHandling.

Unit:2	Utility Classes	15 hours

String Handling: The String Constructors - String Length - Special String Operations - Character Extraction - String Comparison - Searching Strings - Modifying a String - Input/Output: The I/O Classes and Interfaces – File - Byte Streams - Character Streams.

Unit:3	Swing	15 hours

Introducing GUI Programming with Swing– Introducing Swing - Swing Is Built on the AWT-Two Key Swing Features - TheMVC Connection - Components and Containers - The Swing Packages - A Simple Swing Application - Exploring Swing.

Unit:4	JAVA BEANS and JSP	15 hours

Java Beans: Introduction - Advantages of Beans – Introspection - The JavaBeans API. Servlets: Life Cycle Simple Servlet-Servlet API-Packages-Cookies session tracking. JSP Elements: Scripting Elements and Java - Implicit Objects -Directive Elements. JSP in Action: JSP Standard

Actions - JSP's Tag Extension Mechanism - JSTL and EL.		
Unit:5	**Connecting Databases**	**13 hours**
Network Programming: Working with URLs- Working with Sockets - Remote Method Invocation. Introduction to Database Management Systems - Tables, Rows, and Columns - Introduction to the SQL SELECT Statement - Inserting Rows - Updating and Deleting Existing Rows - Creating and Deleting Tables - Creating a New Database with JDBC - Scrollable Result Sets.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books

1	Herbert Schildt, "Java the Complete Reference", 9th Edition, McGraw Hill Publishing Company Ltd, New Delhi, 2017. Unit – I (Chapter 2,3,4,5,6,7,8,10) Unit – II (Chapter 16,20) Unit – III (Chapter 31,32) Unit – IV (Chapter 37,38) Unit – V (Chapter 22)
2	Tony Gaddis, "Starting out with Java from Control Structures Through Objects", 6th Edition, Pearson Education Limited, 2016. Unit V – (Chapter 17)
3	Giulio Zambon, "Beginning JSP, JSF and Tomcat Java Web Development", 2nd edition, Apress publication 2012. Unit- IV (Chapter 2, 4)

Reference Books

1	Keogh, James, "*J2ME: The complete reference*", Osborne, 2003.
2	McFarland, David Sawyer, "*Javascript & jQuery: the missing manual*", O'Reilly Media, Inc.", 2011.
3	Deitel, Paul J, "*Java how to program*", Pearson Education India, 2002.
4	Campione, Mary, Kathy Walrath, and Alison Huml, "*The Java tutorial: a short course on the basics*", Addison-Wesley Professional, 2001.

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

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

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

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

II-SEMESTER

Course code	23UPCSC2L03	DATA SCIENCE AND ANALYTICS LAB	L	T	P	C
Core / Elective		Core			4	2
Pre-requisite		Basics of Data Science Algorithms				

Course Objectives:

The main objectives of this course are:

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

Expected Course Outcomes:

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

CO1	Write programs for Association rules, Clustering techniques	K1 - K6
CO2	Implement data analytics like classification, prediction	
CO3	Use different visualizations techniques	
CO4	Apply different data science algorithms to solve real world applications	
CO5	Apply the statistical interpretations for the solutions	

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

LIST OF PROGRAMS	60 hours

1. Import a Dataset and Perform basic Statistical operations
2. Perform Data Visualization
3. Perform Exploratory Data Analysis
4. Implement K-means clustering technique.
5. Implement Decision Tree.
6. Implement Naïve Bayes Classifier
7. Implement Apriori algorithm to extract association rules.
8. Implement Simple Linear Regression.
9. Implement Multiple Linear Regression
10. Implement Logistic Regression.

Total Lecture hours	60 hours

Text Books	
1	Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools-2016
2	A simple introduction to Data Science-Lars Nielson 2015
Reference Books	
1	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication
2	Data science in big data analytics-Wiley2015 John Wiley& Sons
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication

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
CO5	S	S	S	S	S	S	S	M	S	S

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

II – SEMESTER

Course code	23UPCSC2L04	ADVANCED JAVA PROGRAMMING LAB	L	T	P	C
Core / Elective		Core			4	2
Pre-requisite		Basics in Java Programming				

Course Objectives:

The main objectives of this course are:

1. To enable the students to implement the simple programs using JSP
2. To provide knowledge on using Servlets
3. To introduce JDBC and navigation of records
4. To understand RMI and its implementation
5. To Learn the Java JAR concepts

Expected Course Outcomes:

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

CO1	Implement concepts of Java using HTML forms, JSP and JAR	K1- K6
CO2	Must be capable of implementing JDBC concepts	
CO3	Write Swings applications with Event handling mechanism	
CO4	Create interactive web-based applications using Servlets and JSP	
CO5	Implement the Client Server application using RMI	

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

LIST OF PROGRAMS	60 hours

1. Develop a program for Exception Handling
2. Build a Swing application to design a simple calculator
3. Display a welcome message using Servlet.
4. Design a Purchase Order form using Html form and Servlet.
5. Develop a program for calculating the percentage of marks of a student using JSP.
6. Prepare an Employee pay slip using JSP.
7. Write a program using JDBC for creating a table, Inserting, Deleting records and list out the records.
8. Write a program using Java servlet to handle form data.
9. Write a program in JSP by using session object.
10. Write a program to build a simple Client Server application using RMI.

Expert lectures, online seminars –webinars

Total Lecture hours	60 hours

Text Books	
1	Herbert Schildt, "Java the Complete Reference", 9th Edition, McGraw Hill Publishing Company Ltd, New Delhi, 2017.
2	Campione, Mary, Kathy Walrath, and Alison Huml, "*The Java tutorial: a short course on the basics",* Addison-Wesley Professional, 2001.
Reference Books	
1	Keogh, James, "*J2ME: The complete reference*", Osborne, 2003.
2	McFarland, David Sawyer, "*Javascript & jQuery: the missing manual*", O'Reilly Media, Inc., 2011.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

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

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

23UPPGC1H01 - FUNDAMENTALS OF HUMAN RIGHTS

UNIT I: INTRODUCTION

Meaning and Definitions of Human Rights - Characteristics and Importance of Human Rights - Evolution of Human Rights - Formation, Structure and Functions of the UNO - Universal Declaration of Human Rights - International Covenants - Violations of Human Rights in the Contemporary Era.

UNIT II: HUMAN RIGHTS IN INDIA

Development of Human Rights in India - Constituent Assembly and Indian Constitution - Fundamental Rights and its Classification - Directive Principles of State Policy - Fundamental Duties.

UNIT III

Rights of Marginalized and other Disadvantaged People: Rights of Women - Rights of Children - Rights of Differently Abled - Rights of Elderly - Rights of Scheduled Castes - Rights of Scheduled Tribes - Rights of Minorities - Rights of Prisoners - Rights of Persons Living with HIVAIDS - Rights of LGBT.

UNIT IV

Human Rights Movements: Peasant Movements (Tebhaga and Telangana) - Scheduled Caste Movements (Mahar and Ad-Dharmi) - Scheduled Tribes Movements (Santhal and Munda) - Environmental Movements (Chipko and Narmada Bachao Andolan) - Social Reform Movements (Vaikom and Self Respect).

UNIT V

Redressal Mechanisms: Protection of Human Rights Act, 1993 (Amendment 2019) - Structure and Functions of National and State Human Rights Commissions - National Commission for SCs - National Commission for STs - National Commission for Women - National Commission for Minorities - Characteristics and Objectives of Human Rights Education.

REFERENCES

1. Sudarshanam Gankidi, Human Rights in India: Prospective and Retrospective, Rawat Publications, Jaipur, 2019.
2. Satvinder Juss, Human Rights in India, Routledge, New Delhi, 2020.
3. Namita Gupta, Social Justice and Human Rights in India, Rawat Publications, Jaipur, 2021.
4. Mark Frezo, The Sociology of Human Rights, John Willy & Sons, U.K. 2014.
5. Chiranjivi J. Nirmal, Human Rights in India: Historical, Social and Political Perspectives, Oxford University Press, New York, 2000.
6. Dr. S. Mehartaj Begum, Human Rights in India: Issues and perspectives, APH Publishing Corporation, New Delhi, 2010.
7. Asha Kiran, The History of Human Rights, Mangalam Publications, Delhi, 2011.
8. Bani Borgohain, Human Rights, Kanishka Publishers & Distributors, New Delhi-2, 2007.
9. Jayant Chudhary, A Textbook of Human Rights, Wisdom Press, New Delhi, 2011.

III - SEMESTER

Course code	23UPCSC2E15	MOBILE COMPUTING	L	T	P	C
Core / Elective		Core	3			3
Pre-requisite		Basics of Mobile Computing and its Applications				

Course Objectives:

The main objectives of this course are:

1. To introduce the concepts of wireless devices with signal, Antenna, Radio Frequencies, Signal Propagation.
2. To introduce wireless communication and networking principles, that support connectivity to cellular networks, Wireless LAN, GSM, CDMA
3. To learn the Applications of Cryptographic Hash Functions
4. To understand various Digital Signature Schemes
5. To Introduce the WAP Architecture, MANET and Routing

Expected Course Outcomes:

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

CO1	Understand the basic concepts of Wireless Communication and Spread Spectrum	K1-K6
CO2	Analyze the concepts of Medium Access Control and Global System for Mobile Communication	
CO3	Understand the basic concepts of Wireless LAN and Mobile Network Layer	
CO4	Understand the basic concepts of Wireless Application Protocol	
CO5	Analyze the concepts of Routing Protocols in MANET	

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

Unit:1	Wireless Communication	15 hours

Introduction – Applications – History of wireless communication – A Simplified reference model - Wireless transmission – Frequencies for radio transmission – Regulations – Signals –Antennas - Signal propagation: Path loss of radio signals - Additional signal propagation effects - Multi-path propagation – Multiplexing –Modulation Chapters: 1, 2.1 to 2.6

Unit:2	Medium Access Controls	15 hours

Spread spectrum – Direct sequence spread spectrum – Frequency hopping spread spectrum – Cellular systems. Medium access control: Hidden and exposed terminals – Near and far terminals – SDMA, FDMA, TDMA, Fixed TDM, Classical Aloha, slotted Aloha, Carrier sense multiple access – Reservation TDMA – Multiple access with collision avoidance – Polling – CDMA – Spread Aloha multiple access. Chapters: 3.1 to 3.3, 3.4.1 to 3.4.4, 3.4.7 to 3.4.9, 3.5.1

Unit:3	GSM and Routing Protocols	15 hours

GSM - Mobile services – System architecture – Radio interface – Protocols – Localization and calling – Handover – Security – New Data services. UMTS and IMT-2000 - Satellite Systems: Applications – Basics – Routing – Localization – Handover. Chapters: 3.6, 4.1.1 to 4.1.8, 4.4, 5.2 to 5.6		
Unit:4	**Wireless LAN**	**15 hours**
Wireless LAN: Infra red vs. radio transmission – Infrastructure and ad-hoc network – IEEE 802.11 – System architecture – Protocol architecture – Physics layer – Medium access control layer – MAC management – Blue tooth. Mobile network layer: Mobile IP: Goals, assumptions and requirements – entities and terminology – packet delivery – Agent discovery – Registration – Tunneling and encapsulation Recent technologies Chapters: 7.1 to 7.3.5, 7.5, 8.1.1 to 8.1.6		
Unit:5	**WAP and MANETs**	**13 hours**
WAP: Architecture – wireless datagram Protocol, Wireless transport layer security, Wireless transaction protocol, Wireless session protocol, Wireless application environment, Mobile ad-hoc networks – MANET Characteristics – Classification of MANETs, Routing of MANETs, Proactive Routing Protocol - DSDV, Reactive Routing Protocols – DSR, AODV.Chapter10.3.1 to 10.3.6 (Text Book 2- 6.1, 6.2, 6.4, 6.5, 6.6)		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, 2013.
2	Kum Kum Garg, "Mobile Computing Theory and Practice", Pearson Education, 2014.
Reference Books	
1	Rifaat A. Dayen, "Mobile Data & Wireless LAN Technologies", Prentice Hall, 1997.
2	Steve Mann and Scoot Schibli, "The Wireless Application Protocol", John Wiley & Inc., 2000.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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

S- Strong; M-Medium; L-Low

III – SEMESTER

Course code	23UPCSC2C08	CLOUD COMPUTING	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of Cloud and its Applications				

Course Objectives:

The main objectives of this course are:

1. Gain knowledge on cloud computing, cloud services, architectures and applications.
2. Enable the students to learn the basics of cloud computing with real time usage
3. Understand store and share, in and from cloud
4. To learn the social networks cloud
5. To understand the Storage and sharing in clouds

Expected Course Outcomes:

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

CO1	Understand the concepts of Cloud and its services	K1-K6
CO2	Collaborate Cloud for Event & Project Management	
CO3	Analyze on cloud in –Word Processing, Spread Sheets, Mail, Calendar, Database	
CO4	Analyze cloud in social networks	
CO5	Explore cloud storage and sharing	

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	CLOUD COMPUTING	15 hours

CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloud computing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.

