PERIYAR UNIVERSITY

Periyar Palkalai Nagar, Salem-636011

(NAAC A Grade-STATE UNIVERSITY – NIRF RANK 68)

DEPARTMENT OF COMPUTER SCIENCE

M.Sc. DEGREE

COMPUTER SCIENCE (DATA ANALYTICS)

[Choice Based Credit System (CBCS)]

OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2019-20 and thereafter)

M. Sc. COMPUTER SCIENCE (DATA ANALYTICS)

OBE REGULATIONS AND SYLLABUS

(With effect from the academic year 2019-2020 onwards)

1. Preamble

The **M. Sc-Computer Science (Data Analytics**) programme is aimed at preparing computer professionals for research, academics, design, and development in analytical technologies. The main objective of this programme is to engender software developers for high end IT services, exceptional researchers for research labs in compliance with the highest global standards.

2. General Graduate Attributes

GA 1: The fundamental knowledge

- This refers to a group of concepts associated with the discipline of computer science and how they are applied in user interfaces.
- Initially, students learn about basic concepts of algorithms, programming language, and user interface.
- To develop in-depth knowledge about the data analytics concept through course work.

GA 2: Design and conduct experiments

- To apply the principles of data science to real-world problems.

GA 3: Software and tools

- A proficient user of existing computing tools.
- A proficient developer of new computing tools.
- A competent analyzer, processor, and reporter of simple and complex data.

GA 4: Solve computer science problems

- Be equipped with a range of fundamental principles of Computer Science that will provide the basis for future learning and enable them to adapt to the constant rapid development of the field.
- Be able to apply mathematics, logic, and statistics to the design, development, and analysis of software systems.
- Be able to apply ethical practices in handling data of any kind.

GA 5: To apply algorithmic principles

- Identifies the key intellectual themes of the field as algorithmic thinking, information representation, and computer programs.

GA 6: To acquire the latest technical skills

- To enable the students to acquire the latest technical skills and build their carrier based on continuous learning and adaptability.

GA 7: Theoretical and practical knowledge

- Theoretical knowledge refers to learning things, concept, principle, information regarding anything from books. It means that the theoretical knowledge is knowledge which is basic knowledge or concept of things.
- Practical knowledge and Practical skills are two different things. Practical knowledge is the knowledge in which we can apply and implement ideas using practices.
- Be able to apply algorithms such as clustering and classification to sample dataset
- To build machine intelligence algorithm for solving complex decision-making problems

GA 8: Leadership, initiative, and teamwork:

- Ability to work effectively in a team and lead in a multidisciplinary environment

GA 9: Creative:

- Demonstrates critical thinking, imagination, and intellectual agility.
- Strives to be innovative and experimental in advancing knowledge and in creating solutions.

GA 10: Specialist:

- Possesses breadth and depth of knowledge in their specialist area.
- Applies through research and inquiry a systematic and critical approach
- Analytical approach to identifying and resolving problems.

GA 11: Intellectual Rigour

- An ability to think clearly and deeply with rigour when faced with new knowledge and arguments.
- Demonstrate an ability to apply legal research results to solve legal problems.
- Developing a shared understanding of intellectual rigour

GA 12: Knowledge of a discipline

- Develop the capability of demonstrating comprehensive and considered knowledge of the discipline.
- Enables students to evaluate and utilize information and apply their disciplinary knowledge and their professional skills in the workplace.

3. Programme Specific Qualification Attributes

Mention the programme specific qualification attributes achieved through courses in the programme in terms of

- **Knowledge and understanding level (K1 and K2)**
  - Remember or recognize a term or a basic concept
  - Select an explanation for a statement related to the question topic
  - Understand the existing problems

- **Application-level (K3)**
  - Be able to solve the problems using computing techniques.

- **Analytical level (K4)**
  - Be able to separate information related to a procedure or technique into its constituent parts for better understanding and can distinguish between facts and inferences.

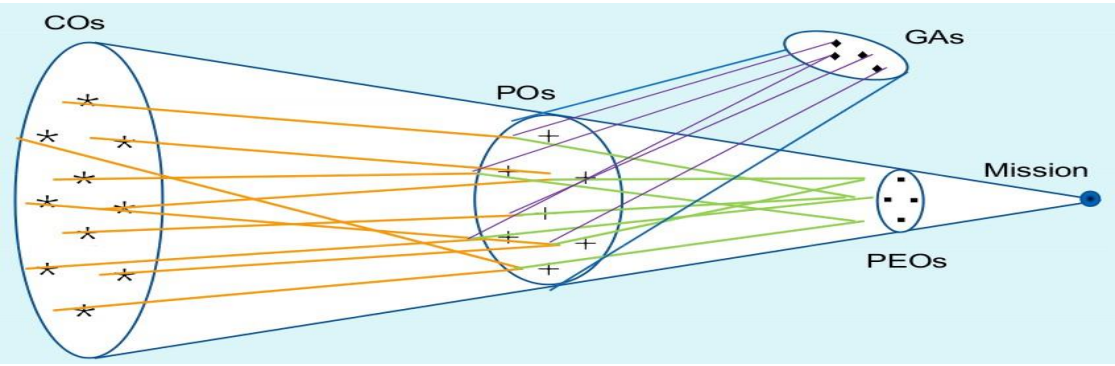
- **Evaluation capability level (K5)**
  - Be able to make judgments based on criteria and standards. Detects inconsistencies or fallacies within a process or product, determines whether a process or product has internal consistency and detects the effectiveness of a procedure as it is being implemented.

- **Scientific or synthesis level (K6)**
  - A scientific way to analyze and solve the problems.

4. Vision

Achieving excellence in Information Technology Enabled Services through Teaching, Research, Extension, and Consultancy.

It must be linked like this



Mission is the Programme Specific Objectives, GAs – Graduate attributes (general)

5. Programme Objectives and Outcomes

Spelt the PEOs (Programme Educational Objectives), Programme Specific Objectives (PSOs) and Programme Outcomes (POs)

Programme Educational Outcomes (PEOs) for M.Sc Computer Science (Data Analytics) are as follows

PEO1: Apply algorithmic, mathematical and scientific reasoning to a variety of computational problems

PEO2: Implement software systems that meet specified design and performance requirements.

PEO3: Work effectively in teams to design and implement solutions to computational problems

PEO4: Communicate effectively, both orally and in writing. Design, correctly implement and document solutions to significant computational problems

Programme Specific Outcomes (PSOs) for M.Sc Computer Science (Data Analytics) are as follows

PSO1: An ability to apply profound knowledge to analyze and design software and systems containing hardware and software components of varying complexity.

PSO2: An ability to apply mathematical model, algorithmic principles, and computer science theory in the design of real-time applications

Programme Outcomes (POs) for M.Sc Computer Science (Data Analytics) are as follows

PO1: Gain the skills and knowledge required to operate your computer and perform common tasks. This basic computer skills course will allow you to gain an understanding of the most popular, current technologies used at home and in the workplace.

PO2: The objective was set as training the students to use mathematical knowledge they have to designing and conducting 'Development Experiments' as well as analyzing and interpreting data using the Scientific Method.

PO3: Engage in effective software development practices over the entire system lifecycle including requirements, analysis, design, implementation, and testing.

PO4: Apply problem-solving skills and the knowledge of computer science to solve real problems

PO5: Apply algorithmic reasoning to a variety of computational problems. Design, correctly implement and document solutions to significant computational problems

PO6: Learn new Programming concepts and coding skills are now essential for the high-tech industry. Everything is about new ways to build and use products and services that are more intuitive.

PO7: Theoretical knowledge and practical knowledge can often lead to a deeper understanding of a concept through seeing it in the context of a greater whole and understanding the why behind it.

PO8: Students will develop *critical* thinking skills. Students will develop an understanding of change *processes* and be able to think critically about obstacles to change.

PO9: Seeks and Progresses opportunities for change and growth. Is flexible and able to adapt to rapidly changing environments

PO10: It is a critical field that promotes systematic ways to design, evaluate, and manage computing solutions.

PO11: Intellectual rigour is encouraged for example during an assessment exercise where a debate or discussion occurs about a challenging topic.

PO12: Knowledge of a discipline is defined as "command of a discipline to enable a smooth transition and contribution to professional and community settings.

PEO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1												
PEO2												
PEO3												
PEO4												

PO-GA MAPPING:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1												
PO2												
PO3												
PO4												
PO5												
PO6												
PO7												
PO8												
PO9												
PO10												
PO11												
PO12												

6. Candidate's eligibility for admission

A candidate who has passed Bachelors degree in Computer Science/ Computer Technology/ Software Engineering/ BCA under 10+2+3 system 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 (Data Analytics)** degree examination of this University after a course of study of two academic years.

7. Duration of the programme

The programme for the degree of **Master of Science in COMPUTER SCIENCE (DATA ANALYTICS)** shall consist of **two Academic years** divided into four semesters. Each semester consists of 90 working days.

8. CBCS- Structure of the Programme

The programme structure comprises of two parts.

Course Component	No. of Courses	Hours of Learning/ Week	Marks	Credits
Part A (Credit Courses)				
Core Courses	10	40	1000	40
Elective Courses	05	20	500	20
Supportive Courses	1	3	100	3
Core - Practical	7	16	700	14
Project	1	-	200	16
Online Courses	3	3		
Total				**93**
Part B (Self-Learning Credit Courses)				
Elective Foundation Courses				
Total				

Core Courses (CC):

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
19UPCSC3C01	Design and Analysis of Algorithm	CC	3	1	-	4
19UPCSC3C02	Advanced Web Technology	CC	3	1	-	4
19UPCSC3C03	Advanced Database	CC	3	1	-	4
19UPCSC3C04	Compiler Design	CC	3	1	-	4
19UPCSC3C08	Distributed Operating System	CC	3	1	-	4
19UPCSC3C09	Advanced Java Programming	CC	3	1	-	4
19UPCSC3C10	Cryptography and Network Security	CC	3	1	-	4
19UPCSC3C13	Digital Image Processing	CC	3	1	-	4
19UPCSC3C14	Internet of Things	CC	3	1	-	4
19UPCSC3C15	Machine Learning	CC	3	1	-	4

Elective Courses (EC):

Course code	Name of the Course	Category	No. of Hours /Week			Credits
			L	T	P	
THEORY						
	Elective-I					
19UPCSC3E01	Discrete Mathematics for Computing	EC	3	1	-	4
19UPCSC3E02	Statistical Computing					
19UPCSC3E03	Fundamentals of Data Science					
19UPCSC3E04	Data Visualization Techniques					
	Elective-II					
19UPCSC3E05	Predictive Analytics	EC	3	-	-	3
19UPCSC3E06	Predictive Analytics Lab		-	-	2	1
19UPCSC3E07	Text Analytics		3	-	-	3
19UPCSC3E08	Text Analytics Lab		-	-	2	1
19UPCSC3E09	Web Analytics		3	1	-	4
19UPCSC3E10	Market Analytics		3	1	-	4
	Elective-III					
19UPCSC3E11	Operations Research	EC	3	-	-	3
19UPCSC3E12	Operations Research Lab		-	-	2	1
19UPCSC3E13	Optimization Techniques		3	1	-	4
19UPCSC3E14	Probability and Stochastic Process		3	1	-	4
19UPCSC3E15	Linear Programming		3	1	-	4

	Elective-IV			
19UPCSC3E16	Big Data Analytics		3 - -	3
19UPCSC3E17	Big Data Analytics Lab		- - 2	1
19UPCSC3E18	Information Retrieval	EC	3 1 -	4
19UPCSC3E19	Natural Language Computing		3 - -	3
19UPCSC3E20	Natural Language Computing Lab		- - 2	1
19UPCSC3E21	Image and Video Analytics		3 1 -	4
	Elective-V			
19UPCSC3E22	Social Networking and Mining		3 1 -	4
19UPCSC3E23	Web Intelligence	EC	3 1 -	4
19UPCSC3E24	Deep Learning Techniques		3 1 -	4
19UPCSC3E25	Bioinformatics		3 1 -	4