Unit:3	CLOUD SERVICES	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	OUTSIDE THE CLOUD	15 hours

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

Unit:5	**STORING AND SHARING**	**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	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**75 hours**

Text Books

1. Miller, Michael. *Cloud computing: Web-based applications that change the way you work and collaborate,* Pearson Publishing, 2008.
   UNIT III: (Chapters: 1, 2,3)
   UNIT IV: (Chapters: 4,5,6)
   UNIT V: (Chapters: 7,8,9,10,11,12,13,14)
   UNIT IV: (Chapters: 18,19,20)
   UNIT V: (Chapters: 15,16,17)

Reference Books

1. Velte, Anthony T., et al. "Cloud computing: a practical approach." (2010).

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

1. https://nptel.ac.in/courses/106/105/106105167/
2. https://www.tutorialspoint.com/cloud_computing/index.htm
3. https://www.javatpoint.com/cloud-computing-tutorial

Mapping with Programming Outcomes

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

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

III - SEMESTER

Course code	23UPCSC2C09	SOFT COMPUTING	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of Neural Networks and its Applications				

Course Objectives:

The main objectives of this course are:

1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
2. To understand supervised and unsupervised learning algorithms
3. To enable the students to gain a basic understanding of neural networks.
4. To know about fuzzy logic, fuzzy inference systems, and their functions.
5. To impart basic knowledge on Genetic algorithms and their applications.

Expected Course Outcomes:

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

CO1	Provide an introduction to the basic principles, techniques, and applications of soft computing	K1-K6
CO2	Get familiar with Neural network architectures and supervised learning algorithms	
CO3	Understand the architectures and algorithms of Unsupervised Learning techniques	
CO4	Develop the skills to gain a basic understanding of fuzzy logic theory and fuzzy inference systems	
CO5	Ability to learn traditional optimization and search techniques and genetic programming	

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

Unit:1	INTRODUCTION	15 hours

INTRODUCTION TO SOFT COMPUTING: Artificial Neural Networks- Biological Neurons- Basic Models of Artificial Neural Networks-Connections-Learning-Activation Functions- Important Terminologies of ANNs- Muculloch and Pitts Neuron-Linear Separability- Hebb Network-Flowchart of Training Process-Training Algorithm.

Unit:2	SUPERVISED LEARNING NETWORK	15 hours

SUPERVISED LEARNING NETWORK : Perceptron Networks–Perceptron Learning Rule-Architecture-Flowchart for Training Process-Perceptron Training Algorithms for Single Output Classes-Perceptron Training Algorithm for Multiple Output Classes-Perceptron Network Testing Algorithm - Adaptive Linear Neuron-Delta Rule for Single Output Unit-Flowchart for training algorithm-Training Algorithm – Testing Algorithm - Multiple Adaptive Linear Neurons-Architecture-Flowchart of Training Process-Training Algorithm-Back Propagation Network-Architecture-Flowchart for Training Process-Training Algorithm-Learning Factors of Back-Propagation Network-Radial Basis Function Network- Architecture-Flowchart for Training Process-Training Algorithm.

Unit:3	UNSUPERVISED LEARNING NETWORK	15 hours
UNSUPERVISED LEARNING NETWORK: Associative Memory Networks - Auto Associative Memory Network-Architecture-Flowchart for Training Process-Training Algorithm-Testing Algorithm- Bidirectional Associative Memory- Architecture-Discrete Bidirectional Associative Memory-Iterative Auto Associative Memory Networks - Linear Auto Associative Memory-Kohonen Self-Organizing Feature Map- Architecture-Flowchart for Training Process-Training Algorithm.		
Unit:4	**INTRODUCTION TO FUZZY LOGIC**	**15 hours**
INTRODUCTION TO FUZZY LOGIC: Classical Sets –Operations on Classical Sets-Fuzzy sets - Fuzzy Sets- Properties of Fuzzy Sets- Fuzzy Relations –Membership Functions: Fuzzification-Methods of Membership Value Assignments – Defuzzification – Lambda-Cuts for Fuzzy sets and Fuzzy Relations – Defuzzification Methods–Max-Membership Principle-Centroid Method-Weighted Average Method-Mean Max Membership-Center of Sums-Center of Largest Area-First of Maxima		
Unit:5	**GENETIC ALGORITHM**	**12 hours**
GENETIC ALGORITHM: Introduction – Biological Background - Basic Operators and terminologies in Genetic algorithm- Search Space-Effects of genetic Operators – Traditional Vs Genetic Algorithm - Simple GA- General Genetic Algorithm- The Scheme Theorem - Applications		
Unit:6	**Contemporary Issues**	**3 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**75 hours**

Text Books

1	S.N. Sivanandam, S.N.Deepa, "Principles of Soft Computing", Wiley, Third Edition, 2019. **UNIT I:** Chapter 1: 2.1,2.3,2.4,2.5,2.6,2.7 **UNIT II:** Chapter 2: 3.2,3.3,3.4,3.5,3.6 **UNIT III:** Chapter 4 and 5: 4.1,4.3,4.5,4.6,4.7,5.3 **UNIT IV:** Chapter 7: 7.2,7.3,8.4,9.3,9.4,10.1,10.2,10.3,10.4 **UNIT V:** Chapter 5: 15.1,15.2,15.3,15.4,15.5,15.6,15.10

Reference Books

1	Das, A. (2018), "Artificial Intelligence and Soft Computing for Beginners"
2	Amit, K. (2018), "Artificial intelligence and soft computing: behavioral and cognitive modeling of the human brain", CRC press.
3	Rajasekaran, S., &Pai, G. V. (2011), "Neural networks, fuzzy logic and genetic algorithm: synthesis and applications (with cd)", PHI Learning Pvt. Ltd.
4	Jang, J. S. R., Sun, C. T., & Mizutani, E. (2004), "Neuro-fuzzy and soft computing-a computational approach to learning and machine intelligence", IEEE Transactions on automatic control, 42(10), 1482-1484
5	Gupta, M. M. (2004), "Soft computing and intelligent systems: theory and applications", Elsevier.

6	Jang, J. S. R., Sun, C. T., & Mizutani, E. (1997). Neuro-fuzzy and soft computing-a computational approach to learning and machine intelligence [Book Review]. IEEE Transactions on automatic control, 42(10), 1482-1484.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	

MAPPING WITH PROGRAMME OUTCOMES

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

S- STRONG; M-MEDIUM; L-LOW

III - SEMESTER

Course code	23UPCSC2C10	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of Artificial Intelligence and an Introduction about Machine Learning				

Course Objectives:

The main objectives of this course are:

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 and impact of Machine Learning.
5. Learn how to develop solution to business problems.

Expected Course Outcomes:

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

CO1	Demonstrate AI problems and techniques	K1- K6
CO2	Understand machine learning concepts	
CO3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning	
CO4	Analyze the impact of machine learning on applications	
CO5	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system	

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

Unit:1	INTRODUCTION	15 hours

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

Unit:2	SEARCH TECHNIQUES	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	PREDICATE LOGIC	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
Understanding Machine Learning: Defining Big Data – Big Data in Context with Machine Learning-The Importance of the Hybrid Cloud-Leveraging the Power of Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context- Approaches to Machine Learning.		
Unit:5	**APPLICATIONS OF MACHINE LEARNING**	**13 hours**
Looking Inside Machine Learning: The Impact of Machine Learning on Applications-Data Preparation-The Machine Learning Cycle- Getting Started with Machine Learning,: Focus on the Business Problem-Machine Learning Requires Collaboration-Executing a Pilot Project - Determining the Best Learning Model -:Learning Machine Skills-Defining the Skills That You Need-IBM-Recommended Resources - Solutions to Business Problems-Applying Machine Learning to Patient Health -Leveraging IoT to Create More Predictable Outcomes-Proactively Responding to IT issues- Protecting Against Fraud		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**75 hours**

Text Books

1	Rich, Elaine, Kevin Knight, and Shivashnkar B. Nair. "*Artificial intelligence*." Tata McGraw Hill Publishers company Pvt. Ltd, Third Edition (2018). UNIT I: (Chapters: 1,1,1.3,1.5,2.1,2.3,2.4,2.5) UNIT II: (Chapters:3.1,3.2,3.3,3.4,3.5,3.6,4.1,4.2,4.3,4.4) UNIT III: (Chapters:5.1,5.2,5.3,5.4,5.5,6.1,6.2,6.3,6.4,6.5)
2	Hurwitz, Judith, and Daniel Kirsch. "*Machine learning for dummies*." *IBM Limited Edition* 75 (2018). Unit IV: (Chapters: 1,2) Unit V: (Chapters: 3,4,5,6)

Reference Books

1	Luger, George F. *Artificial intelligence: structures and strategies for complex problem solving*. Pearson education, 2005.

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

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

Mapping with Programming Outcomes

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

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

III - SEMESTER

Course code	23UPCSC2L05	MOBILE COMPUTING APPLICATION DEVELOPMENT LAB	L	T	P	C
Core / Elective		Core	4			4
Pre-requisite		Basics of Mobile application and develop solutions				

Course Objectives:

The main objectives of this course are:

1. To enable the students practice the concepts of Mobile application and develop solutions for real world problems.
2. Understand how to work with various mobile application development frameworks.
3. Comprehend the capabilities and limitations of mobile devices.
4. To get clear understanding of mobile application development with WML/J2ME.
5. To get advanced methods for mobile application that makes use of any database.

Expected Course Outcomes:

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

CO1	Apply the knowledge of mobile application development with WML/J2ME.	K1- K6
CO2	Design real life situational problems and think creatively about solutions of them.	
CO3	Appraise the best features Programs for creating dynamic and interactive web pages using forms.	
CO4	Create a Mobile application to view the live streaming using video view.	
CO5	Create a mobile application that makes use of any database.	

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

LIST OF PROGRAMS	60 hours

1. Implement the WML tags and Image using WML/J2ME.
2. Design of simple Calculator having +, -, * and / using WML/J2ME.
3. Design of Calendar for any given month and year using WML/J2ME.
4. Design a Timer to System Time using WML/J2ME.
5. Design of a simple game using WML/J2ME.
6. Animate an image using WML/J2ME.
7. Design a personal phone book containing the name, phone no., address, e-mail, etc
8. Browsing the Internet using a Mobile phone simulator.
9. Develop a Mobile application to view the live streaming using video view.
10. Develop a mobile application that makes use of any database.

Expert lectures, online seminars –webinars

Total Lecture hours	60 hours

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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

S- Strong; M-Medium; L-Low

III - SEMESTER

Course code	23UPCSC2L06	CLOUD COMPUTING LAB	L	T	P	C
Core / Elective		Core			4	2
Pre-requisite		Basic Programming using various Cloud platform				

Course Objectives:

The main objectives of this course are:

1. To familiarize the tools required to manage and analyze cloud computing
2. To teach the fundamental techniques and principles in achieving cloud computing with scalability and streaming capability
3. To enable students to have skills that will help them to solve complex
4. To understand the Opennebula cloud tool
5. To enable Cloud environment like Microsoft Azure and Google

Expected Course Outcomes:

On the successful Completion of the course, student will be able to:

CO1	Understand how to use Cloud computing Solutions	K1- K6
CO2	Critically analyse existing applications and implementations, taking practicality, and usefulness metrics into consideration.	
CO3	Implementation of Linux Platform	
CO4	Implement and manipulation using cloud environment	
CO5	Implement and develop the Opennebula platform	

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

LIST OF PROGRAMS	60 hours

1. Working with Google Drive to make spread sheet and notes.
2. Launch a Linux Virtual Machine.
3. To hostastatic 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 S3bucket
8. To Create and Query a NoSQL Table
9. Install a C compiler in the virtual machine and execute a sample program
10. Show the virtual machine migration based on certain condition from one node to the another

Expert lectures, online seminars–webinars

Total Lecture hours	60 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 McGraw Hill Education Private Limited, 2009.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

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

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

III – SEMESTER

Course code	23UPCSC2L07	WEB APPLICATION DEVELOPMENT HOSTING LAB	L	T	P	C
Core / Elective		Core			4	2
Pre-requisite		Basic Programming using HTML tags				

Course Objectives:

The main objectives of this course are:

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 and other controls in a webpage
4. To create interactive applications using PHP
5. Enrich knowledge about HTML controls.