Course code	**Name of the Course**	**Category**	**No. of Hours / Week**			**Credits**
			L	**T**	**P**	
THEORY						
	Supportive-I	SC	3	-	-	3

Core - Practical (CP):

Course code	**Name of the Course**	**Category**	**No. of Hours**			**Credits**
			L	**T**	**P**	
19UPCSC3C05	Algorithm – Lab	CP	-	-	4	2
19UPCSC3C06	Advanced Web Technology – Lab	CP	-	-	4	2
19UPCSC3C07	Statistical Computing – Lab	CP	-	-	3	2
19UPCSC3C11 *	Advanced Java-Lab	CP	-	-	4	2
19UPCSC3C12*	Data Analytics using R – Lab	CP	-	-	4	2
19UPCSC3C16*	Image Processing – Lab	CP	-	-	4	2
19UPCSC3C17 *	Mini Project -Machine Learning	CP	-	-	4	2
19UPCSC3C20	Soft Skill Development – Lab	CP	-	-	2	2

Online Courses (OC):

Course code	**Name of the Course**	**Category**	**No. of Hours / Week**			**Credits**
			L	**T**	**P**	
	SWAYAM/MOOC-I	OC	-	-	1	
	SWAYAM/MOOC-II	OC	-	-	1	
	SWAYAM/MOOC-III	OC	-	-	1	

9. Curriculum structure for each semester as per your courses alignment

Course	L T P	No. of Hours / Week	Number of Credits
Semester-I			
Core Course- 19UPCSC3C01 Design and Analysis of Algorithm	3+1+0	4	4
Core Course- 19UPCSC3C02 Advanced Web Technology	3+1+0	4	4
Core Course- 19UPCSC3C03 Advanced Data Base Management Systems	3+1+0	4	4
Core Course- 19UPCSC3C04 Compiler Design	3+1+0	4	4
Elective-I	3+1+0	4	4
Core Course-19UPCSC3C05 Algorithm – Lab	0+0+4	4	2
Core Course-19UPCSC3C06 Advanced Web Technology – Lab	0+0+4	4	2
Core Course- 19UPCSC3C07 Statistical Computing – Lab			2
SWAYAM / MOOC -01 (Optional)			
Total			26
Semester-II			
Core Course- 19UPCSC3C08 Distributed Operating System	3+1+0	4	4
Core Course- 19UPCSC3C09 Advanced Java Programming	3+1+0	4	4
Core Course- 19UPCSC3C10 Cryptography and Network Security	3+1+0	4	4
Elective-II	3+1+0	4	4
Elective-III	3+1+0	4	4
Non-major Elective / Supportive Course	3+1+0	4	4
Core Course- 19UPCSC3C11 * Advanced Java-Lab	0+0+4	4	2
Core Course- 19UPCSC3C12* Data Analytics using R – Lab	0+0+4	4	2
Core Course- 19UPCSC3C20 Soft Skill Development – Lab	0+0+2	2	2
Human Rights*			
SWAYAM / MOOC - 02 (Optional)			

Total			30
Semester-III			
Core Course- 19UPCSC3C13 Digital Image Processing	3+1+0	4	4
Core Course- 19UPCSC3C14 Internet of Things	3+1+0	4	4
Core Course- 19UPCSC3C15 Machine Learning	3+1+0	4	4
Elective-IV	3+1+0	4	4
Elective-V	3+1+0	4	4
Core Course- 19UPCSC3C16* Image Processing – Lab	0+0+4	4	2
Core Course- 19UPCSC3C17 * Mini Project -Machine Learning	0+0+4	4	2
SWAYAM / MOOC -03 (Optional)			
Total			24

Semester-IV			
Option-I			
Core Course- 19UPCSC3C18 Dissertation and Viva Voice (Industry/Research)	-	-	16
Option-II			
Elective-VI	3+1+0	4	4
Elective-VII	3+1+0	4	4
Core Course-19UPCSC3C19 Dissertation and Viva-Voce(Industry/Research)	-	-	8
Total			16
Total no of Credits: **Core**			40
Elective			20
Practical			16
Supportive			3
Project			16
Grand Total			95

10. Credit Calculation

Method of teaching	Hours	Credits
Lecture	1	1
Tutorial/Demonstration	1	1

Practical/Internship/self-Learning	2	1

CBCS – Scheme of Examinations semester wise structure

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
Semester-I						
Core Course-19UPCSC3C01 Design and Analysis of Algorithm	4	4	3	25	75	100
Core Course- 19UPCSC3C02 Advanced Web Technology	4	4	3	25	75	100
Core Course- 19UPCSC3C03 Advanced DataBase Management Systems	4	4	3	25	75	100
Core Course-19UPCSC3C04 Compiler Design	4	4	3	25	75	100
Elective-I	4	4	3	25	75	100
Core Course-19UPCSC3C05 Algorithm – Lab	2	4	3	40	60	100
Core Course-19UPCSC3C06 Advanced Web Technology – Lab	2	4	3	40	60	100
Core Course-19UPCSC3C07 Statistical Computing – Lab	2	3	3	40	60	100
SWAYAM / MOOC -01 (Optional)						
Total	26					800
Semester-II						
Core Course-19UPCSC3C08 Distributed Operating System	4	4	3	25	75	100
Core Course-19UPCSC3C09 Advanced Java Programming	4	4	3	25	75	100
Core Course-19UPCSC3C10 Cryptography and Network Security	4	4	3	25	75	100
Elective-II	4	4	3	25	75	100
Elective-II	4	4	3	25	75	100
Non-major Elective / Supportive Course	3	3	3	25	75	100
Core Course-19UPCSC3C11* Advanced Java-Lab	2	4	3	40	60	100
Core Course-19UPCSC3C12* Data Analytics using R – Lab	2	4	3	40	60	100
Core Course-19UPCSC3C20 Soft Skill Development – Lab	2	2	3	100	-	100
Human Rights	-	-	3	25	75	100
SWAYAM / MOOC -02 (Optional)						

Total	27					1000
Semester-III						
Core Course-19UPCSC3C13 Digital Image Processing	4	4	3	25	75	100
Core Course-19UPCSC3C14 Internet of Things	4	4	3	25	75	100
Core Course-19UPCSC3C15 Machine Learning	4	4	3	25	75	100
Elective-IV	4	4	3	25	75	100
Elective-V	4	4	3	25	75	100
Core Course-19UPCSC3C16* Image Processing – Lab	2	4	3	40	60	100
Core Course-19UPCSC3C17 * Mini Project - Machine Learning	2	4	3	40	60	100
SWAYAM / MOOC / SOFT SKILL-03 (Optional)						
Total	24					700

Semester-IV						
OPTION-I						
Core Course-19UPCSC3C18 Dissertation and Viva Voice (Industry/Research)	16	--	3	50	150	200
OPTION-II						
Elective-VI	4	4	3			
Elective-VII	4	4	3			
Core Course-19UPCSC3C19 Dissertation and Viva- Voce (Industry/Research)	8	12	-	50	150	200
Total	16					**200**
Total no of Credits: **Core** / **Elective** / **Practical** / **Supportive** / **Project**	40 20 16 3 16					
Grand Total	95					2700

EXAMINATIONS - THEORY

EVALUATION OF **INTERNAL ASSESSMENT**

Test	:	10 (5+5 Marks, 5 marks from best one of Test 1 and Test 2, 5 marks from test 3 – mode examinations)
Seminar	:	05 Marks
Assignment	:	05 Marks
Attendance	:	05 Marks

Total	:	25 Marks

EVALUATION OF **EXTERNAL EXAMINATIONS QUESTION PAPER PATTERN**

Time duration: 3 Hours Max. Marks: 75

PART- A: 20× 1 = 20

Answer all the questions

(Objective type four questions from each unit)

PART- B: 3 × 5 = 15

Answer any three questions out of five questions

(Questions must be of type analytical)

PART- C: 5× 8 = 40

Answer all the questions

(Either or type for each unit)

The Passing minimum shall be 50% out of 75 marks (38 marks)

PRACTICAL / SOFTWARE DEVELOPMENT

EVALUATION OF **INTERNAL ASSESSMENT**

Test 1	:	15 Marks
Test 2	:	15 Marks
Record	:	10 Marks

Total	:	40 Marks

EVALUATION OF **EXTERNAL EXAMINATIONS**

Time duration: 3 Hours Max. Marks: 60

QUESTION PAPER PATTERN

1. One compulsory question from the given list of objectives : 30 Marks
2. One Either/OR type question from the given list of objectives : 30 Marks

Distribution of Marks

Problem Understanding	: 05 Marks
Program writing	: 10 Marks
Debugging	: 10 Marks
For Correct Results	: 05 Marks

Mini-Project Viva-Voce (joint): 60 Marks

DISSERTATION

Evaluation (External)	**: 50 Marks**
Viva-voce (joint)	**: 100 Marks**

11. REGULATIONS OF PROJECT WORK

a. Students should do their five months [Dec to Apr] Project work in Company / Institutions.

b. The Candidate should submit the filled-in format as given in Annexure-I to the department for approval during the Ist Week of January in their Project semester.

c. Each internal guide shall have a maximum of eight Students.

d. Periodically the project should be reviewed a minimum three times by the advisory committee.

e. Students should prepare three copies of the dissertation and submit the same to the college on 30th April for the evaluation by examiners. After evaluation one copy is to be retained in the College Library and one copy is to be submitted to the University (Registrar) and the student can hold one copy.

f. A Sample format of the dissertation is enclosed in Annexure-II.

g. The format of the Title page and certificate are enclosed in Annexure III.

h. The Students should use OHP / PowerPoint presentations during their Project Viva-voce Examinations.

12. PASSING MINIMUM

The candidate shall be declared to have passed the examination if the candidate secures not less than 50 marks put together out of 100 marks (IA+EA) in each paper / practical. Minimum 50% should be secured in EA of each theory and practical subject. The submission of a record notebook is a must.

For the project work and viva-voce, a candidate should secure 50% of the marks for a pass. The candidate should compulsorily attend the viva-voce examination to secure a pass in that paper.

13. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in **First Class**. All other successful candidates shall be declared to have passed in **Second Class**. Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in **First Class with Distinction** provided they pass all the examinations prescribed for the course at the first appearance.

Candidates who pass all the examinations prescribed for the course in the first instance and within two academic years from the year of admission to the course only are eligible for **University Ranking.**

14. COMMENCEMENT OF THIS REGULATION

These regulations shall take effect from the academic year 2015-16, i.e., for students who are to be admitted to the first year of the course during the academic year 2015-16 and thereafter.

15. TRANSITORY PROVISION

Candidates who were admitted to the PG course of study before 2015-16 shall be permitted to appear for the examinations under those regulations for three years i.e., up to and inclusive of the examination of April/May 2018. Thereafter, there will be permitted to appear for the examination only under the regulations then in force

ANNEXURE - I
PERIYAR UNIVERSITY

College Name :

Course :

Student Name :

Register Number :

Title of the Project :

Address of Organization / Institution:

Name of the External Guide :

Designation :

Place :

Date : Signature of External Guide

(with seal)

Name of the Internal Guide :

Qualification :

Teaching Experience :

Place :

Date : Signature of Internal Guide

Principal [Approved or not Approved]
[University Use]

ANNEXURE II

COLLEGE BONAFIDE CERTIFICATE

COMPANY ATTENDANCE CERTIFICATE

Acknowledgment

CONTENTS

ANNEXURE III

Format of the title page

TITLE OF THE DISSERTATION

A Dissertation submitted in partial fulfillment of the requirements for the degree of

Master of Science in Computer Science

to the

Periyar University, Salem - 11

By

STUDENT NAME

REG. NO.