Expected Course Outcomes:

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

CO1	Understand & implement the basic HTML tags to create static webpages	K1-K6
CO2	Capable of using hyperlinks, frames, images, tables,..... in a webpage	
CO3	Able to write dynamic web applications using HTML forms	
CO4	Must be able to write dynamic web applications in HTML tags using XAMPP.	
CO5	Develop interactive web pages using PHP	

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

LIST OF PROGRAMS — **60 hours**

1. Develop a web site 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 6digits, etc.).
8. Write a program to accept two numbers n1and n2 using HTML form and display the Prime numbers between n1 and n2 using PHP
9. Develop a web page in PHP to fetch details from the Database

10. Create a web page consisting of Multimedia objects	
Total Lecture hours	**60 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, NewDelhi, 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
CO5	S	S	S	S	S	S	S	M	S	S

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

ELECTIVE COURSES

ELECTIVE COURSE – I (I - SEMESTER)

Coursecode	23UPCSC2E01	DATA ENGINEERING AND MANAGEMENT	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Data Engineering Management and CRM tools				

Course Objectives:

The main objectives of this course are:

1. To understand Data Management concepts
2. To get brief knowledge on Data Modeling
3. To analyse the techniques used in Distributed Databases
4. To assess Distributed database and Business Modelling
5. To get familiar with CRM tools

Expected Course Outcomes:

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

CO1	Comprehend the Data Management concepts and analyse the relationship with the enterprise	K1- K6
CO2	Analyze Data Modelling concepts and assess its quality	
CO3	Understand and implement business modelling techniques	
CO4	Evaluate the use of Artificial Intelligence and Machine Learning in CRM	
CO5	Develop CRM applications in cloud	

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

Unit:1	DATABASE DEVELOPMENT	12 hours

DATABASE DEVELOPMENT: Database architecture of an information system-Overview of the database development process-Conceptual data modeling-Relational data analysis-Roles of a data model-Physical database design. DATA MANAGEMENT: Problems encountered without data management-Data management responsibilities-Data management activities-Roles within data management-Benefits of data management-Relationship between data management and enterprise.

Unit:2	CORPORATE DATA MODELLING	12 hours

CORPORATE DATA MODELLING: Need for a corporate data model-Nature of a corporate data model- Develop a corporate data model - Corporate data model principles. DATA DEFINITION AND NAMING: Elements of a data definition-Data naming conventions. DATA QUALITY: Issues associated with poor data quality-Causes of poor data quality-Dimensions of data quality-Data model quality-Improving data quality. DATA ACCESSIBILITY: Data security-Data integrity-Data recovery.

Unit:3	USE OF PACKAGED APPLICATION SOFTWARE	12 hours

USE OF PACKAGED APPLICATION SOFTWARE: Application software packages-Impact on data management. DISTRIBUTED DATA AND DATABASES: Rationale for distributing data-Perfect distributed database system-Top down fragmentation and partitioning. Bottom up integration-The management of replication. BUSINESS INTELLIGENCE: Data warehousing-Multidimensional model of data-Standard reporting tools-Online analytical processing OLAP-Relational schema for a data warehouse.		
Unit:4	**CRM**	**12 hours**
CRM: Three main pillars of CRM. GETTING TO KNOW YOUR CUSTOMER: 360-degree client view. UTILIZING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN YOUR CRM STRATEGY: Evolution of AI-Current state of AI-Teaming up AI with people-Applying AI to your CRM solution-ethical aspects of AI-An example of AI in CRM processes.		
Unit:5	**HYBRID OF CRM AND CLOUD**	**10 hours**
CLOUD VERSUS ON PREMISE VERSUS HYBRID: Factors influencing vendor selection-Hybrid deployment-what are your options. CRM DIFFERENTIATORS: It's not about the feature list; it's about the ecosystem-Fourth industrial revolution and CRM-AI and smart cloud-To cloud or not to cloud-Leveraging smart cloud into CRM-Big data-Social selling and advertising-Implementation tools-Sustainable CRM platform.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**
Text Books		
1	Keith Gordon, "Principles of Data Management Facilitating Information Sharing", BCS Learning, 2013. (Chapters:1-5, 7,8,12,13,14)	
2	Max Fatouretchi, "The Art of CRM", Packt. Publishing, 2019.(Chapters: 1,2,5,8,9)	
Reference Books		
1	Peter Ghavami, "Big Data Management_ Data Governance Principles for Big Data Analytics", De Gruyter, 2020.	
2	Francis Buttle, Stan Maklan, Customer Relationship Management Concepts and Technologies, Routledge, 2019.	

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE – I (I – SEMESTER)

Course code	23UPCSC2E02	DATA ENGINEERING AND MANAGEMENT LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming using MangoDB and Zoho CRM				

Course Objectives:

The main objectives of this course are:

1.To acquire basic scripting knowledge in MongoDB
2.To learn CRUD Operation on MongoDB database
3.To comprehend MongoDB using DbVisualizer
4.To be familiar with Zoho CRM features
5.To customize your application using Zoho CRM

Expected Course Outcomes:

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

CO1	Comprehend the scripting knowledge in MongoDB and perform basic operations in shell prompt	K1- K6
CO2	Implement, Create, Read, Update and Delete Operations on MongoDB database	
CO3	Analyze MongoDB using DbVisualizer	
CO4	Assess Zoho CRM features for managing the customer relationships	
CO5	Create a customized application in Zoho CRM	

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

LIST OF PROGRAMS	30 hours

1. Write a script to create a MongoDB database and perform insert operation
2. Write a MongoDB script to perform query operations
3. Write a MongoDB Script to perform update operations
4. Write a MongoDB Script to update documents with aggregation pipeline
5. Write a MongoDB script to delete single and multiple documents
6. Write a MongoDB script to perform string aggregation operations
7. Design a Data Model for MongoDB using DbVisualizer
8. Perform CRUD operations using DbVisualizer
9. Create a Zoho CRM account and organize your Tasks, Meetings and Deals
10. Create and maintain a project using Zoho CRM features

Total Lecture hours	30 hours

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – I (I - SEMESTER)

Coursecode	23UPCSC2E03	ARCHITECTURE AND FRAMEWORKS	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Software Architecture and it's Applications				

Course Objectives:

The main objectives of this course are:

1. To understand the basics, benefits and purpose of software architecture
2. Understand the quality attributes to fulfil the software requirements and relates the software with an organization
3. Explore the design patterns, best practice and paradigms of efficient software development
4. Understand the performance and security measures of software architecture
5. Enable the developers to advance their carrier in software domain

Expected Course Outcomes:

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

CO1	Understand, analyze and evaluate the purpose of Software architecture and development methodologies with consideration of risk management	K1-K6
CO2	Comprehend, apply and evaluate the domain knowledge for software development process and determine the impact of quality attributes.	
CO3	Understand, track and examine the systematic approach for various software design models with effective document process	
CO4	Illustrate and summarize the functions of orthogonal systems with complexity, design principles and design pattern for software architecture	
CO5	Comprehend, analyze and evaluate the performance and security measures for Server, Web and Database applications in order to create the secure software systems for various domain applications	

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

Unit:1	INTRODUCTION	12 hours

Software architecture introduction – Importance of Software architecture –Software architecture consumers – Architect role - software architecture in an organization – Types of software architects – Software development methodologies – Project management – Office politics – Software risk management – Configuration management – Software product lines.

Unit:2	DOMAIN KNOWLEDGE	12 hours

Domain Knowledge – Developing business acumen – Domain-driven design – requirement engineering – requirement elicitation –Software Quality attributes: Maintainability – Usability – Availability – Portability – Interoperability - Testability

Unit:3	ARCHITECTURE DESIGN	12 hours
Software Architectures design – Importance - Top-down Versus bottom-up design approaches – Architectural drivers – Documenting the Software architecture design – Systematic approach - Attribute-driven design – Microsoft's technique for architecture and design –Architecture-centric design method – Architecture development method – Tracking the progress of the software architecture's design.		
Unit:4	**SOFTWARE SYSTEMS**	**12 hours**
Designing orthogonal software systems – Minimizing complexity – SOLID design principles – Software architecture patterns – layered – Event-driven architecture – Model-View patterns – Service-oriented architecture.		
Unit:5	**APPLICATIONS**	**10 hours**
Architecting Modern Applications.- Importance of Performance – Performance improvement - Server side caching – Web application performance – Database performance -Securing software systems – Threat modelling – Secure by design .		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books

1	Joseph Ingeno, "Software Architect's Handbook" Packt. Publishing 2018.

Reference Books

1	Oliver Vogel, Indo Arnold, ArifChughtai and TImoKehrer, "Software Architecture" Springer-Verlag, 2011.
2	Ian Gorton, "Essential Software architecture", Second Edition, Springer, 2011.
3	Len Bass, Paul Clements and Rick Kazman, "Software architecture in practice", Third edition, Addison-Wesley, 2013.

Mapping with Programme Outcome

	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10
CO1	M	S	L	L	M	S	M	M	L	S
CO2	M	S	M	M	M	L	S	S	M	M
CO3	S	M	S	S	S	M	S	M	M	S
CO4	S	M	L	S	M	L	S	L	S	M
CO5	M	S	M	L	S	L	M	S	L	S

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – I (I - SEMESTER)

Course code	23UPCSC2E04	ARCHITECTURE AND FRAMEWORKS - LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming Software Architecture and Routing Protocols				

Course Objectives:

The main objectives of this course are:

1. To understand and implement the basic concepts of Software architecture and its functions.
2. To acquire programming skills to develop Implement various technologies and services associated with network protocols along with the challenges of data transfer.
3. Implement the importance and functioning of Routing Protocols over communication service.
4. To acquire skills to connect two routers and any two switches.
5. To comprehend related to SSH protocols and accessing the remote device.

ExpectedCourseOutcomes:

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

CO1	Comprehend the programming skills of Software architecture tools and packages	K1-K6
CO2	Understand and implement the user profiles and authentication with recovery mechanism.	
CO3	Comprehend and evaluate the access control and content representation use of FTP server.	
CO4	Understand and implement reading and writing resources for various applications	
CO5	Identify and examine the notifications, friends, and follower list of social application protocols.	

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

LIST OF PROGRAMS	30 hours

Note: Use the solid servers and client specification for implementation https://github.com/solid/specification/.

Implement the following using Linux / Windows environments

1. Find the WebID profile document and display the necessary attributes
2. Set and access the primary authentications with account recovery mechanisms
3. Set and access the secondary authentications with account recovery mechanisms
4. Design authorization and web access control
5. Find the content representation
6. Reading resources from HTTP REST API and WebSockets API
7. Writing resources from HTTP REST API and WebSockets API
8. Data notification using Social Web App protocol

9. Managing subscriptions and friends list using Social Web App protocol 10. Managing list of followers and following list using Social Web App protocol	
Total Lecture hours	**30 hours**

Mapping Course outcomes with Programme outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – I (I - SEMESTER)

Course code	23UPCSC2E05	NETWORK PROTOCOLS	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Network Protocols and its Problems				

Course Objectives:

The main objectives of this course are:

1. To understand the basic concepts of Transmission Control Protocol/Internet Protocol and associated functions
2. Explore to describe the internet architecture and its processes associated with the data transfer and to provide the quality of service
3. To understand technologies and services associated with network protocols along with the challenges of data transfer.
4. Learners will understand the importance and functioning of Routing Protocols over communication service.
5. Empower the learners to comprehend and manage the issues associated with IP protocols like data traffic problems, security and mobility.

Expected Course Outcomes:

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

CO1	Understand, analyse and examine the concepts of Communication Protocols with its architecture and functions	K1- K6
CO2	Illustrate and apply the appropriate internet architecture along with efficient protocol models for the user defined communication environment	
CO3	Comprehend, categorize and formulate the appropriate IP routing protocol to establish a efficient data transfer	
CO4	Comprehend, analyse and evaluate the concepts of Virtual wired service and IP/optical networking with its functions and deployment	
CO5	Elucidate, analyse and inspect the IP traffic engineering and its models along with the security mechanisms	

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

Unit:1	INTRODUCTION	12 hours

Transmission Control Protocol/Internet Protocol: Fundamental Architecture - Internet Protocol Basics - Routing - Transport-Layer Protocols: Transmission Control Protocol - User Datagram Protocol - Stream Control Transmission Protocol - Real-Time Transport Protocol.