College emblem

COLLEGE NAME (AFFILIATED TO PERIYAR UNIVERSITY)

PLACE with Pin Code

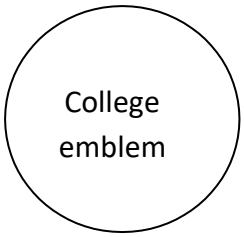
MONTH – YEAR

Format of the Certificate

COLLEGE NAME

(AFFILIATED TO PERIYAR UNIVERSITY)

PLACE with PIN CODE



MONTH – YEAR

PROJECT WORK

TITLE OF THE DISSERTATION

Bonafide Work Done

by STUDENT NAME

REG.NO

A Dissertation submitted in partial fulfillment of the requirements for the degree of **Master of Science in Computer Science** to the **Periyar University, Salem - 11.**

INTERNAL GUIDE HEAD OF THE DEPARTMENT

Submitted for the Viva-Voce Examination held on _____

Internal Examiner External Examiner

M. Sc- COMPUTER SCIENCE (DATA ANALYTICS) - SYLLABUS

SEMESTER-I

COURSE CODE-19UPCSC3C01 **Credits: 4**

DESIGN AND ANALYSIS OF ALGORITHMS

Course Objectives:

- To introduce the fundamental concepts of the algorithm and its performance analysis. To choose the appropriate data structure and algorithm design method for a specified application
- To apply design and analysis techniques for a Divide and Conquer algorithm to analyses the time and space complexity
- To apply design and analysis techniques for the greedy method algorithm to analyses the time and space complexity
- To apply design and analysis techniques for Dynamic Programming and Basic Traversal and Search Technique algorithm to analyses the time and space complexity
- To apply design and analysis techniques for Backtracking algorithm to analyses the time and space complexity

UNIT I

Introduction: Algorithm Definition – Algorithm Specification – Performance Analysis-Asymptotic Notations. Elementary Data Structures: Stacks and Queues – Trees – Dictionaries –Priority Queues – Sets and Disjoint Set Union – Graphs

UNIT II

Divide and Conquer: The General Method – Defective Chessboard – Binary Search – Finding The Maximum And Minimum – Merge Sort – Quick Sort – Selection - Strassen‟s Matrix Multiplication.

UNIT III

The Greedy Method: General Method - Container Loading - Knapsack Problem – Tree Vertex Splitting – Job Sequencing With Deadlines - Minimum Cost Spanning Trees – Optimal Storage On Tapes – Optimal Merge Patterns - Single Source Shortest Paths.

UNIT IV

Dynamic Programming: The General Method – Multistage Graphs – All-Pairs Shortest Paths – Single-Source Shortest Paths - Optimal Binary Search Trees - String Editing - 0/1 Knapsack - Reliability Design - The Traveling Salesperson Problem - Flow Shop Scheduling. Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees – Biconnected Components and DFS.

UNIT V

Backtracking: The General Method – The 8-Queens Problem – Sum of Subsets – Graph Coloring – Hamiltonian Cycles – Knapsack Problem Branch and Bound: Least Cost searched - 0/1 Knapsack Problem.

Text Book:

1. Ellis Horowitz, Satraj Sahni, and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, Second Edition, Reprint 2009.

Course Outcomes

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

S.No.	Course Outcomes	Knowledge Level	
CO1	Understand the fundamental concepts of the algorithm and its performance analysis. To choose the appropriate data structure and algorithm design method for a specified application	**K1, K2**	**LO**
CO2	Apply design and analysis techniques for a Divide and Conquer algorithm. Apply design and analysis techniques for the greedy method algorithm. Apply design and analysis techniques for Dynamic Programming and Basic Traversal and Search Technique algorithm to analyses the time and space complexity	**K3**	**IO**
CO3	Analyze the performance analysis for given algorithms approaches, techniques and methods	**K4,K5**	**HO**

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	-	-	L	-	-	-	-	-	-
CO2	-	-	M	-	M	-	M	-	-	M	M	-
CO3	-	-	-	-	-	-	-	S	S	S	S	S

S- Strong; M-Medium; L-Low

COURSE CODE -19UPCSC3C02 **Credits: 4**

ADVANCED WEB TECHNOLOGY

Course Objectives:

- Explore the backbone of web page creation by developing.NET skill.
- Enrich knowledge about HTML control and web control classes
- Provide depth knowledge about ADO.NET
- Understand the need for usability, evaluation methods for web services

Unit 1:

OVERVIEWOFASP.NET-The.NET framework – Learning the .NET languages: Data types–Declaring variables-Scope and Accessibility- Variable operations-Object Based manipulation-Conditional Structures-Loop Structures-Functions and Subroutines. Types, Objects, and Namespaces: The Basics about Classes- Value types and Reference types- Advanced class programming- Understanding namespaces and assemblies. Setting Up ASP.NET and IIS.

Unit – II

DevelopingASP.NETApplications-ASP.NET Applications: ASP.NET applications – Cod behind-The Global.asax application file- UnderstandingASP.NETClasses-ASP.NET Configuration. Web Form fundamentals: A simple page applet-Improving the currency converter – HTML control classes – The page class-Accessing HTML server controls. Web controls: WebControl Classes–Auto PostBack and WebControl events- Accessing web controls. Using VisualStudio.NET: Starting aVisualStudio.NET Project-Web form Designer- Writing code- Visual studio.NET debugging. Validation and Rich Controls: Validation- A simple Validation example- Understanding regular expressions- A validated customer form. State management-Tracing, Logging, and Error Handling.

Unit – III

Working with Data - Overview of ADO.NET - ADO.NET and data management-CharacteristicsofADO.NET ADO.NET object model. ADO.NET data access: SQL basics– Select, Update, Insert, Delete statements- Accessing data-Creating a connection- Using a command with a DataReader- Accessing Disconnected data - Selecting multiple tables – UpdatingDisconnecteddata.Data binding: Single value Data Binding-Repeated value data binding-Data binding with databases. Data list – Data grid–Repeater–Files, Streams, and Email– Using XML

Unit -IV

Web Services – Web services Architecture: Internet programming the and now-WSDL–SOAP-Communicating with a web service-Web service discovery and UDDI. Creating Web services: Web service basics – The Stock Quote web service – Documenting the web service- Testing the web service - Web service Data types-ASP.NET intrinsic objects. Using web services: Consuming a web service-Using the proxy class – An example with Terra Service.

Unit – V

Advanced ASP.NET - Component-Based Programming: Creating a simple component –Properties and state-Database components-Using COM components. Custom controls: User Controls – Deriving Custom controls. Caching and Performance Tuning: Designing and scalability –Profiling-Catching-Output catching-Data catching. Implementing security: Determining security requirements – The ASP.NET security model-Forms authentication - Windows authentication.

TextBook:

1. Mathew MacDonald, "ASP.NET Complete Reference", TMH 2005.

Unit-I: (Chapters:1to4) Unit– II:(Chapters:5 to11)
Unit-III: (Chapters:10to17)
Unit– IV: (Chapters:18to20) Unit– V:(Chapters:21to24)

References:

1. Crouch Matt J, "ASP.NET andVB.NET Web Programming", Addison Wesley2002.

2. J.Liberty, D.Hurwitz, "Programming ASP.NET", Third Edition, O"REILLY,2006.

Course Outcomes

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

CO1:	Evaluate a web page with Webform fundamentals and web control classes	**K3**	**IO**
CO2:	Recognize the importance of validation control, cookies, and session	**K1, K2**	**LO**
CO3:	Apply the knowledge of ASP.NET object,ADO.NET data access	**K4, K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	L	-	-	L	L	-	-
CO2	M	M	-	M	M	-	-	-	M	-	M	M
CO3	S	-	S	S	S	-	-	S	-	S	-	-

S- Strong; M-Medium; L-Low

COURSE CODE –19UPCSC3C03 **Credits: 4**

ADVANCED DATABASE MANAGEMENT SYSTEMS

Course Objectives:

- To acquire knowledge of data models, Need of normalization, and various database architecture.
- To get familiar with Distributed and Object-based databases
- To analyze the various techniques of spatial databases and learn knowledge pattern of logic-based databases
- To learn about XML hierarchical data model
- To realize various applications of multimedia and knowledge about temporal database

Unit-I

Relational and parallel Database Design: Basics, Entity Types, Relationship Types, ER Model, ER-to-Relational Mapping algorithm. Normalization: Functional Dependency, 1NF, 2NF, 3NF, BCNF,4NF and 5NF. Architecture, I/O Parallelism, Interquery Parallelism, Intraquery Parallelism, Intra operation, Parallelism, Interoperation Parallelism.

Unit-II

Distributed and Object-based Databases: Architecture, Distributed data storage, Distributed transactions, Commit protocols, Concurrency control, Query Processing. Complex Data Types, Structured Types and Inheritance, Table Inheritance, array and Multiset, Object Identity and Reference Types, Object-Oriented versus Object-Relational.

Unit-III

Spatial Database: Spatial Database Characteristics, Spatial Data Model, Spatial Database Queries, Techniques of Spatial Database Query, Logic-based Databases: Introduction, Overview, Propositional Calculus, Predicate Calculus, Deductive Database Systems, Recursive Query Processing.

Unit-IV

XML Databases: XML Hierarchical data model, XML Documents, DTD, XML Schema, XML Querying, XHTML, Illustrative Experiments.

Unit-V

Temporal Databases: Introduction, Intervals, Packing and Unpacking Relations, Generalizing the relational Operators, Database Design, Integrity Constraints, Multimedia Databases: Multimedia Sources, Multimedia Database Queries, Multimedia Database Applications.

Text Book

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th edition, McGraw-Hill International Edition, 2011 Unit-I : (Chapters: 2,7,18), Unit – II: (Chapters: 19,22), Unit – IV: (Chapters: 23), Unit – V: (Chapters: 25)
2. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education Reprint 2016. Unit-I : (Chapters: 11,12,14), Unit – II: (Chapters: 23), Unit – IV: (Chapters: 24)

Reference Books:

1. Ramez Elmasri, Shamkant B Navathe, "Fundamentals of Database Systems", Pearson, 7th edition 2016.
2. Thomas Connolly, Carolyn Begg., "Database Systems a practical approach to Design, Implementation, and Management ", Pearson Education, 2014.

Course Outcomes

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

CO1:	Understand the Concepts of Relational database, parallel Database, Distributed database, Object-based Databases, Spatial database, and temporal database	**K1, K2**	**LO**
CO2:	Apply Query Statements for Create Table, Insert Data and Alter Data	**K3**	**IO**
CO3:	Analyze the concepts need of normalization, various Normal forms, spatial and temporal database	**K4, K5, K6**	**HO**

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	-	-	-	-	-	-	L
CO2	M	M	M	M	M	-	-	-	-	M	M	M
CO3	S	S	S	S	S	-	-	-	-	S	-	S

S- Strong; M-Medium; L-Low

COURSE CODE -19UPCSC3C04 **Credits : 4**

COMPILER DESIGN

Course Objectives:

- To get familiar with the structure of the compilation process and analyze the role of the lexical analysis phase.
- To analyze the role of the parser and the parsing methods, for writing rules for grammar.
- To Examine the Inherited and Synthesized attributes and understand the basic concepts of Dependency graphs, Ordering the evaluation of attributes, and Syntax Directed translations schemes
- To Translate given input to intermediate code using Three Address code and apply Switch Statements and Procedure calls during the conversion of source code to intermediate code
- To Identify various types of optimizations on intermediate code and generate assembly code

UNIT – I

LEXICAL ANALYSIS - Language Processors, The Structure of a Compiler, Parameter passing mechanism– Symbol table-The role of the lexical analyzer- Input buffering- Specification of tokens -Recognition of tokens– Finite automata- Regular expression to automata

UNIT–II:

SYNTAX ANALYSIS - The role of the parser -Context-free grammars- Writing a grammar–Top-down Parsing- Bottom-up Parsing- LR parsers- LALR parsers.

UNIT–III:

SEMANTIC ANALYSIS - Inherited and Synthesized attributes–Dependency graphs–Ordering the evaluation of attributes– S-attributed definitions– L-attributed definitions–Applications of Syntax Directed translation– Syntax Directed translation schemes- Storage organization– Stack allocation of space.

UNIT–IV:

INTERMEDIATE CODE GENERATION - Variants of Syntax trees–Three Address code– Types and Declarations- Translation of Expressions– Type checking- Control flow- Back patching- Switch Statements- Procedure calls.

UNIT–V :

CODE GENERATION AND CODE OPTIMIZATION – Issues in the design of a code generator–The target language–Address in the Target Code– Basic Block and Flow graphs–Optimization of Basic Blocks – A simple code generator– Peephole Optimization

Text Book

1. Alfred V. Aho, Monica.Lam, Ravi Sethi, and Jeffrey D. Ullman, "Compilers-Principles, Techniques, and Tools", Second Edition, Pearson Education Asia, 2009.

   Unit-I:(Chapters:1.1,1.2,1.6.6,2.7,3.1,3.2,3.3,3.4,3.6,3.7)

   Unit–II:(Chapters:4.1.1,4.2,4.3,4.4,4.5,4.5,4.7)

   Unit-III: (Chapters:5.1.1,5.2.1,5.2.2,5.2.3,5.2.4,5.3,5.4,7.1,7.2)

   Unit– IV:(Chapters:6.1to 6.9)

   Unit– V:(Chapters:8.1to8.7)

Reference books

1. A.V. Aho, Ravi Sethi, J.D. Ullman, Compilers- Principles, Techniques and Tools, Addison-Wesley, 2003.
2. Fischer Leblanc, Crafting Compiler, Benjamin Cummings, Menlo Park, 1988.
3. Kennath C. Louden, Compiler Construction Principles and Practice, Vikas Publishing House, 2004.
4. AllenI. Holub, Compiler Design in C, Prentice Hall of India, 2001.
5. S.GodfreyWinster, S.Aruna Devi, R.Sujatha, "Compiler Design", yesdee Publishers, Third Reprint2019

Course Outcomes

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

CO1:	Understand the structure of the compilation Process and should distinguish what happens at every phase of a compiler	**K1, K2**	**LO**
CO2:	Evaluate the Context-free grammars and parsing methods for removing useless productions, symbols and removing epsilon productions	**K3**	**IO**
CO3:	Apply code optimization techniques to reduce the number of instructions in a program.	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	L	-	-	-	-	-	-	-	L	-
CO2	M	M	M	M	M	-	-	-	-	-	M	-
CO3	S	S	S	S	S	-	-	-	S	-	S	S

S- Strong ; M-Medium ; L-Low

COURSE CODE - 19UPCSC3C05 **Credits: 2**

ALGORITHM – LAB

Course Objectives:

- Learn to create graphs
- Design algorithms to solve computational problems

1. Apply the divide and conquer technique to arrange a set of numbers using merge sort.
2. Apply the divide and conquer technique to implement Strassen‟s matrix multiplication Algorithm
3. Computer the transitive closure of a given directed graph using Warshall‟s Algorithm.
4. Implement 0/1 knapsack problem using Dynamic programming
5. Find a minimum cost spanning tree of a given undirected graph using Kruskal‟s Algorithm.
6. Find minimum cost spanning Tree of a given undirected graph using Prim‟s Algorithm.
7. Implement 8 Queen‟s problem using backtracking
8. Implement Knapsack problem using backtracking
9. Solve Dijkstra‟s Algorithm using greedy technique
10. Solve the subset sum problem using backtracking

Course Outcomes:

- Implement techniques to create graphs
- Able to Design algorithms to solve computational problems

COURSE CODE - 19UPCSC3C06 **Credits: 2**

ADVANCED WEB TECHNOLOGY - LAB

Course Objectives:

- Learn how to create websites using Asp.Net
- Implement the advanced web concepts using Asp.Net and Ado.Net
- Learn to use Asp.Net web controls
- Design web applications using Asp.Net and Ado.Net

List of Programs:

Programs using ASP.NET Server controls

1. Create a website for a bank and include types of navigation.
2. Write a program to perform Asp.Net State.
3. Design Image Mapping using Asp.Net
4. Create the following using web controls a) Money conversion b) Temperature conversion
5. Write a program to create an advertisement using Ad rotator.
6. Create a user control that contains a list of colors. Add a button to the Web Form which when clicked changes the color of the Form to the color selected from the list.
7. Create a user control that displays the current date and time. Include it in a Web Form and refresh it each time a button is clicked.
8. Create a user control that receives the user name and password from the user and validates them. If the user name is "Radiant" and the password is "asp.net" then the user is authorized, otherwise not.

Programs using ADO.NET and ASP.NET

1. Create a web application to insert 3 records inside the SQL database table having the following fields(DeptId, DeptName, EmpName, Salary). Update the salary for any one employee and increment it to 15% of the present salary. Perform delete operation on 1 row of the database table.
2. Create a Web App to display all the Empname and Deptid of the employee from the database using SQL source control and bind it to GridView. Database fields are(DeptId, DeptName, EmpName, Salary)

Course Outcomes:

- Apply .NET concepts to design and develop web applications
- Create a basic website using Asp.Net concepts
- Design web page and connect to the backend databases
- Applying different functionalities in Asp.Net and Ado.Net

COURSE CODE - 19UPCSC3C07 **Credits: 2**

STATISTICAL COMPUTING - LAB

Course Objectives:

- Learn how to using statistical functions in Excel
- Implement the advanced data analysis tool

List of Programs:

Implement the following statistical concepts and computation in Ms-Excel

1. Compute the descriptive statistics of a dataset
2. Calculate Test of Hypothesis concerning the population mean
3. Calculate the difference between the mean of two population
4. Calculate ANOVA test

i. Single-factor ANOVA Test,

ii. Two way ANOVA without Replication

iii. Two way ANOVA with Replication

5. Calculate Goodness-of-fit Test for Discrete Random Variables
6. Calculate the Test Hypothesis Concerning the Variance of Two Populations
7. Calculate Linear Correlation and Regression Analysis between two variables and find the model that predicts one variable in terms of another.
8. Calculate Moving Average and Exponential Smoothing
9. Calculate Binomial Distribution for discrete and continuous random variables
10. Calculate Regression analysis for the given problem

Course Outcomes

At the end of the course, the students will be able to:

- Apply statistical functions for the real-time data
- Perform data analysis of any real-world problem using advanced data analysis tools in Ms-Excel.

SEMESTER II

COURSE CODE – 19UPCSC3C08 **Credits: 4**

DISTRIBUTED OPERATING SYSTEM

Course Objectives:

- To study features of the Distributed operating system.
- To understand the communication of different hardware and software environments in a distributed environment.
- To learn the distributed resource management components.
- To gain knowledge on modern operating system working principles.
- To learn about the different fault tolerance mechanisms.

UNIT I:

Introduction – Operating System Definition – Functions of Operating System – Types of Advanced Operating System – Design Approaches – Synchronization Mechanisms – concepts of a Process – Critical Section Problem – Process Deadlock – Models of Deadlock – Conditions for Deadlock – System with single-unit requests, Consumable Resources, Reusable Resources.

UNIT II:

Distributed Operating Systems: Introduction- Issues – Communication Primitives – Inherent Limitations –Lamport‟s Logical Clock, Vector Clock, Global State, Cuts – Termination Detection – Distributed Mutual Exclusion – Non-Token Based Algorithms – Lamport‟s Algorithm - Token-Based Algorithms –Distributed Deadlock Detection – Distributed Deadlock Detection Algorithms – Agreement protocols.

UNIT III:

Distributed Resource Management – Distributed File Systems – Architecture – Mechanisms – Design Issues – Distributed shared Memory – Architecture – Algorithm – Protocols – Design Issues – Distributed Scheduling – Issues – Components – Algorithms.

UNIT IV:

Failure Recovery and Fault Tolerance – Concepts – Failure Classifications – Approaches to Recovery – Recovery in Concurrent Systems – Synchronous and Asynchronous Checkpointing and Recovery –Checkpointing in Distributed Database Systems – Fault Tolerance Issues – TwoPhase and Nonblocking Commit Protocols – Voting Protocols – Dynamic Voting Protocols.

UNIT V:

Multiprocessor and Database Operating Systems –Structures – Design Issues – Threads – Process Synchronization – Processor Scheduling – Memory

management – Reliability/Fault Tolerance – Database Operating Systems – concepts – Features of Android OS, Ubuntu, Google Chrome OS, and Linux operating systems.

Text Books:

1. MukeshSinghalN.G.Shivaratri, "Advanced Concepts in Operating Systems", McGraw Hill 2000.

2. Distributed Operating System – Andrew S. Tanenbaum, PHI.

Reference Books:

1. Abraham Silberschatz, Peter B.Galvin, G.Gagne, "Operating Concepts", 6th Edition Addison Wesley publications 2003.

2. Andrew S.Tanenbaum, "Modern Operating Systems", 2nd Edition Addison Wesley 2001

Course Outcomes

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

CO1:	Understand the several resource management techniques like distributed shared memory and other resources.	**K1, K2**	**LO**
CO2:	Design and implement algorithms of distributed shared memory and commit protocols.	**K3**	**IO**
CO3:	Apply and implement fault-tolerant distributed systems.	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	-	-	L	L	-	-	L	-	-	-	-
CO2	M	M	M	M	-	-	-	-	M	-	M	-
CO3	S	S	S	S	S	-	-	-	S	-	S	S

S- Strong; M-Medium; L-Low

COURSE CODE –19UPCSC3C09 **Credits:4**

ADVANCED JAVA PROGRAMMING

Course Objectives:

- To get familiar with the concept of packages, interface, Inheritance, and Exception handling in java.
- To learn the concept of Graphical User Interface (GUI), Network Programming, and database manipulation
- The student will be able to develop web application using Java Servlet and Java Server Pages technology

UNIT – I

Data Types, Variables, and Arrays: Primitive Types-Literals-Variables-Type Conversion and Casting- Arrays. Operators: Arithmetic- Bitwise-Relational-Boolean-Logical – Assignment-Conditional. Control Statements: Selection statements- Iteration Statements- Jump Statements. Classes and Methods: Fundamentals- Declaring objects- Methods- Constructors-Overloading Methods-Recursion – Nested and Inner Classes-Command Line Arguments.

UNIT–II

Inheritance: Basics-Super Class- Method Overriding- Abstract Classes. Packages and Interfaces: Packages- Access Protection – Importing Packages- Interfaces. Exception Handling: Fundamentals – Types – Try and Catch – Throw – throws-Finally – Built-in Exceptions.

UNIT-III

The Applet Class: Basics – Architecture – Applet Skeleton – Display Methods – Status Window- Passing Parameters. Event Handling: Event Model – Classes – KeyEventClass- Event Listener Interfaces. AWT: Window Fundamentals – Working with frame windows- Graphics- Working with color- working with fonts. AWT controls – Labels- Buttons- CheckBox- Choice Controls – Lists- Scroll Bars – Text Field- Text Area.

UNIT-IV

Servlet Fundamentals: Servlet overview and Architecture- Servlet Basics- Servlets and HTML- servlet Sessions- Servlets, JDBC, and Inter Servlet Communications. JSP Fundamentals: JSP Overview and Architecture – JSP Implicit Objects – JSP Standard Actions- Handling JSP Errors – Custom JSP Tag Libraries.

UNIT–V

Using Relational Databases: Introduction – JDBC Drivers for RDBM Systems-Using java.sql API, Using javax.sql API – connection pooling. Network Programming: Introduction – Working with URLs – Working with Sockets – Remote Method Invocation.