Unit:2	INTERNET ARCHITECTURE	12 hours

Internet Architecture: Internet Exchange Point - History of Internet Exchange Points - Internet Service Provider Interconnection Relationships - Peering and Transit - IP Routing Protocols: Overview of Routing Protocols - Routing Information Protocol - Open Shortest Path First - Border Gateway Protocol - Multiprotocol Label Switching.

Unit:3	IP QUALITY OF SERVICE	12 hours
IP Quality Of Service : Introduction - Quality of Service in IP Version 4 - Integrated Services - Differentiated Services - Quality of Service with Nested Differentiated Services Levels - IP Multicast and Any cast: Addressing - Multicast Routing - Routing Protocols –Any casting- IPv6 Any cast Routing Protocol: Protocol Independent Any cast—Sparse Mode - Transport over Packet: Draft-Martini Signaling and Encapsulation - Layer-2 Tunneling Protocol.		
Unit:4	**VIRTUAL ROUTER**	**12 hours**
Virtual Private Wired Service - Types of Private Wire Services - Generic Routing Encapsulation - Layer-2 Tunneling Protocol - Layer-3 Virtual Private Network 2547bis, Virtual Router - IP and Optical Networking: IP/Optical Network Evolution - Challenges in Legacy Traditional IP/Optical Networks - Automated Provisioning in IP/Optical Networks - Control Plane Models for IP/Optical Networking - Next-Generation Multi-Layer Network Design Requirements - Benefits and Challenges in IP/Optical Networking - IP Version 6: Addresses in IP Version 6 - IP Packet Headers - IP Address Resolution - IP Version 6 Deployment: Drivers and Impediments.		
Unit:5	**IP TRAFFIC ENGINEERING**	**10 hours**
IP Traffic Engineering: Models of Traffic Demands - Optimal Routing with Multiprotocol Label Switching - Link-Weight Optimization with Open Shortest Path First - Extended Shortest-Path-Based Routing Schemes - IP Network Security: Introduction - Detection of Denial-of-Service Attack - IP Trace back- Edge Sampling Scheme - Advanced Marking Scheme - Mobility Support for IP: Mobility Management Approaches - Security Threats Related to IP Mobility - Mobility Support in IPv6 - Reactive Versus Proactive Mobility Support - Relation to Multihoming - Protocols Supplementing.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books

1	Advanced Internet Protocols, Services and Applications", Eiji Oki, Roberto Rojas-Cessa, Mallik arjun Tatipamula, Christian Vogt, Copyright © 2012 by John Wiley & Sons, Inc.

Reference Books

1	TCP/IP Protocol Suite", BehrouzA.Forouzan, Fourth Edition, Tata Mcgraw-Hill Edition 2010
2	"Computer Communications and Networking Technologies" - Michael A. Gallo & William M. Hancock- BROOKS&COLE
3	"Computer Networks and Internets" -Douglas E. Comer- PEARSON.
4	Data and Computer Communications- Eighth Edition- William Stallings- Pearson Education.
5	Network Security Bible, 2nd edition, Eric Cole, Wiley Publishers.
6	Data communication and networks –James Irvine and David Harley- Publishers: Wiley India

Mapping with Programme Outcome

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – I (I - SEMESTER)

Course code	23UPCSC2E06	NETWORK PROTOCOLS LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basics of Network Protocols and its Routing Protocols problems				

Course Objectives:

The main objectives of this course are:

1. To understand and implement the basic concepts of Transmission Control Protocol/Internet Protocol and associated functions.
2. To acquire programming skills in Implement various technologies and services associated with network protocols along with the challenges of data transfer.
3. Implement the importance and functioning of Routing Protocols over communication service.
4. To acquire skills to connect two routers and any two switches.
5. To comprehend related to SSH protocols and accessing the remote device.

Expected Course Outcomes:

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

CO1	Comprehend the programming skills the SSH protocols and accessing the remote device	K1-K6
CO2	Understand and implement the various functioning of Routing Protocols over communication service.	
CO3	Evaluate the use of FTP server	
CO4	Design to Connect any two switches and get the status of each switches	
CO5	Solve to Connect two routers and get packets from the routers.	

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

LIST OF PROGRAMS — **30 hours**

1. Implement the following commands
    a. ipconfig
    b. ping
    c. traceroute
    d. netsat
    e. nslookup
2. Implement the following server commands
    a. ifconfig
    b. ip
    c. tracepath
    d. ss
    e. tcpdum
3. Connect and place the given file in the FTP server
4. Install packet tracer and connect a computer to router, switch and get a Icmp request

5. Implement the SSH protocols and accessing the remote device 6. Connect any two switches and get the status of each switches 7. Connect two routers and get packets from the routers. 8. Get the access of the router by connecting with working computer 9. Identify the route password of server and get the connection using telnet 10. Install wire shark for capture and analyse the packets (TCP /UDP)		
	Total Lecture hours	**30 hours**

Mapping Course outcomes with Programme outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – I (I - SEMESTER)

Course code	23UPCSC2E07	DOT NET TECHNOLOGIES	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of DOT NET Technologies and its Types				

Course Objectives:

The main objectives of this course are to:

1. To get strong understanding of .NET Framework and C# programming.
2. To get advanced programming skills in Visual Studio with C# language.
3. To get advanced methods of manipulating data using Microsoft SQL Server.
4. To get clear idea of how to developing real-time standalone, web applications using .NET Technologies.
5. To get clear understanding and get experience in Microsoft Azure

Expected Course Outcomes:

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

CO1	Understand and learn .NET Framework and C# .NET	K1- K6
CO2	Apply the concepts to develop the applications for real-time problem in C# .NET and ASP .NET	
CO3	Analyze the feasibility of using .NET for real time problems	
CO4	Access MS SQL Server	
CO5	Evaluate the use of Micro Soft Azure	

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

Unit:1	INTRODUCTION to C#	12 hours

Introducing C#: .NET Framework - C# language - Visual Studio 2017 - Writing a C# Program: Visual Studio 2017 Development Environment - Console Applications - Desktop Applications - Variables and Expressions: Basic C# Syntax - Basic C# Console Application Structure - Variables - Expressions - Flow Control: Boolean Logic – Branching - Looping.

Unit:2	Object Oriented Programming	12 hours

More About Variables: Type Conversion - Complex Variable Types - String Manipulation – Functions: Defining and Using Functions - Variable Scope - The Main Function - Struct Functions - Overloading Functions - Using Delegates - Debugging and Error Handling: Debugging in Visual Studio - Error Handling - Introduction to Object Oriented Programming: Object-Oriented Programming - OOP Techniques - OOP in Desktop Applications.

Unit:3	ASP . NET	12 hours

Defining Classes: Class Definitions in C# - System.Object - Constructors and Destructors - OOP Tools in Visual Studio - Class Library Projects - Interfaces Versus Abstract Classes - Struct Types - Shallow Copying Versus Deep Copying - Defining Class Members: Member Definitions - Additional Class Member Topics - Interface Implementation - Partial Class Definitions - Partial Method Definitions - The Call Hierarchy Window - Basic Cloud Programming: Cloud, Cloud Computing, and the Cloud Optimized Stack - Cloud Patterns and Best Practices - Using Microsoft Azure C# Libraries to Create a Storage Container - Creating an ASP.NET 4.7 Web Site That Uses the Storage Container - Advanced Cloud Programming and Deployment: Creating an ASP.NET Web API - Deploying and Consuming an ASP.NET Web API on Microsoft Azure - Scaling an ASP.NET Web API on Microsoft Azure.

Unit:4	**XML and JSON**	**12 hours**

.NET Standard and .NET Core: Cross-Platform Basics and Must Know Terms – Need of .NET - Referencing and Targeting Frameworks - .NET Core - Building and Packaging a.NET Standard Library - Building a .NET Core Application with Visual Studio - Porting from .NET Framework to .NET Core - ASP.NET and ASP.NET Core: Overview of Web Applications – Use of ASP.NET - ASP.NET Web Forms - Creating ASP.NET Core Web Applications – Files: File Classes for Input and Output – Streams - Monitoring the File System - XML and JSON: XML Basics - JSON Basics - XML Schemas - XML Document Object Model - Converting XML to JSON - Searching XML with XPath.

Unit:5	**LINQ and SQL Server**	**10 hours**

LINQ: LINQ to XML - LINQ Providers - LINQ Query Syntax - LINQ Method Syntax - Ordering Query Results - Understanding the order by Clause - Querying a Large Data Set -Using Aggregate Operators - Using the Select Distinct Query - Ordering by Multiple Levels -Using Group Queries - Using Joins – Databases: Using Databases - Installing SQL Server - Express - Entity Framework - Code First Database - Finding the Database - Navigating Database Relationships - Handling Migrations - Creating and Querying XML from an Existing Database - Universal Apps: Windows Universal Apps - App Concepts and Design - App Development - Common Elements of Windows Store Apps - Windows Store.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars

	Total Lecture hours	**60 hours**

Text Books

1. Benjamin Perkins, Jacob Vibe Hammer, Jon D. Reid, “Beginning C# Programming with Visual Studio 2017”, Wiley Publishing, 2018. Chapters: 1 to 10, 16 to 23, and 25.

	Reference Books
1	Nagel, Christian, “Professional C 7 and .NET Core 2.0”, Wrox Publishing, 2018.
2	Mehboob Ahmed Khan, Ovais, “C# 7 and .NET Core 2.0 High Performance”, Packt Publishing, 2018

MAPPING WITH PROGRAMME OUTCOMES:

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

L - Low, M- Medium, S - Strong

ELECTIVE COURSE – I (I - SEMESTER)

Course code	23UPCSC2E08	DOT NET TECHNOLOGIES LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basics of DOT NET Technologies and its problems				

Course Objectives:

The main objectives of this course are:

1. To get strong understanding of .NET Framework and C# programming.
2. To get advanced programming skills in C# .NET OOPs Concepts
3. To get advanced methods of manipulating data using Microsoft SQL Server.
4. To get clear idea of how to developing real-time standalone, web applications using ASP .NET.
5. To get clear understanding and get experience in Microsoft Azure.

Expected Course Outcomes:

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

CO1	Get a strong understanding of .NET Visual Studio platform	K1-K6
CO2	Become a strong knowledge in C# .NET.	
CO3	Get real-time application developing using .NET Cloud Technologies	
CO4	Create web application using ASP .NET	
CO5	Develop applications using Micro Soft Azure	

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

LIST OF PROGRAMS	30 hours

Implement the following problems using C# with Visual Studio 2017

1. Demonstrate method overloading and method overriding
2. Class and Objects
3. Multilevel Inheritance
4. Interfaces

5. Demonstrate multiple type of Exceptions 6. Azure Storage Container Using the Microsoft Azure Storage Client Library 7. Demonstrate Read and Write a Data using Random Access Files 8. Employee management database using LINQ 9. Student management system using ASP.NET 10. Demonstrates simple Universal App.		
	Total Lecture hours	**30 hours**

MAPPING WITH PROGRAMME OUTCOMES:

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

L - Low, M- Medium, S - Strong

ELECTIVE COURSE – I (I - SEMESTER)

Course code	23UPCSC2E09	SOFTWARE DEVELOPMENT TECHNOLOGIES	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Software Development Technologies and its Applications				

Course Objectives:

The main objectives of this course are to:

1. To learn and Implementing Micro services
2. To analyzing the Azure Kubernetes Service
3. To learn and analyzes .NET DevOps for Azure and its applications
4. To building code for .NET core applications
5. To get familiarized with Azure pipelines

Expected Course Outcomes:

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

CO1	Understand, apply and summarize the basic concepts of Micro services communication Microsoft Azure and Dev Ops for software development life cycle	K1-K6
CO2	Illustrate, and implement Azure Kubernetes Service tools for software development life cycle	
CO3	Recognize, analyse and summarize the functionalities of .NET Dev Ops for Azure applications	
CO4	Understand, design and evaluate the principles and architecture service tools for software development life cycle.	
CO5	Comprehend, implement and review the functionalities of API and API gateways for cloud and Azure applications	

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

Unit:1	INTRODUCTION	12 hours

Implementing Microservices: Client to microservices communication, Interservice communication, data considerations, security, monitoring, microservices hosting platform options. Azure Service Fabric: Introduction, core concepts, supported programming models, service fabric clusters, develop and deploy applications of service fabric. Monitoring Azure Service Fabric Clusters: Azure application, resource manager template, Adding Application Monitoring to a Stateless Service Using Application Insights, Cluster monitoring, Infrastructure monitoring.