Text Books

1. Herbert Schildt, "Java the Complete Reference", 9th ed., Oracle Press, TMH Company Ltd, New Delhi, 2014.
   Chapters: 3-10, 23-26
2. James goodwill, " Developing Java Servlets: Web applications with servlets and JSP", 2nd ed., SAMS Publishers, USA
   Chapters:2,3,4,5,7,14,15,16,18,19
3. Joe Wiggles worth and Paula McMillan, "Java Programming Advanced Topics", 3rd ed., TMH, 2009.
   Chapters: 9, 11.

Reference books

1. John Dean, Raymond Dean, "Introduction to Programming with JAVA- A Problem Solving Approach", Tata McGraw Hill, 2012.
2. Ralph Bravaco, Shai Simonson, "Java Programming: From the Ground Up", Tata McGraw Hill, 2012.
3. Herbert Schildt, Dale Skrien, " Java Fundamentals – A Comprehensive Introduction", Tata McGraw Hill, 2013

Course Outcomes

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

CO1:	Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to a specific problem	**K1, K2**	**LO**
CO2:	Identify and describe common abstract user interface components to design GUI in Java using Applet & AWT along with response to events	**K3**	**IO**
CO3:	Apply Servlets and JSP for creating Web-based applications using JDBC	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	L	-	-	-	-	-	-	-	L	-
CO2	M	M	M	M	M	-	-	-	-	-	M	-
CO3	S	S	S	S	S	-	-	-	S	-	S	S

S- Strong; M-Medium; L-Low

COURSE CODE – 19UPCSC3C10 **Credits : 4**

CRYPTOGRAPHY AND NETWORK SECURITY

Objectives:

- To understand Cryptography Theories, Algorithms, and Systems
- To understand necessary Approaches and Techniques to build protection mechanisms to secure computer networks.
- To know about the malicious software & firewalls.

Unit I:

Introduction **-** Security trends – Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies – Model of network security – Security attacks, services, and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product crypto system – cryptanalysis.

Unit II:

Symmetric Encryption and Message Confidentiality **-** Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Stream Ciphers, and RC4, Cipher Block Modes of Operation, Location of Encryption Devices, Key Distribution. Public-key Cryptography and Message Authentication: Approaches to Message Authentication, Secure Hash Functions and HMAC, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures, Key Management.

Unit III:

Authentication Applications **-** Kerberos, x.509 Authentication Service, Public-Key Infrastructure. Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME.

Unit IV:

IP Security - IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations. Web Security: Web Security Considerations, Secure Socket Layer(SSL) and Transport Layer Security(TLS), Secure Electronic Transaction(SET).Network Management Security: Basic Concepts of SNMP, SNMPv1 Community Facility, SNMPv3.

Unit V :

Intruders **-** Intruders, Intrusion Detection, Password Management. Malicious Software: Virus and Related Threats, Virus Countermeasures, Distributed Denial of Service Attacks. Firewalls: Firewall Design Principles, Trusted Systems, Common Criteria for Information Technology Security Evaluation.

Textbooks:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007, Reprint 2015.
2. Stallings William, "Cryptography and Network Security - Principles and Practice 2017.
3. William Stallings, "Network Security Essentials Applications and Standards "Third Edition, Pearson Education, 2008.

References:

1. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms And Protocols", Wiley Publications, 2003.
2. Charles Pfleeger, "Security In Computing", 4th Edition, Prentice-Hall Of India, 2006.
3. Ulysses Black, "Internet Security Protocols", Pearson Education Asia, 2000.
4. Charlie Kaufman And Radia Perlman, Mike Speciner, "Network Security, Second Edition, Private Communication In Public World", PHI 2002.
5. Bruce Schneier And Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
6. Douglas R Simson "Cryptography – Theory And Practice", First Edition, CRC Press, 1995.
7. Http://Nptel.Ac.In/.

Course Outcomes

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

CO1:	Understand the fundamentals of networks security, security architecture, threats and vulnerabilities Understand various Security practices and System security standards	**K1, K2**	**LO**
CO2:	Apply the different cryptographic operations of symmetric cryptographic algorithms machine learning algorithms. Apply the different cryptographic operations of public key cryptography. Apply the various Authentication schemes simulate different applications	**K3**	**IO**
CO3:	Analyze the problem and develop the optimal model based on data in real-time. Evaluate and compare the model performances using various evaluation measures.	**K4, K5, K6**	**HO**

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

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	-	L	L	-	-	-	L	L	L	-
CO2	M	M	M	M	M	-	-	M	M	-	M	M
CO3	-	S	-	S	S	-	-	-	S	S	S	S

S- Strong; M-Medium; L-Low

COURSE CODE - 19UPCSC3C11* **Credits: 2**

ADVANCED JAVA LAB

Course Objective:

- To enable the students to implement different java packages.
- To develop the students with the skills to implement different java tools.

Use JAVA Programming Language to implement the following:

1. To create applets incorporating the following Features:

   a. Create a color palette with a matrix of buttons

   b. Set the background and foreground of the control text area by selecting a color from the color palette.

   c. To select Foreground or background use check box control as radio buttons d. To set background images

2. Use GridLayout to design a calculator and simulate the functions of a simple calculator.

3. To create Input-output and Random files

4. To develop a chat application with datagram sockets and datagram packets.

5. To invoke servlet from HTML forms.

6. To invoke servlet from Applets.

7. To invoke servlet from JSP.

8. Simple client/server application.

9. JDBC to interact with the database.

10. To create multiple chat applications using TCP packets.

DATA ANALYTICS USING R - LAB

COURSE CODE: 19UPCSC3C12*

Credits: 2 CourseObjectives

- To implement mathematical aggregation operators in “R-script”.
- To understand the Statistical operations in “R”.

1. To get the input from the user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) using in R.

2. To perform data import/export (.CSV, .XLS, .TXT) operations using data frames in R.

3. To get the input matrix from the user and perform Matrix addition, subtraction, multiplication, inverse transpose, and division operations using vector concept in R.

4. To perform statistical operations (Mean, Median, Mode, and Standard deviation) using R.

5. To perform data pre-processing operations i) Handling Missing data ii) Min-Max normalization

6. To perform dimensionality reduction operation using PCA for Houses Data Set

7. To perform Simple Linear Regression with R.

8. To perform K-Means clustering operation and visualize for iris data set

9. Write R script to diagnose any disease using KNN classification and plot the results.

10. To perform market basket analysis using Association Rules (Apriori).

COURSE- 19UPCSC3C20 **Credits: 2**

SOFT SKILL DEVELOPMENT LAB

Course Objective

- This course provides opportunities to students to develop and demonstrate basic communication skills in technical, professional and social contexts effectively.

List of Programs

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

SEMESTER – III

COURSE CODE – 19UPCSC3C13 **Credits : 4**

DIGITAL IMAGE PROCESSING

Course Objectives:

- To get familiar with the image acquisition process and color image processing models.
- To analyze the functionalities of spatial and frequency filters for image enhancement.
- To investigate the various edge detection models and their applications.
- To learn the concept of image compression and analyze the various compression techniques.
- To identify the requirements of various image segmentation methods and object recognition models for various real-time applications.

UNIT – I

Fundamentals: Image Sensing and Acquisition, Image Sampling and Quantization, relationship between Pixels; Random noise; Gaussian Markov Random Field, σ-field, Linear and Non-linear Operations; Image processing models: Causal, Semi-causal, Non- causal models. Color Models: Color Fundamentals, Color Models, Pseudo-color Image Processing, Full-Color Image Processing, Color Transformation, Noise in Color Images.

UNIT–II

Spatial Domain: Enhancement in spatial domain: Point processing - Mask processing - Smoothing Spatial Filters - Sharpening Spatial Filters - Combining Spatial Enhancement Methods - Frequency Domain - Image transforms – FFT – DCT –Karhunen-Loeve transform - Hotlling's T2 transform -Wavelet transforms and their properties - Image filtering in the frequency domain.

UNIT-III

Edge Detection: Types of edges – threshold - zero-crossing - Gradient operators: Roberts– Prewitt - and Sobel operators - residual analysis based technique - Canny edge detection - Edge features and their applications.

UNIT-IV

Image Compression: Fundamentals, Image Compression Models - Elements of Information Theory. Error-Free Compression: Huff-man coding - Arithmetic coding - Wavelet transform based coding - Lossy Compression: FFT – DCT – KLT – DPCM - MRFM based compression - Wavelet transform-based - Image Compression standards.

UNIT–V

Image Segmentation: Detection and Discontinuities: Edge Linking and Boundary Deduction; Threshold; Region-Based Segmentation - Segmentation by

Morphological watersheds - The use of motion in segmentation - Image Segmentation based on Color - Morphological Image Processing: Erosion and Dilation - Opening and Closing - Hit-Or- Miss Transformation - Basic Morphological Algorithms - Gray-Scale Morphology. Object Recognition: Patterns and Classes – Recognition based on decision – Structural methods.

Text Book:

1. Rafael Gonzalez, Richard E. Woods, "Digital Image Processing", Fourth Edition, PHI/Pearson Education, 2013.
   Unit–I (Chapters: 2.3-2.5, 6.1-6.5,6.8)
   Unit – II (Chapters:3.5-3.7,4.11.3)
   Unit – IV (Chapters:8.1,8.1.6,8.2.1,8.2.3,8.2.10,8.1.7)
   Unit – V (Chapters:10.2.2,10.2.7,10.3,10.4,10.5,10.6,6.7,9.2-9.6,12.2-12.3)
2. A. K. Jain, Fundamentals of Image Processing, Second Ed., PHI, New Delhi, 2015.
Unit – II (Chapters:7.2) Unit – III (Chapters:9.4)

Reference Books

1. B. Chan la, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI,2003.
2. Nick Elford, "Digital Image Processing a practical introducing using Java", Pearson Education, 2004.
3. Todd R.Reed, "Digital Image Sequence Processing, Compression, and Analysis", CRC Press, 2015.
4. L.Prasad, S.S.Iyengar, "Wavelet Analysis with Applications to ImageProcessing", CRC Press, 2015.

Course Outcomes

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

CO1:	Understand the needs of image processing in various discipline like medical, engineering, etc.,	**K1, K2**	**LO**
CO2:	Evaluate the performance of various image enhancement models and edge detection models.	**K3**	**IO**
CO3:	Apply different image compression schemes, segmentation models, feature extraction and pattern classification models.	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	-	-	L	L	-	-	L	-	-	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	-
CO3	S	S	S	S	S	S	-	-	S	-	S	S

S- Strong ; M-Medium ; L-Low

COURSE CODE – 19UPCSC3C14 **Credits:4**

INTERNET OF THINGS

Course Objectives:

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

UNIT – I

The Internet of Things: An Overview –The Internet of Things – The Technology of the Internet of Things - Enchanted objects. Design Principles for Connected Devices: Calm and Ambient Technology – metaphor – Privacy – Web thinking for connected Devices.

UNIT – II

Internet Principles: Internet Communications overview – IP – TCP – TCP/IP – UDP. IP Addresses: DNS – Static and Dynamic IP Address Assignment – MAC Addresses – TCP and UDP Ports – Application Layer Protocols. Thinking about Prototyping: Sketching – Familiarity – Prototypes and Production – Open Source versus Closed Source.

UNIT – III

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-IV

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 – V

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.

Text Book:

1. Adrian McEwen and Hakim Cassimally, **"Designing the Internet of Things"**, Wiley, 2014. (Chapters : 1, 2, 3, 4, 5, 6, 7, 9, 10, 11)

Reference Books:

1. Ovidiu Vermesan and Peter Friess, “Internet of Things – From Research and Innovation to Market Deployment”, River Publishers, 2014.
2. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015.
3. Donald Norris, “The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black”, McGraw Hill, 2015.

Course Outcomes

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

CO1:	Explain the Evolution of the Internet of Things. Describe the principles for developing an IOT application	**K1, K2**	**LO**
CO2:	Develop an IoT API using various protocols and techniques. Design kits and follow ethics to secure the IoT applications	**K3**	**IO**
CO3:	Compare and contrast Arduino, Raspberry Pi, and Beagle Bone Black. Analyze various protocols to build the business models	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	-	L	L	L	L	L	-	L
CO2	M	M	-	M	M	M	M	M	M	-	M	M
CO3	S	S	S	-	S	S	S	-	S	S	S	S

S- Strong; M-Medium; L-Low

COURSE CODE – 19UPCSC3C15 **Credits: 4**

MACHINE LEARNING

Course Objectives:

- To understand the relationship between the target and one or more predictors
- To implement regression for developing a statistical model to predict the target
- To understand the basic concept of classification and construct a binary classification model
- To outline the various models used for developing classification models
- To identify the optimization problem to be solved by the evolutionary or heuristic search algorithm

UNIT – I

Simple Linear Regression: Introduction to Simple Linear Regression-The Least-Squares Estimates- Dangers of Extrapolation- The Coefficient of Determination, r- Standard Error of the Estimate s- Correlation Coefficient r-ANOVA Table for Simple Linear Regression- Outliers, High Leverage Points, and Influential Observations- Population Regression Equation- Verifying the Regression Assumptions- Inference in Regression- t-Test for the Relationship Between x and y -Confidence Interval for the Slope of the Regression Line - Confidence Interval for the Correlation Coefficient ρ -Confidence Interval for the Mean Value of y Given x - Prediction Interval for a Randomly Chosen Value of y Given x - Transformations to Achieve Linearity-Box–Cox Transformations

UNIT – II

Multiple Regression and Model Building: Introduction to Multiple Regression-The Population Multiple Regression Equation-Inference in Multiple Regression-Regression with Categorical Predictors, Using Indicator Variables-Adjusting R2: Penalizing Models for Including Predictors that are not Useful- Sequential Sums of Squares- Multicollinearity- Variable Selection Methods- An Application of Variable Selection Methods- Using the Principal Components as Predictors in Multiple Regression.

UNIT – III

Logistic Regression: Simple Example of Logistic Regression- Maximum Likelihood Estimation- Interpreting Logistic Regression Output-Odds Ratio and Relative Risk-Interpreting Logistic Regression for a Dichotomous Predictor-Interpreting Logistic Regression for a Polychotomous Predictor-Interpreting Logistic Regression for a Continuous Predictor- Assumption of Linearity-Zero-Cell Problem- Multiple Logistic Regression- Introducing Higher-Order Terms to Handle Nonlinearity - Validating the Logistic Regression Model-WEKA: Hands-On Analysis Using Logistic Regression.

UNIT-IV

NAIVE BAYES AND BAYESIAN NETWORKS: Bayesian Approach- Maximum a Posteriori (Map) Classification- Posterior Odds Ratio- Balancing the Data- Naïve Bayes Classification- Interpreting the Log Posterior Odds Ratio- Zero-Cell Problem - Numeric Predictors for Naïve Bayes Classification- WEKA: Hands-on Analysis Using Naïve Bayes- Bayesian Belief Networks - Clothing Purchase Example- Using the Bayesian Network to Find Probabilities.

UNIT – V

GENETIC ALGORITHMS: Introduction to Genetic Algorithms-Basic Framework of a Genetic Algorithm- Simple Example of a Genetic Algorithm at Work - Modifications and Enhancements: Selection-Modifications and Enhancements: Crossover- Genetic Algorithms for Real-Valued Variables- Using Genetic Algorithms to Train a Neural Network - WEKA: Hands-On Analysis Using Genetic Algorithms- Case Study: Clustering and Principal Components Analysis

Text Book: Daniel T. Larose, Chantal D. Larose, Data mining and Predictive analytics, Second Ed., Wiley Publication, 2015.Ch:1,2,4,10,11,19,22,23,29

Reference Books:

1. Bertt Lantz, Machine Learning with R: Expert techniques for predictive modeling, 3rd Edition, April 15, 2019,
2. Jason Bell, Machine Learning: Hands-On for Developers and Technical Professionals, Wiley Publication, 2015

Course Outcomes

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

CO1:	Understand the concept of how the machine learns using a huge amount of data. Identify the model based on the predictor and target variable. Recognize the parameters to be optimized in a machine learning task.	**K1, K2**	**LO**
CO2:	Apply different machine learning algorithms to model the relationship between independent and dependent variables. Employ a genetic algorithm to optimize the parameters used in machine learning algorithms.	**K3**	**IO**
CO3:	Analyze the problem and develop the optimal model based on data in real-time. Evaluate and compare the model performances using various evaluation measures.	**K4, K5, K6**	**HO**

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

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	-	L	L	-	-	-	L	L	L	-
CO2	M	M	M	M	M	-	-	M	M	-	M	M
CO3	-	S	-	S	S	-	-	-	S	S	S	S

S- Strong; M-Medium; L-Low

COURSE CODE: 19UPCSC3C16* **Credits: 2**

IMAGE PROCESSING - LAB

Course Objectives

- To understand the concepts of Image Processing.
- To develop the programming skills in Python.

List of Experiments

1. Write a Python program using different Morphological Operations
2. Write a Python program using different Edge Detection Methods
3. Write a Python program using the concepts of Histogram Equalization to improve the contrast of images
4. Write a Python program to find objects in an image using Template Matching concepts
5. Write a Python program using Marker-based Image Segmentation using Watershed algorithm
6. Write a Python program using GrabCut algorithm to extract foreground in images Interactive Foreground Extraction
7. Write a Python program for implementing the concepts of Harris Corner Detection
8. Write a Python program for implementing the string match features in one image with others using the Brute-Force matcher method.
9. Write a Python program for implementing the hand-written data OCR with the SVM algorithm
10. Write a Python program for implementing the data clustering concept using K-means algorithm

Reference Website

1. https://opencv-pythontutroals.readthedocs.io/en/latest/py_tutorials/py_gui/py_image_display/py_imag e_display.html#display-image.

Course Outcomes:

On completion of the course students will be expected to:

- To learn the key aspects of image processing.
- Implement image processing through applications.
- Gain research knowledge to develop applications using image processing techniques.
- To gain knowledge in machine learning through the Python language.

COURSE CODE: 19UPCSC3C17 * **Credits: 2**

MINI PROJECT - MACHINE LEARNING

The students are expected to develop Machine Learning Models. The mini project report may contain the following:

1. Introduction
2. Data Collection
3. System development
4. Implementation
5. Conclusion

LIST OF ELECTIVES

ELECTIVE - I

DISCRETE MATHEMATICS FOR COMPUTING

COURSE CODE -19UPCSC3E01 **Credits: 4**

(Theorems and Proofs are not expected)

Objectives:

- To understand the applications of functions and relations
- To understand the basic concepts of mathematical logic and predicate calculus
- To understand the concept of the method of induction
- To develop the skills in solving recurrence relations

Unit-I

Well-formed formulas – truth table of well-formed formula – a tautology, contradiction, and contingency –the equivalence of formulas. Algebra of propositions – Functionality complete sets – Normal forms of well-formed formulas- Rules of Inference for propositional calculus – well-formed formulas of predicate calculus – Rules of Inference for predicate calculus – predicate formulas involving two or more quantifiers. (2.1-2.11)

Unit-II

Set theory – relations- functions – set identities – Binary relations – properties of binary relations in a set – Equivalence relations and partial orderings – Representation of a relation by a matrix representation of a relation by a digraph - Basics of Counting – Integers and Induction. (1.3-1.7, 4.1-4.2, 5.1-5.5)

Unit-III

Formulation as Recurrence Relations-solving recurrence Relation by Iteration-solving Recurrence Relations- Solving Linear Homogeneous Recurrence Relations of Order Two-Solving Linear Nonhomogeneous Recurrence Relations. Permutations-Combinations-Permutations with repetitions-Combinations with repetition-permutations of sets with indistinguishable objects. (6.1-6.5, 3.1-3.6)

Unit-IV

Definition and examples-properties of lattices –lattices as algebraic systems-Sub lattices and lattice Isomorphism-special classes of lattice –distributive lattices and Boolean algebras. (8.1-8.6)

Unit-V

Connected Graphs-Euler Graphs-Hamiltonian circuits and paths – planar graphs – matrix representation of graphs. (10.1-10.5 and 10.8)

Text Book:

1. N.Chandrasekaran and M.Umaparvathi, Discrete mathematics, PHI Learning Private Limited, New Delhi, 2010

References:

1. J.P.Trembley and R.Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, New Delhi, 1997.
2. T. Sengadir, Discrete Mathematics, and Combinatorics, Pearson New Delhi 2009.

RakeshDube, AdeshPandeyRitu Gupta, Discrete Structures and Automata Theory, Narosa Publishing House New Delhi 2007

Course Outcomes

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

CO1:	Understand the use of well-formed formula, logical connectives, predicates of formula and so on	**K1, K2**	**LO**
CO2:	Evaluate Relations, functions, recurrence relations, and their types	**K3**	**IO**
CO3:	Apply lattices with the use of Hassee diagram and study of its properties and various study of different graphs.	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	-	-	L	L	-	-	L	-	L	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	-
CO3	S	S	S	S	S	S	-	-	S	-	S	S

S- Strong; M-Medium; L-Low

COURSE CODE: 19UPCSC3E02 **Credits: 4**

Statistical Computing

On completion of this course you should be able to:

- Understanding the basics of Correlation, Scatter Diagram, Data collection, Sampling, Random Variable,
- Understanding the basic elements of Statistical Inference, Regression, and Correlation. Point and interval concepts
- Analysis Merits and Limitations of Coefficient of Correlation, Linear Regression Equations, Merits and Limitations of Sampling and Methods of Sampling-
- Analysis of the various Python built-in modules and packages which enrich the programming ability of students.
- Apply the Coefficient of Correlation and Probable Error of r, Coefficient of Determination, Testing of Hypothesis, Merits and Limitations of Coefficient of Correlation, Spearman's Rank Correlation
- Apply the Properties of Regression Coefficients- Standard Error of Estimate, Expectation of Random Variable, Properties of Expected Value and Variance
- Apply the Sampling Distribution of a Statistic, Spearman's Rank Correlation
- Evaluate the Confidence interval using normal, *t* and *x2*Distributions- Testing of Hypothesis, Significance of a mean, Using *t* Distribution

Unit-I:

Correlation - Definition of Correlation- Scatter Diagram- Kari Pearson's Coefficient of Linear Correlation- Coefficient of Correlation and Probable Error of r- Coefficient of Determination - Merits and Limitations of Coefficient of Correlation- Spearman's Rank Correlation(7.1-7.9.4).

Unit-II:

Regression Analysis - Regression and Correlation(Intro)- Difference between Correlation and Regression Analysis- Linear Regression Equations -Least Square Method- Regression Lines- Properties of Regression Coefficients- Standard Error of Estimate. (8.1-8.8)

Unit-III:

Probability Distribution and mathematical Expectation- Random Variable- Defined - Probability Distribution a Random Variable- Expectation of Random Variable- Properties of Expected Value and Variance(12.2-12.4).

Unit-IV:

Sampling and Sampling Distributions - Data Collection- Sampling and Non-Sampling Errors – Principles of Sampling-- Merits and Limitations of Sampling- Methods of Sampling- Parameter and Statistic- Sampling Distribution of a Statistic- Examples of Sampling Distributions- Standard Normal, Student's t, Chi-Square (x2) and Snedecor's F- Distributions(14.1-14.16).

Unit-V:

Statistical Inference- Estimation and Testing of Hypothesis - Statistical Inference- Estimation- Point and interval- Confidence interval using normal, t, and x2Distributions- Testing of Hypothesis- Significance of a mean - Using t Distribution(15.1-15.10.2).