Unit:2	Azure Kubernetes Service	12 hours

Azure Kubernetes Service (AKS): Introduction to kubernetes and AKS, AKS development tools, Deploy applications on AKS. Monitoring AKS: Monitoring, Azure monitor and analytics, monitoring AKS clusters, native kubernetes dashboard, Prometheus and Grafana. Securing Microservices: Authentication in microservices, Implenting security using API gateway pattern, Creating application using Ocrlot and securing APIs with Azure AD. Database Design for Microservices: Data stores, monolithic approach, Microservices approach, harnessing cloud computing, database options on MS Azure, overcoming application development challenges.

Building Microservices on Azure Stack: Azure stack, Offering IaaS, PaaS on-premises simplified, SaaS on Azure stack.

Unit:3	.NET DevOps for Azure	12 hours

.NET DevOps for Azure: DevOps introduction, Problem and solution. Professional Grade DevOps Environment: The state of DevOps, professional grade DevOps vision, DevOps architecture, tools for professional DevOps environment, DevOps centered application. Tracking work: Process template, Types of work items, Customizing the process, Working with the process. Tracking code: Number of repositories, GIT repository, structure, branching pattern, Azure repos configuration, GIT and Azure.

Unit:4	Azure pipelines	12hours

Building the code: Structure of build, using builds with .NET core and Azure pipelines, Validating the code: Strategy for defect detection, Implementing defect detection. Release candidate creation: Designing release candidate architecture, Azure artifacts workflow for release candidates, Deploying the release: Designing deployment pipeline, Implementing deployment in Azure pipelines. Operating and monitoring release: Principles, Architectures for observability, Jumpstarting observability.

Unit:5	AWS API gateway	10 hours

Introduction to APIs: Introduction, API economy, APIs in public sector. API Strategy and Architecture: API Strategy, API value chain, API architecture, API management. API Development: Considerations, Standards, kick-start API development, team orientation. API Gateways: API Gateways in public cloud, Azure API management, AWS API gateway. API Security: Request-based security, Authentication and authorization.

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

Text Books

1	Harsh Chawla and Hemant Kathuria, Building Micro services Applications on Microsoft Azure- Designing, Developing, Deploying, and Monitoring, Apress, 2019.
2	Jeffrey Palermo, NET DevOps for Azure A Developer's Guide to DevOps Architecture the Right Way, Apress, 2019.
3	Thurupathan and Vijayakumar, Practical API Architecture and Development with Azure and AWS - Design and Implementation of APIs for the Cloud, Apress, 2018.

	Reference Books
1	Karl Matthias and Sean P. Kane, Docker: Up and Running, O'Reilly Publication, Second Edition 2018.
2	Len Bass, Ingo Weber, Liming Zhu," DevOps, A Software Architects Perspective", Addison Wesley-Pearson Publication, First Edition 2015.
3	John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication, First Edition 2011.

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – I (I - SEMESTER)

Course code	23UPCSC2E10	SOFTWARE DEVELOPMENT TECHNOLOGIES LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming DevOps and Docker Platform				

Course Objectives:

The main objectives of this course are:

1. To understand the concept of DevOps with associated technologies and methodologies.
2. To be familiarized with Jenkins, which is used to build & test software Applications
3. To understand Continuous integration in DevOps environment.
4. To understand Docker to build, ship and run containerized images
5. To use Docker to deploy and manage Software applications running on Container.

Expected Course Outcomes:

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

CO1	Understand and analyse the importance of Jenkins to Build, Deploy and Test Software Applications	K1-K6
CO2	Synthesis and summarize the importance of Software Configuration Management in DevOps	
CO3	Identify, analyze and illustrate the Containerization of OS images and deployment of applications over Docker	
CO4	Design, analyze and develop the Pull based Software Configuration Management	
CO5	Design, analyze and develop Puppet Manifest	

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

LIST OF PROGRAMS	30 hours

1. Deploy Version Control System / Source Code Management, install GIT and create a GitHub account.
2. Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet
3. Continuous Integration: install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
4. Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
5. Implement Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.
6. Setup and Run Selenium Tests in Jenkins Using Maven.
7. Implement Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
8. Implement Docker file instructions, build an image for a sample web application using Docker file.

9. Install and Configure Pull based Software Configuration Management and provisioning tools using Puppet. 10. Implement LAMP/MEAN Stack using Puppet Manifest.	
Total Lecture hours	**30 hours**

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – II (II - SEMESTER)

Course code	23UPCSC2E11	INTERNET OF THINGS	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Internet of Things and its Applications				

Course Objectives:

The main objectives of this course are:

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

Expected Course Outcomes:

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

CO1	Comprehend the IoT evolution with its architecture and sensors	K1-K6
CO2	Understand the networking concepts for communication and underlying IoT protocols	
CO3	Assess the embedded technologies and develop prototypes for the IoT products	
CO4	Evaluate the use of Application Programming Interface and design an API for IoT in real time	
CO5	Recognize the ethics of business models and perform security analysis	

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

Unit:1	FUNDAMENTALS OF IOT	12 hours

Evolution of Internet of Things – Enabling Technologies – IOT Architectures: oneM2M, IOT World Forum (IOTWF) and Alternative IOT models – Simplified IOT Architecture and Core IOT Functional Stack -– Fog, Edge and Cloud in IOT – Functional blocks of an IOT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.

Unit:2	IOT PROTOCOLS	12 hours

IOT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IOT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory

Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.		
Unit:3	**DESIGN AND DEVELOPMENT**	**12 hours**
. Prototyping Embedded Devices: Electronics - Embedded Computing Basics – Arduino - Raspberry Pi - Beagle Bone Black - Electric Imp. Prototyping the Physical Design: Non digital Methods - Laser Cutting - 3D printing - CNC Milling - Repurposing/Recycling.		
Unit:4		**12 hours**
Prototyping Online Components: Getting started with an API - Writing a New API - Real-Time Reactions - Other Protocols. Techniques for Writing Embedded Code: Memory Management - Performance and Battery Life - Libraries - Debugging.		
Unit:5		**10 hours**
Business Models: History of Business Models – Model – Internet of Starting up – Lean Startups. Moving to Manufacture: Designing Kits - Designing Printed circuit boards – Certification – Costs - Scaling Up Software. Ethics: Privacy – Control – Environment – Solutions.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017 (UNIT I and II)
2	Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014. (UNIT III, IV and V)

Reference Books

1	OvidiuVermesan and Peter Friess, "Internet of Things – From Research and Innovation to Market Deployement" , River Publishers, 2014.
2	Peter Waher, "Learning Internet of Things" ,Packt Publishing, 2015.
3	Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBoneBlack", McGraw Hill, 2015.

MAPPING WITH PROGRAMME OUTCOMES

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – II (II - SEMESTER)

Course code	23UPCSC2E12	INTERNET OF THINGS LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programs in IOT				

Course Objectives:

The main objectives of this course are:

1. To create IoT program to turn ON/OFF LED
2. To implement IoT program for object detection
3. To develop IoT programs for agricultural purpose
4. To create web server program for local hosting
5. To design IoT application for health monitoring

Expected Course Outcomes:

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

CO1	Implement IoT programs to turn ON/OFF LED	K1-K6
CO2	Develop IoT programs for object detection	
CO3	Create IoT programs for agricultural purpose	
CO4	Implement web server program for local hosting	
CO5	Design IoT application for health monitoring	

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

LIST OF PROGRAMS	30 hours

1. To develop an IoT program to turn ON/OFF LED light (3.3V)
2. To develop an IoT program using IR sensor (Smart Garbage Monitoring, Detecting Parking Availability, etc.)
3. To develop an IoT program using Humidity and Temperature Monitoring (Forest fire Detection, Weather Monitoring)
4. To develop an IoT web server program for local hosting
5. To develop an IoT program using Soil Moisture Sensor
6. To develop an IoT program using Ultrasonic Sensor (Distance Measurement, etc.)
7. To develop an real-time IoT program using Relay Module (Smart Home Automation with 230V)
8. To develop an IoT program for Fire Detection (Home, Industry, etc.)
9. To develop an IoT program for Gas Leakage detection (Home, Industry, etc.)
10. To develop an IoMT program using Heartbeat Sensor

Total Lecture hours	30 hours

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – II (II - SEMESTER)

Course code	23UPCSC2E13	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Cryptography and Network Security				

Course Objectives:

The main objectives of this course are:

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

Expected Course Outcomes:

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

CO1	Comprehend and analyze the security concepts to apply and evaluate the encryption techniques in various models	K1-K6
CO2	Understand and examine the various data encryption standards and number theory. Illustrate and evaluate the various techniques in different applications	
CO3	Grasp the knowledge of AES techniques and apply to evaluate the performance with different key types	
CO4	Comprehend and analyse the basics of hash function and MAC that helps to develop the encryption models in various application	
CO5	Understand and illustrate the need of digital signature to examine the method of providing good security to the document. And also learn the concept of key management	

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

Unit:1	Computer Security Concepts	12 hours

Overview: Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services – Security Mechanisms –A Model for Network Security – Classical Encryption Techniques: Symmetric Cipher Model
– Substitution Techniques – Transposition Techniques – Rotor Machines – Steganography.

Unit:2	Block Ciphers and the Data Encryption Standard	12 hours

Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure –The Data Encryption Standard – The DES Example – The Strength of DES – Block Cipher Design Principles –Basic Concepts in Number Theory and Finite Fields: Divisibility and the Division Algorithm – The Euclidean Algorithm – Modular Arithmetic – Groups, Rings, and Fields – Finite Fields of the Form GF(p) – Polynomial Arithmetic.

Unit:3	Advanced Encryption Standard	12 hours

Advanced Encryption Standard: Finite Field Arithmetic– AES Structure – AES Transformation Functions – AES Key Expansion –Block Cipher Operation: Multiple Encryption and Triple DES – Stream Ciphers – RC4 – Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems – The RSA Algorithm –Diffe-Hellman Key Exchange – Elgamal Cryptographic System – Elliptic Curve Arithmetic – Elliptic Curve Cryptography – Pseudorandom Number Generation Based on an Asymmetric Cipher.		
Unit:4	**Cryptographic Hash Functions**	**12 hours**
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions – Two Simple Hash Functions – Requirements and Security – Hash Functions Based on Cipher Block Chaining – Secure Hash Algorithm(SHA) – SHA-3 – Message Authentication Codes: Requirements – Functions – Security of MACs – MACs Based on Hash Functions: HMAC – MACs based on Block Ciphers: DAA and CMAC – Authenticated Encryption: CCM and GCM – Key Wrapping.		
Unit:5	**Digital Signatures**	**10 hours**
Digital Signatures – Elgamal Digital Signature Scheme – Schnorr Digital Signature Scheme – NIST Digital Signature Algorithm – Elliptic Curve Digital Signature Algorithm – RSA-PSS Digital Signature Algorithm – Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption – Symmetric Key Distribution Using Asymmetric Encryption – Distribution of Public Keys – X.509 Certificates – Public-Key Infrastructure.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	William Stallings, “Cryptography and Network Security – Principles and Practices”, Pearson Education / PHI, 7th Edition. 2017.
2	Behrouz A Forouzan, Debdeep Mukhopadhyay, “Cryptography And Network Security”, McGraw Hill Education, 3rd Edition.2015.
Reference Books	
1	Bernard Menezes, “Network Security and Cryptography”, Cengage,1st Edition, 2010.
2	William Stallings, “Cryptography and Network Security”, Pearson Education India, Sixth Edition, 2016.
3	V.K. Jain, “Cryptography and Network Security”, Khanna Book Publishing, New Delhi, 2016.
4	C.K. Shyamala, N. Harini, Dr. T. R. Padmanabhan, “Cryptography and Security”, Wiley India Pvt. Ltd.,2011

MAPPING WITH PROGRAMME OUTCOMES:

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

S – Strong, M – Medium, L - Low

ELECTIVE COURSE – II (II - SEMESTER)

Course code	23UPCSC2E14	CRYPTOGRAPHY AND NETWORK SECURITY LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming of Cryptography algorithms				

Course Objectives:

The main objectives of this course are:

1. To develop in classical encryption techniques and advanced encryption standards.
2. To acquire programming skills in Implement various cryptographic algorithms including secret key cryptography.
3. To develop hashes, message digests and public key algorithms.
4. Implement different encryption and decryption techniques.
5. To comprehend related to confidentiality and authentication techniques.