Textbook:

1. K.L. Sehgal, "Quantitative Techniques and Statistics", First Edition, Himalaya Publishing House, 2011.

References:

1. N. P. Bali, P. N. Gupta, C. P. Gandhi, "A Textbook of Quantitative Techniques", First Edition, Laxmi Publications, 2008.

2. U. K. Srivastava, G. V. Shenoy, S. C. Sharma, "Quantitative Techniques for Managerial Decisions", Second Edition, New Age International Publishers, 2005.

3. David Makinson, "Sets, Logic, and Maths for Computing", Springer, 2011.

4. Christopher Chatfield," Statistics for Technology- A Course in Applied Statistics, Third Edition", CRC Press, 2015.

Course Outcomes

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

CO1:	Understand correlation and its methods	**K1, K2**	**LO**
CO2:	Apply the correlations using Scatter Diagram-Kari Pearson's method	**K3**	**IO**
CO3:	Understand Regression Analysis - Regression and Correlation(Difference between Correlation and Regression Analysis, Linear Regression Equations	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	-	-	L	L	-	-	L	-	L	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	-
CO3	S	S	S	S	S	S	-	-	S	-	S	S

S- Strong; M-Medium; L-Low

COURSE CODE - 19UPCSC3E03 **Credits: 4**

FUNDAMENTALS OF DATA SCIENCE

Course Objective:

- To learn about the fundamental science of data and concepts of big data
- To learn the lifecycle of the data analytics and data analytics using R
- To learn advanced data analytics methods and big data analytics

Unit - I

Introduction to Big Data Science- Definition of Big Data - Big data characteristics & considerations - Data repositories- analyst perspective - Business drivers for analytics - Typical analytical architecture - Business Intelligence Vs Data science - Drivers of Big data analytics - Role of a data scientist in Big data ecosystem - Applications of Big data analytics.

Unit - II

Data Analytics Lifecycle -Need of Data analytic lifecycle - Key roles for successful analytic projects - various phases of Data analytic lifecycle: Discovery - Data Preparation - Model Planning - Model Building - Communicating Results - Operationalization.

Unit - III

Basic Data Analytics methods using R: Introduction to R: GUI of R - Getting data into & out of R - Data types in R - Basic operations - Basic statistics - Generic functions - Data visualization using R - Data exploration & presentation - Statistics for model building & evaluation.

Unit – IV

Advanced Analytics- Theory & Methods: Clustering - Association Rules - Apriority algorithm - Linear Regression - Logistics Regression - Naïve Bayesian classifiers - Decision Trees

Unit - V

Advanced Analytics –Big Data: Time series analysis - Text analysis -Technology and Tools: MapReduce and Hadoop- Communicating and Operationalizing an Analytics Project - Creating the Final Deliverables

Text Books

1. David Dietrich - Barry Hiller - “Data Science & Big Data Analytics” - EMC education services - Wiley publications - 2012
2. Trevor Hastie - Robert Tibshirani - Jerome Friedman - "The Elements of Statistical Learning" - Springer - Second Edition - 2011.

Reference Books

1. Mark gardner - “Beginning R: The Statistical Programming Language” - Wrox Publication
2. Adam Fowler - “NoSQL For Dummies” - John Wiley & Sons - ISBN-1118905628

Course Outcomes

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

CO1:	Recognize the evolution of data science with its design principles	**K1, K2**	**LO**
CO2:	Evaluate the fundamental science of data and concepts of big data and Basic Data Analytics methods using R	**K3**	**IO**
CO3:	Analyze the impact of Data Analytics Lifecycle and various Time series analysis and Text analysis	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	-	-	L	L	-	-	L	-	L	-	L
CO2	M	M	-	M	M	-	M	-	M	-	M	-
CO3	S	S	S	-	S	-	S	-	S	-	S	S

S- Strong; M-Medium; L-Low

COURSE CODE - 19UPCSC3E04 **Credits: 4**

Data Visualization Techniques

Course Objective:

- To develop skills to both design and critique visualization
- To understand why visualization is an important part of data analysis
- To understand the components involved in visualization design
- To understand the type of data impacts the type of visualization

Unit-I

Data Preparation: Importing Data - Text files -Excel spreadsheets -Statistical packages - Databases - Cleaning Data: Selecting variables - Selecting observations - Creating/Recoding variables - Summarizing data - Using pipes - Reshaping data - Missing data - Introduction to ggplot2 -ggplot- geoms - grouping scales - facets -labels- themes - Placing the data and mapping options-Graphs as objects

Unit-II

Univariate Graphs - Categorical: Bar Chart -Pie Chart - Tree Map- Quantitative - Histogram - Kernel Density plot - Dot Chart - Bivariate Graphs - Categorical vs. Categorical: Stacked bar chart - Grouped bar chart - Segmented bar chart - Improving the color and labeling - Other plots - Quantitative vs. Quantitative: Scatterplot - Line plot- Categorical vs. Quantitative: Bar chart (on summary statistics) - Grouped kernel density plots - Box plots -Violin plots - Ridgeline plots - Mean/SEM plots - Strip plots -Beeswarm Plots -Cleveland Dot Charts - Multivariate Graphs - Grouping - Faceting

Unit- III

Maps: Dot density maps-Choropleth maps: Data by country-Data by US state-Data by US county -Time-dependent graphs: Time series- Dumbbell charts - Slope graphs - Area Charts - Statistical Models: Correlation plots - Linear Regression - Logistic regression - Survival plots - Mosaic plots

Unit- IV

3-D Scatterplot: Biplots - Bubble charts - Flow diagrams -Sankey diagrams-Alluvial diagrams - Heatmaps - Radar charts - Scatterplot matrix - Waterfall charts- Word clouds -Customizing Graphs - Axes: Quantitative axes - Categorical axes - Date axes- Colors: Specifying colors manually-Color palettes: Points & Lines: Points - Lines - Fonts - Legends: Legend location-Legend title - Labels- Annotations: Adding text - Adding lines - Highlighting a single group - Themes- Altering theme elements - Pre-packaged themes

Unit- V

Saving Graphs: Via menus - Via code - File formats -External editing - Interactive Graphs - leaflet - plotly -rbokeh - rCharts - high charter- Best Practices: Labeling - Signal to noise ratio - Color choice- y-Axis scaling - Attribution

Text Book

1. Rob Kabacoff , Data Visualization with R, Bookdown, 2018. Chapters: 1-13 https://rkabacoff.github.io/datavis/

Reference Book

1. Kirthi Raman - Mastering Python Data Visualization -Packt Publishing - 2015

Course Outcomes

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

CO1:	Recognize the feasibility of Data Preparation and Univariate Graphs	**K1, K2**	**LO**
CO2:	Analyze Maps and Statistical Models	**K3**	**IO**
CO3:	Evaluate effectively use 3-D Scatterplot and Saving Graphs	**K4, K5, K6**	**HO**

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

The mapping of course outcomes with programme outcomes is tabulated as follows

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	-	L	-	L	L	L	-	-
CO2	-	-	-	-	-	-	M	M	M	M	M	-
CO3	-	-	-	-	-	-	S	S	S	S	S	S

S- Strong ; M-Medium; L-Low

COURSE CODE – 19UPCSC3E05 **Credits: 3**

PREDICTIVE ANALYTICS

Course Objective:

- To learn fundamentals of data, predictive analytics methods, and techniques.
- To understand the given problem and analyze the results efficiently

Unit -I

Introduction- Entering the Arena: Exploring Predictive Analytics-Adding Business Value-Starting a Predictive Analytics Project-Surveying the Market place: Predictive Analytics in the Wild-Online Marketing and Retail Implementing a Recommender System-Exploring Your Data Types and Associated Techniques: Recognizing Your Data Types-Identifying Data Categories-Generating Predictive Analytics-Connecting to Related Disciplines.

Unit- II

Complexities of Data: Finding Value in Your Data-Constantly Changing Data Complexities in Searching Your Data-Differentiating Business Intelligence from Big-Data Analytics-Visualization of Raw Data-Incorporating Algorithms in Your Models: Applying Models-Modeling Data-Healthcare Analytics Case Studies - Social and Marketing Analytics Case Studies.

Unit- III

Identifying Similarities in Data: Explaining Data Clustering - Converting Raw Data into a Matrix-Identifying K-Groups in Your Data-Finding Associations Among Data Items-Applying Biologically Inspired Clustering Techniques Predicting the Future Using Data Classification: Introducing Data Classification to Your Business-Exploring the Data-Classification Process Using Data Classification to Predict the Future: Decision trees, Support vector machine, Naïve Bayes classification algorithm, Neural networks, The Markov Model, Linear regression. del-Going Live with the Model- Visualization of Analytical Results: Visualization As a Predictive Tool-Evaluating Your Visualization-Visualizing Your Model's Analytical Results.

Unit-V

The Part of Tens-Ten Reasons to Implement Predictive Analytics: Outlining Business Goals-Knowing Your Data-Organizing Your Data-Satisfying Your Customers-Reducing Operational Costs-Increasing Returns on Investments (ROI)-Increasing Confidence-Making Informed Decisions-Gaining Competitive Edge-Improving the Business-Ten Steps to Build a Predictive Analytic Model Building a Predictive Analytics Team-Setting the Business Objectives-Preparing Your Data-Sampling Your Data-Avoiding "Garbage In, Garbage Out"-Creating Quick Victories-Fostering Change in Your Organization-Building Deployable Models-Evaluating Your Model-Updating Your Model.

Textbook

1. Anissa Bari, Mohammad Chaouchi, Tommy Jung, Predictive Analytics For Dummies, 2nd Edition, 2017.

Course Outcomes

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

CO1:	Understand the needs of predictive analytics in various domains.	**K1, K2**	**LO**
CO2:	Evaluate the performance of various classification models with different data.	**K3**	**IO**
CO3:	Design and develop different data predictive models.	**K4, K5, K6**	**HO**

The mapping of course outcomes with program me outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	-	-	L	L	-	-	L	-	-	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	-
CO3	S	S	S	S	S	S	-	-	S	-	S	S

S- Strong; M-Medium; L-Low

COURSE CODE – 19UPCSC3E06 **Credits: 1**

Predictive Analytics Lab

Implement the followings in R studio

1. Perform basics of R programming such as data types, operators, matrices, lists and functions
2. Calculate exploratory data analysis in R
    a. Graphical representation of variables
    b. Dealing with Continuous and Categorical variables
3. Data manipulation in R
    a. Manipulating in rows and columns (Filtering and sorting)
    b. Merging datasets
    c. Reshaping data
4. Perform simple summary statistics of the dataset using R
5. Solve real-world problem using machine learning algorithm of Linear (Multiple) Regression for the given dataset
6. Solve the problem using Decision Tree for the given dataset
7. Cluster the target variable using the K-means clustering algorithm
8. Calculate the Radom Forest to find the optimum value of model parameters
9. Solve the classification problem using Logistic Regression for the given dataset
10. Calculate the Naive Bayes for the given dataset

COURSE CODE - 19UPCSC3E07 **Credits: 3**

TEXT ANALYTICS

Course Objective:

- To interpret the basics of text analysis.
- To infer about text mining - text analytics and web analytics.
- To illustrate the domains that makeup text analytics and web analytics.

Unit - I

History of Text Mining 6: Roots of text mining - Information extraction and text mining - Development of enabling technology in text mining - Sentiment analysis and opinion mining.

Unit - II

Basics of Text Analytics 6: Definition - Business challenges addressed: information organization and access - Discovery of patterns – Discovery.

Unit - III

Seven Practice Areas of Text Analytics 6: Seven practice areas of text analytics - Finding the appropriate solution to a problem - Overall relationship - Visualizing the domains of text analytics.