Expected Course Outcomes:

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

CO1	Comprehend the programming skills in classical encryption techniques and to develop advanced encryption standards	K1-K6
CO2	Understand and implement the various cryptographic algorithms including secret key cryptography, hashes and message digests	
CO3	Evaluate the use of different encryption and decryption techniques	
CO4	Design to Solve related confidentiality and authentication problems	
CO5	Create public key algorithms	

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

LIST OF PROGRAMS	30 hours

1. Write a program that contains a string (char pointer) with a value 'Hello world'. The program should XOR each character in the string with 0 and display the result
2. Write a program to perform encryption and decryption using the Ceaser Cipher
3. Write a program to perform encryption and decryption using the Hill Cipher
4. Write a program to perform encryption and decryption using the Vernam Cipher
5. Write a program to perform encryption and decryption using the Substitution Cipher
6. Write a program to perform encryption and decryption using the DES algorithm
7. Write a program to implement hash function using SHA algorithm

8.	Connect to switch with a computer and enable the port security	
9.	Implement signature scheme – Digital Signature Standard	
10.	Identify and capture the user name and password in a same network using wireshark	
	Total Lecture hours	**30 hours**

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – II (II - SEMESTER)

Course code	23UPCSC2E15	COMPUTER VISION	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Computer Vision and its Applications				

Course Objectives:

The main objectives of this course are:

1. To get understanding about Computer vision techniques behind a wide variety of real- world applications.
2. To get familiar with various Computer Vision fundamental algorithms and how to implement and apply.
3. To get an idea of how to build a computer vision application with Python language.
4. To understand various machine learning techniques that are used in computer vision tasks.
5. To incorporate machine learning techniques with computer vision systems.

Expected Course Outcomes:

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

CO1	Understand and recall computer vision and its application areas	K1-K6
CO2	Develop build a computer vision system	
CO3	Apply and analyze a design range of algorithms for image processing and computer vision	
CO4	Develop incorporate machine learning techniques with computer vision system	
CO5	Apply and analyze image segmentation and image registration	

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

Unit:1		12 hours

Basic Image Handling and Processing: PIL – the Python Imaging Library-Matplotlib-NumPy-SciPy-Advanced example: Image de-noising. **Local Image Descriptors:** Harris corner detector-SIFT - Scale-Invariant Feature Transform-Matching Geotagged Images.

Unit:2		12 hours

Image to Image Mappings: Homographies-Warping images-Creating Panoramas. **Camera Models and Augmented Reality:** The Pin-hole Camera Model-Camera Calibration-Pose Estimation from Planes and Markers-Augmented Reality.

Unit:3		12 hours

Multiple View Geometry: Epipolar Geometry-Computing with Cameras and 3D Structure-Multiple View Reconstruction-Stereo Images. **Clustering Images:** K-means Clustering-Hierarchical Clustering-Spectral Clustering.

Unit:4		12 hours

Searching Images: Content based Image Retrieval-Visual Words-Indexing Images- Searching the Database for Images-Ranking Results using Geometry-Building Demos and Web Applications. **Classifying Image Content:** K-Nearest Neighbors-Bayes Classifier-Support Vector Machines-Optical Character Recognition.

Unit:5		10 hours
Image Segmentation: Graph Cuts-Segmentation using Clustering-Variational Methods. **OpenCV:** Python Interface-OpenCV Basics-Processing Video-Tracking.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

	Text Books
1	Jan Erik Solem, "Programming Computer Vision with Python: Tools and Algorithms for Analyzing Images", O'REILLY Media, Inc. 2012.
	Reference Books
1	David A. Forsyth, Jean Ponce, "Computer Vision A Modern Approach", Second Edition, Pearson publication, 2012.
2	Xiaoyue Jiang, Abdenour Hadid, Yanwei Pang, Eric Granger, Xiaoyi Feng, "Deep Learning in Object Detection and Recognition", Springer, 2019.
3	Benjamin Planche and Eliot Andres, "Hands-On Computer Vision with TensorFlow 2: Leverage Deep Learning to Create Powerful Image Processing Apps with TensorFlow 2.0 and Keras", 2019.

Mapping with Programme Outcomes:

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

L - Low, M- Medium, S - Strong

ELECTIVE COURSE – II (II – SEMESTER)

Course code	23UPCSC2E16	COMPUTER VISION LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming of Computer Vision fundamental algorithms				

Course Objectives:

The main objectives of this course are:

1. To get an idea of how to build a computer vision application with Python language.
2. To learn the basic image handling and processing
3. To get familiar with various Computer Vision fundamental algorithms and how to implement and apply.
4. To get an idea of how to implement the image transforms.
5. To understand various image segmentation algorithms.

Expected Course Outcomes:

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

CO1	Develop and implement the image loading and exploring	K1-K6
CO2	Evaluate the image transforms	
CO3	Apply and analyze for image processing denoising algorithms	
CO4	Design and develop the Image Segmentation using Edge detection and Histograms	
CO5	Apply and analyze image clustering and classification algorithms	

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

LIST OF PROGRAMS — **30 hours**

Implement the following problems using Python with Open CV

1. Image Loading, Exploring, and displaying an Image.
2. Access and Manipulate of Image Pixels.
3. Image Transformations.
   i) Resizing
   ii) Rotation
4. Addition operation of Two Images.
5. Image filtering operations
   i) Mean Filtering
   ii) Gaussian Filtering
6. Image Binarization Using Simple Thresholding method.
7. Edge Detection operation using Sobel and Scharr Gradients.
8. Find Grayscale and RGB Histograms of an Image.
9. Segment an Image using K-means Clustering algorithm.

10. Write a program to classify an Image using KNN Classification algorithm.	
Total Lecture hours	**30 hours**

Mapping with Programme Outcomes:

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

L - Low, M- Medium, S - Strong

ELECTIVE COURSE – II (II - SEMESTER)

Course code	23UPCSC2E17	SOCIAL NETWORKS	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Social Networks and its Applications				

Course Objectives:

The main objectives of this course are to:

1. To learn about Social media, Social networking and Webcasts
2. To understanding and building a Word Press Powered Website
3. To analysis the Social Networking & Micro-Blogging.
4. To learn and analysis the Widgets & Badges.
5. To explore the importance of Website optimization.

Expected Course Outcomes:

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

CO1	Understand, impart and summarize the concepts of Social media, Social networking and Webcasts	K1-K6
CO2	Comprehend, design and develop a Word Press Powered Website	
CO3	Understand, implement and perform evaluation of Social Networking and Micro-Blogging	
CO4	Collaborate, implement and analyse the Widgets and Badges in social networking environment	
CO5	Understand, illustrate and perform evaluation of web optimization for social networks	

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

Unit:1	Social Media Strategy	12 hours

Introduction: Social Media Strategy-Important First Decisions -Websites, Blogs - RSS Feeds Mapping -Preparation - Multimedia Items Gathering Content for Blog Posts RSS Feeds & Blogs-RSS Feeds-The Feed Reader-The Feed-Options for Creating an RSS Feed-Planning Feed –Blogs-Options for Starting. Blog and RSS Feed-Feed or Blog Content-Search Engine Optimization (SEO)-Feed Burner-RSS Feed and Blog Directories-An Optimization Plan for Blog or RSS Feed

Unit:2	Word Press and Webcasting	12 hours

Building a Word Press Powered Website: Word Press as A CMS - Diversity of Word Press Sites-The Anatomy of a Word Press Site -a Brief Look at the Word Press Dashboard Planning - Site Themes Plug-ins setting up Sidebars Building Pages- Posting Blog Entries. Podcasting, Vidcasting, & Webcasting- Publishing Options for Podcast- Creating and Uploading Podcast Episodes-Publishing Podcast Optimizing Podcast- Webcasting.

Unit:3	Social Networking & Micro-Blogging	12 hours

Social Networking & Micro-Blogging: Facebook-The Facebook Profile -Myspace LinkedIn – Twitter-Niche Social Networking Sites-Creating Own Social Network-Promoting Social Networking Presence- Social Bookmarking & Crowd-Sourcing - Social Bookmarking-A Social

Bookmarking Strategy – Crowd-Sourced News Sites- Preparation And Tracking Progress Media Communities-Image Sharing Sites-Image Sharing Strategy-Video Sharing Sites-Video Sharing Strategy-Searching And Search Engine Placement-Connecting With Others.

Unit:4	**Widgets and Badges**	**12 hours**

Widgets and Badges: Highlighting Social Web Presence-Sharing And Syndicating Content Making Site More Interactive-Promoting Products And Making Money-Using Widgets In Word Press-Widget Communities And Directories- Working Widgets Into Strategy Social Media Newsrooms-Building Social Media Newsroom - Populating The Newsroom-Social Media News Releases-Social Media Newsroom Examples. More Social Tools-Social Calendars-Social Pages Wikis-Social Search Portals-Virtual Worlds.

Unit:5	**Website optimization**	**10 hours**

Website optimization: A Website Optimization Plan - Streamlining Web Presence-An Integration Plan- Looking to the Future-Life streaming: The Future of Blogging-Distributed Social Networking-Social Ranking, Relevancy, and - Defriending-Web 3.0 or The Semantic Web-Mobile Technology-Measuring Your Success-A Qualitative Framework-A Quantitative Framework-Tools to Help You Measure-Come To Your Own Conclusions.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**60 hours**

Text Books

1. Deltina hay -A Survival Guide To social Media and Web 2.0 Optimization‖, Dalton Publishing, 2009.

Reference Books

1. Miriam Salpeter ―Social Networking for Career Success‖ Learning Express, 2011.
2. Miles, Peggy, ―Internet world guide to webcasting‖ Wiley, 2008 Professionals", Wiley Publication, 2015.

Mapping with Programme Outcomes:

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

L - Low, M- Medium, S - Strong

ELECTIVE COURSE – II (II – SEMESTER)

Course code	23UPCSC2E18	SOCIAL NETWORKS LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming of Social Networks applications				

Course Objectives:

The main objectives of this course are:

1. To familiarize the tools required to manage social network applications
2. To analyze social networks like Facebook, LinkedIn, Google+, GitHub
3. To teach the fundamental techniques and principles in achieving social networking environment.
4. To enable students to have skills that will help them to solve real time applications.
5. To get explore in the Github API.

Expected Course Outcomes:

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

CO1	Understand, implement and review the fundamental techniques and principles for social networks.	K1-K6
CO2	Design and develop the programs using the tools required to develop and manage social network like Facebook, LinkedIn, Google+, GitHub	
CO3	Create and explore the functionality of social networking tools such as GitHub	
CO4	Understand, implement and review the fundamental principles for social network graph.	
CO5	Comprehend and critically analyse the existing API for social networks	

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

LIST OF PROGRAMS	30 hours

Implement the following problems using Python with OpenCV

1. Creating and Exploring Twitter's API
2. To analyzing and visualizing tweets and tweet entities with frequency analysis
3. Creating and Exploring Facebook's Social Graph API
4. To analyzing the Facebook's Social Graph connections
5. Creating and Exploring LinkedIn API
6. To downloading LinkedIn connections as a CSV file
7. Creating and Exploring Google+ API
8. To create and querying Human Language Data with TF-IDF
9. Creating and Exploring GitHub's API
10. To analyzing GitHub interest graph

Total Lecture hours	30 hours

Mapping with Programme Outcomes:

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

L - Low, M- Medium, S - Strong

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E19	CYBER SECURITY	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Cyber Security and its Applications				

Course Objectives:

The main objectives of this course are to:

1. To understand the basics of Cybercrime and Computer forensics with protecting mechanism
2. To explore the working principles of WLAN, Email and Smartphone along with security mechanism and guidelines
3. To gain the ability to understand the importance of cyber investigations with its functioning role and learn the basics of Wi Fi and its security measures
4. To understand and learn the method of seize the digital evidence
5. To learn and analyze the concepts of digital forensics with cybercrime prevention techniques

Expected Course Outcomes:

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

CO1	Understand, describe, analyze and examine the basics of Cyber security concepts and its implementation in India	K1-K6
CO2	Comprehend and demonstrate the security tips in browsers, WLAN, social networks, Email security and Smart phone. Apply the investigations in post mortem and Forensics	
CO3	Understand, apply and evaluate the various investigation roles and Wi Fi protecting mechanisms.	
CO4	Understand, illustrate and evaluate the method of seize the digital information and evidences forensics data and evaluate the forensics reports	
CO5	Comprehend, apply and appraise the methods digital forensics with cybercrime prevention techniques	

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

Unit:1	Cybercrime	12 hours

Introduction to cybercrime: Classification of cybercrimes – reasons for commission of cybercrime – malware and its type – kinds of cybercrime – authentication – encryption – digital signatures – antivirus – firewall – steganography – computer forensics – why should we report cybercrime – introduction counter cyber security initiatives in India – generating secure password – using password manager-enabling two-step verification – security computer using free antivirus.

Unit:2	Wireless LAN	12 hours

Tips for buying online: Clearing cache for browsers – wireless LAN-major issues with WLAN-safe browsing guidelines for social networking sites – email security tips – introduction-smart

phone security guidelines – purses, wallets, smart phones – platforms, setup and installation-communicating securely with a smart phone.		
Unit:3	**Cyber investigation roles**	**12 hours**
Cyber investigation roles**:** Introduction – role as a cybercrime investigator – the role of law enforcement officers – the role of the prosecuting attorney – incident response: introduction-post mortem versus live forensics – computer analysis for the hacker defender program-network analysis – legal issues of intercepting Wi-Fi transmission – Wi-Fi technology – Wi-Fi RF-scanning RF – eavesdropping on Wi-Fi – fourth amendment expectation of privacy in WLAN.		
Unit:4	**Seizure of digital information**	**12 hours**
Seizure of digital information: introduction – defining digital evidence – digital evidence seizure methodology – factors limiting the wholesale seizure of hardware – other options for seizing digital evidence – common threads within digital evidence seizure – determining the most appropriate seizure method– conducting cyber investigations–demystifying computer/cybercrime – IP addresses – the explosion of networking – interpersonal communication.		
Unit:5	**Digital forensics**	**10 hours**
Digital forensics and analyzing data: introduction – the evolution of computer forensics–phases of digital forensics-collection – examination-analysis – reporting – Cybercrime prevention: Introduction – crime targeted at a government agency.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

	Text Books
1	Dr. Jeetendra Pande, **"**Introduction to Cyber Security" Published by Uttarakhand Open University, 2017.(Chapter: 1.2-6.4,9.3-12.2)
2	Anthony reyes, Kevin o'shea, Jim steele, Jon R. Hansen, Captain Benjamin R. Jean Thomas Ralph, "Cyber-crime investigations" - bridging the gaps between security professionals, law enforcement, and prosecutors, 2007.(Chapter: 4, 5, 6, 7, 8, 9,10)
	Reference Books
1	Sebastian Klipper, "Cyber Security" Einblickfur Wirtschafts wissen schaftler Fachmedien Wiesbaden,2015
2	John G.Voller Black and Veatch, "Cyber Security" Published by John Wiley & Sons, Inc., Hoboken, New Jersey Published simultaneously in Canada ©2014.

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E20	Cyber Security Lab	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming Cyber Security Tools				

Course Objectives:

The main objectives of this course are:

1. To learn and implement to Change the wireless device mode as monitor mode
2. To develop in multiple vulnerabilities web server
3. To understand and implement the open ports in the network
4. To acquire programming skills in Implement various wireless device modes
5. To comprehend related to find the sub domains of webpage

Expected Course Outcomes:

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

CO1	Comprehend the programming skills in Change the wireless device mode as monitor mode	K1-K6
CO2	Understand and implement multiple vulnerabilities web server	
CO3	Evaluate the use of different wireless device modes	
CO4	Design to Solve related to find the sub domains of webpage	
CO5	Create and apply open ports in the network	

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

LIST OF PROGRAMS	30 hours

1. Install virtual box (kali Linux)
2. Generate a secure password using keepass
3. Change the wireless device mode as monitor mode
4. Find the known and open vulnerabilities of system using metaspolit
5. Identify the multiple vulnerabilities webserver using nikto tool
6. Identify the open ports in the network using nmap tools
7. List all the network around us and display the information about the networks
8. Sniff and capture the packet sent over HTTP requests
9. Find the owners of internet resources using Whois Lookup tool
10. Find the sub domains of webpage using knock tool

Total Lecture hours	30 hours

Mapping Course outcomes with Programme outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E21	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Block chain technologies and its Applications				

Course Objectives:

The main objectives of this course are:

1. To understand about Block chain is an emerging technology platform for developing decentralized applications and data storage.
2. To comprehend fundamentals of Public Key Cryptography technology and Consensus Algorithms.
3. To familiarize with Bitcoin Network, Bitcoin Clients, APIs and Payments technology of block chain operations.
4. To engage with Components of the Ethereum ecosystem.
5. To grasp about Development Tools and Frameworks.

Expected Course Outcomes:

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

CO1	Understand, apply and examine the characteristics of block chain, bitcoin and consensus algorithm in centralized and decentralized methods.	K1-K6
CO2	Comprehend and demonstrate the application of hashing and public key cryptography in protecting the block chain.	
CO3	Understand and analyse the elements of trust in a Block chain: validation, verification, and consensus.	
CO4	Comprehend and evaluate the alternate coin, Ethereum and smart contract.	
CO5	Grasp and apply the knowledge of Tools and languages for applications	

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

Unit:1	Blockchain, Decentralization	12hours

Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Blockchain - Consensus - CAP theorem and blockchain. **Decentralization:** Decentralization using blockchain - Methods of decentralization -Routes to decentralization - Blockchain and full ecosystem decentralization - Pertinent terminology - Platforms for decentralization - Innovative trends.

Unit:2	Public Key Cryptography, Consensus Algorithms and Smart Contracts	12hours

Public Key Cryptography: Asymmetric cryptography - Cryptographic constructs and blockchain technology. **Consensus Algorithms:** Introducing the consensus problem -Analysis and design - Classification - Algorithms - Choosing an algorithm. **Smart Contracts:** History - Definition -

Ricardian contracts - Smart contract templates – Oracles - Deploying smart contracts - DAO		
Unit:3	**Bitcoin**	**12hours**
Bitcoin: Bitcoin—an overview - Cryptographic keys - Transactions - Blockchain – Mining. **Bitcoin Network and Payments:** The Bitcoin network - Wallets - Bitcoin payments -Innovation in Bitcoin - Advanced protocols - Bitcoin investment and buying and selling Bitcoin. **Bitcoin Clients and APIs:** Bitcoin client installation - Experimenting further with bitcoin-cli - Bitcoin programming.		
Unit:4	**Alternative Coins**	**12hours**
Alternative Coins: Theoretical foundations - Difficulty adjustment and retargeting algorithms - Bitcoin limitations - Extended protocols on top of Bitcoin -Development of altcoins. **Ethereum: Ethereum –** an overview - Ethereum network - Components of the Ethereum ecosystem - Ethereum Virtual Machine (EVM) - Smart contracts. - Blocks and blockchain - Wallets and client - Nodes and miners - APIs, tools, and DApps - Supporting protocols - Programming languages.		
Unit:5	**Development Tools and Frameworks, Use Cases & Security**	**10hours**
Development Tools and Frameworks : Languages - Compilers - Tools and libraries - Frameworks - Contract development and deployment - Layout of a Solidity source code file - Solidity language. **Use Cases:** IoT – Government - Health -Finance – Media. **Scalability and Other Challenges:** Scalability - Privacy - Security - Other challenges.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60hours**
Text Books		
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder. Bitcoin and Crypto currency Technologies. Princeton University Press, 2016. ISBN 978-0691171692	
Reference Books		
1	Andreas Antonopoulos. Mastering Bitcoin: Programming the open block chain.Oreilly Publishers, 2017. ISBN 978-9352135745	

Mapping Course outcomes with Programme outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – III (III – SEMESTER)

Course code	23UPCSC2E22	BLOCKCHAIN TECHNOLOGIES LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming of Blockchain Algorithms				

Course Objectives:

The main objectives of this course are:

1. To learn the basics of Blockchain and apply cryptographic algorithms
2. To design, build, and deploy smart contracts and distributed applications,
3. To deploy Private Blockchain and smart contracts on Ethereum.
4. To understand and deploy crypto currencies and their functions in applications
5. To implement Blockchain for various use cases.

Expected Course Outcomes:

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

CO1	Enable to setup your own private Blockchain and deploy smart contracts on Ethereum.	K1-K6
CO2	Gains familiarity and implement with cryptography and Consensus algorithms.	
CO3	Create and deploy projects using Web3j.	
CO4	Recall and deploy the structure and mechanism of Bitcoin, Ethereum, Hyperledger	
CO5	Implement Blockchain for various use cases	

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

LIST OF PROGRAMS	30 hours

1. Create a Public Ledger and Private Ledger with the various attributes like Access, Network Actors, Native token, Security, Speed and examples.
2. Building and Deploying MultiChain private Blockchain
3. Write Hello World smart contract in a higher programming language (Solidity)
4. Construct the Naïve block chain
5. Construct and deploy your contract (Use deploy method)
6. Set up a Regtest environment
7. Build a payment request URI
8. Hashcash implementation
9. Develop a toy application using Blockchain

10. Create simple wallet transaction from one account to another account using Metamask.	
Total Lecture hours	**30 hours**

MAPPING WITH PROGRAMME OUTCOMES:

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

S – Strong, M – Medium, L - Low

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E23	OPTIMIZATION TECHNIQUES	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Optimization Techniques and its various Models				

Course Objectives:

The main objectives of this course are:

1. To understand the concept of Linear optimization
2. To develop mathematical models of transportation and assignment Problems
3. To understand the Networking models
4. To study non-linear optimization models
5. To develop optimization algorithms based on Evolutionary concepts

Expected Course Outcomes:

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

CO1	Understand, apply and examine the characteristics of blockchain, bitcoin and consensus algorithm in centralized and decentralized methods.	K1-K6
CO2	Comprehend and demonstrate the application of hashing and public key cryptography in protecting the blockchain.	
CO3	Understand and analyse the elements of trust in a Blockchain: validation, verification, and consensus.	
CO4	Comprehend and evaluate the alternate coin, Ethereum and smart contract.	
CO5	Grasp and apply the knowledge of Tools and languages for applications.	

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

Unit:1	Linear Programming Problem	12 hours

Linear Programming Problem (LPP): Mathematical Formulation of Linear Programming Problem - Graphical Solution of LPP - canonical and standard forms of linear programming problem- Simplex method for solving LPP

Unit:2	Transportation and Assignment Problems	12 hours

Transportation Model: North West corner Method, Least cost method, and Vogel's Approximation Method. Assignment Model : Hungarian assignment model – Travelling Sales Man Problem.

Unit:3	CPM/PERT	12 hours

Project Scheduling PERT/CPM Networks – Fulkerson's Rule – Measure of Activity –PERT Computation – CPM Computation – Resource Scheduling.

Unit:4	Non-Linear Optimization Models	12 hours

Simplex Method – Gradient of function – Steepest Descent method – Conjugate Gradient method.

Unit:5	Evolutionary Algorithms	10 hours

Particle Swarm Optimization method – Ant Colony optimization algorithm – Fruit Fly method – Fire Fly method.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60hours**
Text Books		
1	. Kanti Swarup, P. K. Gupta and Man Mohan, Operations Research, Sultan Chand and Sons, New Delhi, 2014. (Unit 1, 2, and 3)	
2	S. S. Rao, Engineering Optimization: Theory and Practice, JOHN WILEY & SONS, INC., 2009. (Unit 4)	
3	Bo Xing and Wen-Jing Gao, Innovative Computational Intelligence: A Rough Guide to Clever Algorithms, Springer, 2014.(Unit 5)	
Reference Books		
1	Hamdy A. Taha, Operations Research: An Introduction, Pearson, 2010.	

MAPPING WITH PROGRAMME OUTCOMES

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E24	OPTIMIZATION TECHNIQUES LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming of Optimization algorithms				

Course Objectives:

The main objectives of this course are:

1. To Grasp optimization principles for real time problems
2. Translate real world issues in to mathematical models
3. Study diverse optimization algorithms and their applications
4. Understand and apply optimization algorithms effectively
5. Enhance problem solving skills using optimization techniques

Expected Course Outcomes:

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

CO1	Define optimization problem efficiently in various domain	K1-K6
CO2	Create accurate mathematical models for algorithmic solutions	
CO3	Comprehend applications of various optimization algorithms.	
CO4	Apply algorithms adeptly to solve diverse problems.	
CO5	Select appropriate algorithms for specific optimization problems	

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

LIST OF PROGRAMS	30 hours

Implement the following algorithms using Python

1. Simplex algorithm
2. North-West Corner algorithm
3. Least Cost algorithm
4. Vogel's Approximation Algorithm
5. Modi algorithm
6. Hungarian assignment Algorithm
7. Travelling Sales man algorithm
8. Steepest Descent algorithm
9. Conjugate gradient algorithm
10. Ant Colony algorithm

Total Lecture hours	30 hours

Mapping Course outcomes with Programme outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E25	SOLUTION ARCHITECTURE	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of Solution Architecture and its Considerations				

Course Objectives:

The main objectives of this course are:

1. To get familiar with the evolution of solution architecture
2. To outline the functionalities of Solution Architecture Design
3. To assess the Performance Considerations of Solution Architecture
4. To analyze the Architectural Reliability Considerations
5. To identify the design principles for cost optimization

Expected Course Outcomes:

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

CO1	Comprehend the types, benefits and attributes of solution architecture	K1-K6
CO2	Assess the cloud architecture and create hybrid cloud architecture	
CO3	Analyze the design patterns for solution architecture	
CO4	Understand Architecture Reliability and Operational Excellence	
CO5	Optimize the cost in cloud and assess the legacy system	

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

Unit:1	Evolution of Solution Architecture	12 hours

Evolution of solution architecture - The benefits of solution architecture - Solution architecture in the public cloud - Solution Architects in an Organization - Types of solution architect role - Understanding a solution architect's responsibilities - Attributes of the Solution Architecture - Scalability and elasticity - Security and compliance - Cost optimization and budget.

Unit:2	Principles of Solution Architecture Design	12 hours

Principles of Solution Architecture Design - Scaling workload - Building resilient architecture - Design for performance - Using replaceable resources - Cloud Migration and Hybrid Cloud Architecture Design - Benefits of cloud-native architecture - Creating a cloud migration strategy - Steps for cloud migration - Creating a hybrid cloud architecture - Designing a cloud-native architecture.

Unit:3	Solution Architecture Design Patterns	12 hours

Solution Architecture Design Patterns - Building an n-tier layered architecture - Creating multi-tenant SaaS-based architecture - Building stateless and stateful architecture designs - Understanding SOA - Performance Considerations - Design principles for architecture performance - Technology selection for performance optimization - Managing performance monitoring.

Unit:4	Architectural Reliability Considerations	12 hours

Architectural Reliability Considerations - Design principles for architectural reliability - Technology selection for architecture reliability - Improving reliability with the cloud - Operational Excellence Considerations - Designing principles for operational excellence - Selecting technologies for operational excellence - Achieving operational excellence in the public cloud.		
Unit:5	**Cost Considerations and Legacy Systems**	**10 hours**
Cost Considerations - Design principles for cost optimization - Techniques for cost optimization - Cost optimization in the public cloud - Architecting Legacy Systems - Learning the challenges of legacy systems - Defining a strategy for system modernization - Looking at legacy system modernization techniques - Defining a cloud migration strategy for legacy systems.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Saurabh Shrivastava and Neelanjali Srivastav, " Solutions Architect's Handbook", Packt Publishing, 2020.
Reference Books	
1	Alan McSweeney , "Introduction to Solution Architecture", Kindle Edition, 2019.
2	Bernard, Scott A. An introduction to holistic enterprise architecture. Author House, 2020.

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E26	SOLUTION ARCHITECTURE LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming of AWS Solution Architecture				

Course Objectives:

The main objectives of this course are:

1. To get familiar with AWS cloud services
2. To design secure, scalable, and well-structured cloud solutions
3. To create EC2 instance and configure options
4. To connect EC2 with Linux instance
5. To connect VPN server to securely access instances

Expected Course Outcomes:

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

CO1	Understand AWS cloud services and manage the cloud data	K1-K6
CO2	Develop secure, scalable, and well-structured cloud solutions	
CO3	Implement EC2 instance and configure the instance	
CO4	Connect EC2 with Linux instance and perform operations	
CO5	To connect VPN server to access instances with more security	

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

LIST OF PROGRAMS	30 hours

Implement the following s

1. Managing Virtual Private Cloud
2. Creating and Configuring Internet Gateways
3. Configuring Routing Tables
4. Working with Amazon Elastic Cloud Compute (EC2)
5. Connecting EC2 Linux instance using PuTTY, Gitbash and Console
6. Recovering and connecting EC2 instance if the SSH key is lost
7. Creating and Configuring Elastic Load Balancer
8. Scheduling Auto Snapshot of volumes
9. Configuring Centralized Log Management using Cloud Watch Log
10. Connecting OpenVPN server

Total Lecture hours	30 hours

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E27	HIGH PERFORMANCE COMPUTING	L	T	P	C
Core / Elective		Elective	3			3
Pre-requisite		Basics of High Performance Computing and its Applications				

Course Objectives:

The main objectives of this course are:

1. To get a clear idea of High Performance Computing concept.
2. To get brief knowledge about how to function the HPC systems.
3. To get idea of what techniques used in HPC models.
4. To understand a Parallel computing concepts.
5. To get familiar with OpenMP technology that is widely used in HPC technology.

Expected Course Outcomes:

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

CO1	Understand of the HPC and ccNUMA concepts	K1-K6
CO2	Design and develop a parallel programming with modern C, C++ and new version of FORTRAN	
CO3	Apply with parallel computing	
CO4	Develop an efficient OpenMP programming	
CO5	Evaluate an efficient MPI programming	

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

Unit:1	Modern processors	12 hours

Modern processors: Stored-program computer architecture-General purpose cache based microprocessor architecture-Memory hierarchies-Multi core processors-Multithreaded processors-Vector processors. **Basic optimization techniques for serial code:** Scalar profiling-Common sense optimizations-Simple measures, large impact-The role of compilers-C++ optimizations.

Unit:2	Data access optimization	12 hours

Data access optimization: Balance analysis and light speed estimates-Storage order-Algorithm classification and access optimizations-The Jacobi algorithm-Algorithm classification and access optimizations-Sparse matrix-vector multiply. **Parallel computers:** Taxonomy of parallel computing paradigms-Shared-memory computers-Distributed memory computers-Hierarchical systems-Networks.

Unit:3	Basics of parallelization	12 hours

Basics of parallelization: Introduction to Parallelism -Parallel scalability. **Shared memory parallel programming with OpenMP:** Short introduction to OpenMP-OpenMP-parallel Jacobi algorithm.

Unit:4	Efficient OpenMP programming	12 hours

Efficient OpenMP programming: Profiling OpenMP programs-Performance pitfalls-Parallel sparse matrix-vector multiply. **Locality optimizations on ccNUMA architectures:** Locality of access on ccNUMA-ccNUMA optimization of sparse MVM-Placement pitfalls-ccNUMA issues with C++.		
Unit:5	**Distributed-memory parallel programming with MPI**	**10 hours**
Distributed-memory parallel programming with MPI: Message passing-A short introduction to MPI-MPI parallelization of a Jacobi solver. **Efficient MPI programming:** MPI performance tools-Communication parameters-Synchronization, serialization, contention-Reducing communication overhead-Understanding intranode point-to-point communication.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Georg Hager, Gerhard Wellein "Introduction to High Performance Computing for Scientists and Engineers", CRC Press, 2011. **Chapters:** 1 to 10.
Reference Books	
1	Michael W. Berry, Kyle A. Gallivan, Efstratios Gallopoulos, Ananth Grama, Bernard Philippe, Yousef Saad, Faisal Saied, "High-performance scientific computing: algorithms and applications", Springer, 2012.
2	Victor Eijkhout, "Introduction to High Performance Scientific Computing", MIT Press, 2011.

MAPPING WITH PROGRAMME OUTCOMES:

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

L - Low, M- Medium, S - Strong

ELECTIVE COURSE – III (III - SEMESTER)

Course code	23UPCSC2E28	HIGH PERFORMANCE COMPUTING LAB	L	T	P	C
Core / Elective		Elective			2	1
Pre-requisite		Basic Programming Linux and Windows				

Course Objectives:

The main objectives of this course are:

1. To understand concepts of High Performance Computing.
2. To get brief knowledge about PB and Slurm.
3. To understand techniques of OpenMP and OpenMPI.
4. To understand Parallel computing concepts.
5. To get familiar with CUDA.

Expected Course Outcomes:

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

CO1	Apply and Evaluate the HPC Programs	K1-K6
CO2	Design and Develop a MPI Programs	
CO3	Design and Develop a different programming concepts of OpenMP	
CO4	Develop an efficient PB and Slurm programming	
CO5	Evaluate an efficient CUDA programming	

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

LIST OF PROGRAMS	30 hours

(Implemented either PB, Slurm, OpenMP, OpenMPI, and CUDA)

1. Demo: - Access and best practices on HPC
2. Matrix multiplication with Job scheduling (PB or Slurm)
3. Vectors add with malloc shared
4. Vector add program with MPI
5. Hello world task for Multithreading with openMP
6. openMP shared memory on Host and Device
7. openMP Matrix Multiplication with parallelism and Barrier
8. openMP with Reduction on operands and aggregate functionality
9. Vector and Matrix multiplication on CUDA
10. Feed forward computing on CUDA

Total Lecture hours	30 hours

MAPPING WITH PROGRAMME OUTCOMES:

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

L - Low, M- Medium, S - Strong

SEMESTER II

Subject Code: 23UPCSC2P01 **Credits: 02**

Professional Competency Skill – Mini Project

Subject Code: 23UPCSC2X01 **Credits: 01**

Extension Activity - Internet Safety and protecting personal information

The following activities may be carried out (Internal evaluation only)

1. Understanding online threats
2. Online privacy basics
3. Securing personal information
4. Safe browsing practices
5. Managing online presence

SEMESTER III

Subject Code: 23UPCSC2I01 **Credits: 02**

Internship / Industrial Activity

SEMESTER IV

Subject Code: 23UPCSC2P02 **Credits: 02**

Project with Viva Voce

Subject Code: 23UPCSC2I02 **Credits: 02**

Credit Seminar (Industry / Entrepreneurship)

Student should attend any lecture series / workshop / panel discussion / presentation on specific subject and submit the report with detailed description

NON-MAJOR ELECTIVE – II
(Supportive Course)

Advanced Microsoft Office Lab

Course Code: 23UPCSC1N01 **Credit: 2**

List of Programs

MS-Word:

1. Design an admission/enquiry form using shapes, textbooks, colors, tables with formatting options.
2. Design a text book with cover page, content page and text using indenting options, rulers, page layout, header/footer and hyperlinks.
3. Design Newspaper advertisement with images and texts.
4. Design mark statement copy using tables, images and watermarks.
5. Design conference/seminar invitation with logos, formatting options, margins and borders.
6. Write a Research article with Chart, Tables, Symbols, Equations and References.

MS-Excel:

7. Design an application for student Exam Result using Data validation, Aggregate functions and Conditional formatting.
8. Prepare Cost-Benefit Analysis for an organization using Statistical tools.
9. Develop an application to predict population of a city using analysis Macros.

MS- Access:

10. Design an Employee payroll system with Forms and Reports using Macros.
11. Develop relational integrity databases.
12. Develop applications which automatically update a table using Triggers.
13. Design an inventory database and generate conditional report.

MS-PowerPoint:

14. Prepare a presentation with embedding multimedia objects.
15. Prepare presentation with slide layout, animations, font effects, hyperlinks.

MS-Publisher:

16. Prepare an academic calendar for an institution.

Reference Books:

1. Lisa A. Bucki, “MS Office 2013 Bible”, Wiley Publications, 2013.
2. Richard Mansfield, “Mastering VBA for Microsoft office 2016”, Wiley Publications, 2016.
3. Wayne L. Winston, “Microsoft Excel Data Analysis and Business Modeling”, PHI, 2017.
4. Manisha Nigam, “Data Analysis with Excel”, BPB Publications, 2019.
5. Michael Alexander and Dick Kusleika, “Excel Power Programming with VBA”, Wiley Publications, 2016.
6. Michael Alexander and Dick Kuskeika, “Access the Comprehensive tutorial guide”, Wiley Publications, 2016.

NON-MAJOR ELECTIVE – II

Course Code: 23UPCSC1N02 Biopython Programming Lab Credit: 2

List of Programs

Implement the following in Python:

1. Program to implement Functions.
2. Program to perform Basic Operations on Sequence objects.
3. Program to perform Operations on Sequence annotation objects.
4. Program to perform Operations on Sequence Input/Output.
5. Program to perform Operations on Multiple Sequence Alignment objects.
6. Program to perform Operations on BLAST.
7. Program to perform Sequence motif analysis.
8. Program to perform Cluster analysis.
9. Program to perform Supervised learning methods.
10. Program to perform Genome Data visualization.

References

1. Via, A., Rother, K., & Tramontano, A. (2014). Managing your biological data with Python. Chapman and Hall/CRC.
2. Rocha, M., & Ferreira, P. G. (2018). Bioinformatics Algorithms: Design and Implementation in Python. Academic Press.
3. Chun, W. (2001). Core python programming (Vol. 1). Prentice Hall Professional.