Unit - IV

Web Analytics and Web Mining 9: Value of web analytics - Components of web mining - Concepts and terminology in web analytics - Web analytics and web mining - Optimal paths to successful web analytics evolution in a company.

Unit - V

Future of Text and Web Analytics 9: Text analytics and text mining - Future of web analytics - Future of text mining - Integration of web analytics with standard business intelligence tools – New areas that may use text analytics.

Text Books

1. Gary Miner John Elder IV - Robert Nisbet - DursunDelen - Thomas Hill - Andrew Fast - “Practical Text Mining and Statistical Analysis for Non-structured Text Data Applications” -1st Edition - Academic Press - 2012.
2. Brian Clifton Sybex - “Advanced Web Metrics with Google Analytics” - 3rd Edition - Pearson education - 2012.

Course Outcomes

CO1:	Recognize the feasibility of History of Text Mining and Basics of Text Analytics	**K1, K2**	**LO**
CO2:	Analyze Seven Practice Areas of Text Analytics	**K4**	**IO**
CO3:	Evaluate effectively use of Web Analytics and Web Mining and Future of Text and Web Analytics	**K4, K6**	**HO**

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

The mapping of course outcomes with program outcomes is tabulated as follows

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	-	L	-	L	L	L	-	-
CO2	-	-	-	-	-	-	M	M	M	M	M	-
CO3	-	-	-	-	-	-	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

COURSE CODE - 19UPCSC3E08 **Credits: 1**

Text Analytics Lab

Implement the followings in python:

1. Perform Text –Wrangling and pre-processing textual data using python
2. Calculate number of words, number of characters, average word length and number of stop words
3. Remove the words using Tokenization (Stop words removal, punctuations ,etc.,) for text data.
4. Calculate N-grams and term frequency for multiple words in the dataset
5. Calculate Inverse Document Frequency and Term Frequency –Inverse Document Frequency (TF-IDF) for words
6. Perform sentiment analysis of few tweets in python
7. Convert the text into vectors using words embedding techniques
8. Write code that groups document by topic
9. Solve using supervised model for text data
10. Solve using the unsupervised model for text data

COURSE CODE - 19UPCSC3E09 **Credits: 4**

WEB ANALYTICS

Course Objective:

- To learn effective problem-solving methodologies in Computing applications
- To provide an overview and establish the need for web analytics.
- To understand and apply metrics to analyze the web data.
- To provide exposure to the usage of web analytic tools.

Unit - I

Introduction to Web Analytics 7: A Brief History of Web Analytics –Web Analytics Terminology – Traditional Web Analytics – Web Analytics 2.0 – Capturing Data-Tools Selection – Quality Aspects –Implementing Best Practices.

Unit - II

Web Data Collection 9: Web Traffic Data – Web Transactional Data – Web Server Data – Page Weights– Usability Studies – User Submitted Information – Integrating Form-based data – Web Data Sources – Server Log Files – Page Tags – Clickstream Data –Outcomes Data – Research Data –Competitive Data.

Unit - III

Web Analytics Strategy 7: Component of Web Analytics Strategy – Customer-Centric Focus – Business Problem Solving Focus – Reporting vs Analysis – IT and Business Strength – Clickstream vs Web 2.0 – Vendor-Specific Options and Issues.

Unit - IV

Metrics and KPIs 7: Measuring Reach – Measuring Acquisition – Measuring Conversion – Measuring Retention – Focus on 'Critical Few'- Key Performance Indicators – Case Studies.

Unit - V

Data Analysis: Customer centricity – Lab Usability Studies – Usability Alternatives – Surveys – Heuristic Evaluations - Web-enabled user research options – Competitive Intelligence Analysis Content organization tool – Process measurement tools- Visitor Segmentation Tools- Campaign Analysis – Commerce Measurement Tools -Google Analytics – Piwik Web Analytics – Yahoo Web Analytics – Emerging Analytics: Social - Video - Mobile.

Reference Books

1. Avinash Kaushik - “Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity” - 1st Edition - Sybex - 2009.
2. Brian Clifton - “Advanced Web Metrics with Google Analytics” - 3rd Edition - Sybex - 2012.
3. Eric Peterson - “Web Analytics Demystified: A Marketer's Guide to Understanding How Your Web Site Affects Your Business” -1st Edition - Celilo Group Media - 2004.
4. Avinash Kaushik - “Web Analytics: An Hour a Day” - 6th Edition - Sybex - PAP/ CDR Edition - 2007.
5. Justin Cutroni - “Google Analytics” - 2nd Edition - O'Reilly Media - 2010.

Course Outcomes

CO1:	Recognize Component of Web Analytics Strategy	**K1, K2**	**LO**
CO2:	Analyze Key Performance Indicators Techniques	**K4**	**IO**
CO3:	Evaluate Process measurement and Visitor Segmentation tools	**K4, K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	-	-	-	L	L	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	-
CO3	S	S	S	M	S	-	-	M	S	S	S	-

S- Strong; M-Medium; L-Low

COURSE CODE - 19UPCSC3E10 **Credits: 4**

MARKET ANALYTICS

Course Objective:

- To learn effective problem-solving methodologies in Computing applications
- To introduce the principles and strategic concepts of marketing analytics.
- To understand cost concepts (TOTAL HOURS - fixed - variable) - profit margins - and lifetime value of the customer.
- To get an overview of the benefits and objectives of quantitative marketing.

Unit - I

Introduction: Introduction to Marketing Analytics – Market Insight – Market sizing and trend analysis.

Unit - II

Market Segmentation: Market segmentation – Segment identification - analysis - and strategy - Competitive analysis- Competitor identification - analysis and strategy.

Unit - III

Business Strategy and Operations: Business Strategy - Analytics-based strategy selection - Business Operations - Forecasting - predictive analytics - and data mining.

Unit - IV

Product - Service and Price Analytics: Product and Service Analytics - Conjoint analysis and product/service metrics - Price Analytics - Pricing techniques and assessment.

Unit - V

Distribution and Promotion Analytics: Distribution Analytics - Analytics-based channel evaluation and selection - Promotion Analytics - Promotion budget estimation and allocation. Sales Analytics and Analytics in Action: Sales Analytics - Metrics for sales - profitability - and support- Analytics in Action - Pivot tables and data-driven presentations.

Text Books

1. Stephan Sorger - “Marketing Analytics: Strategic Models and Metrics” - 1st Edition - Create Space Independent Publishing Platform - 31-Jan-2013.
2. Stephan Sorger - “Marketing Planning: Where Strategy Meets Action” - 1st Edition - Prentice Hall PTR - 03-Sep-2011.
3. Cesar A.Brea - “Pragmalytics: Practical approaches to the Marketing analytics in the Digital Age” -1st Edition - iUniverse - 2012.

Course Outcomes

CO1:	Understanding the concepts of various problem-solving methodologies in market analytics	**K2**	**IO**
CO2:	Apply and Analyze the various business strategies and its operations and competitor analysis	**K3, K4**	**LO**
CO3:	Analyze and Evaluate various budget estimation and allocation, sales analytics methodologies and apply in real-time	**K4, K5, K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	-	L	-	L	L	L	L	L
CO2	M	M	M	M	-	M	M	-	M	M	-	M
CO3	S	S	S	-	S	S	-	S	S	-	S	S

S- Strong; M-Medium; L-Low

ELECTIVE - III

COURSE CODE – 19UPCSC3E11 **Credits: 3**

OPERATIONS RESEARCH

Course Objectives:

- To understand the concept of optimization
- To develop a mathematical model of real-life cases
- To study Optimization algorithms

Unit – I

Linear Programming Problem (LPP): Formulations and graphical solution of (2 variables) canonical and standard terms of linear programming problem.

Unit – II

Algebraic Solution: Simplex algorithm - Simplex methods – solving problems with slack variable

Unit – III

Transportation Model: North West corner Method - Least cost method - and Vogel‟s approximation method. Assignment Model: Hungarian assignment model – Travelling salesman problem.

Unit – IV

Replacement Problem: Replacement policy for equipment that deteriorate gradually - Replacement of item that fails suddenly-Individual and group replacement - Problems in mortality and staffing.

Unit – V

Project Scheduling PERT/CPM Networks – Fulkerson‟s Rule – Measure Of Activity – PERT Computation – CPM Computation – Resource Scheduling.

Text Books

1. Kanti Swarup - P.K. Gupta &Manmohan – Operation Research 1996.
2. S.Kalavathy: Operations Research – Second Edition – Vikas Publishing House Pvt.Ltd. – 2004.

Course Outcomes

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

CO1:	Understand the optimization	**K1, K2**	**LO**
CO2:	Apply the optimization algorithms and linear programs	**K3**	**IO**
CO3:	Develop a mathematical model of real-life cases	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	-	L	-	L	L	L	-	-
CO2	-	-	-	M	M	-	M	M	M	M	M	-
CO3	-	-	-	-	-	-	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

COURSE CODE – 19UPCSC3E12 **Credits: 1**

Operations Research Lab

Problems to be performed using OR/Statistical packages

1. Solution of Transportation Problem.
2. Solution of Assignment Problem
3. Solution of traveling salesman problem.
4. Solution of Shortest path problem.
5. Project planning (Deterministic case-CPM).
6. Project planning (Probabilistic case-PERT).
7. Crashing of the Project.
8. Resource Scheduling.
9. Simplex problem
10. Solution of shortest path problem.

COURSE CODE:19UPCSC2E13 **Credits: 4**

OPTIMIZATION TECHNIQUES

Course Objective

- To understand the concept of optimization
- To develop a mathematical model of real-life cases
- To study Optimization algorithms

Unit – I: Linear Programming Problem

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 – II: Transportation and Assignment Problems

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

Unit – III: CPM/PERT

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

Unit – IV: Non-Linear Optimization Models

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

Unit – V: Unconstraint Optimization Models

Particle Swarm Optimization method – Ant Colony optimization algorithm – Fruit Fly method – FireFly method

Text Book

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 134 Clever Algorithms, Springer, 2014. (Unit 5)

Reference Books:

1. Hamdy A. Taha, Operations Research: An Introduction, Pearson, 2010

 Course outcome

On successful completion of the course, the students will

CO1:	Understand the concept of optimization	**K1, K2**	**LO**
CO2:	Formulate the Mathematical Model on various applications	**K3**	**IO**
CO4:	Solve the Linear Programming Problems using different models	**K4, K5, K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	L	-	-	L	L	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	M
CO3	S	S	S	S	S	-	-	S	S	S	-	-

S- Strong; M-Medium; L-Low

COURSE CODE – 19UPCSC3E14 **Credits: 4**

Probability and Stochastic Process

Course Objectives:

- To learn the basic methodology of "probabilistic thinking" and to apply it to probabilistic problems in signal processing and Communication Engineering;
- To understand basic concepts of probability theory - random variables - Conditional probability and conditional expectation - joint distribution and independence - mean square estimation.
- To understand the difference between time averages and statistical averages

Unit – I

Probability: Probability introduced through Sets and Relative Frequency - Experiments and Sample Spaces - Discrete and Continuous Sample Spaces - Events - Probability Definitions and Axioms - Mathematical Model of Experiments - Probability as a Relative Frequency - Joint Probability - Conditional Probability - Total Probability - Baye's Theorem - Independent Events. Random Variable: Definition of a Random Variable - Conditions for a Function to be a Random Variable - Discrete - Continuous - and Mixed Random Variables

Unit – II

Distribution & Density Functions: Distribution and Density functions and their Properties – Binomial - Poisson - Uniform - Gaussian - Exponential - Rayleigh and Conditional Distribution - Methods of defining Conditional Event - Conditional Density - and Properties. Operation on One Random Variable – Expectations: Introduction - Expected Value of a Random Variable - Function of a Random Variable - Moments about the Origin - Central Moments - Variance and Skew - Chebychev's Inequality - Characteristic Function - Moment Generating Function - Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable - Non-monotonic Transformations of Continuous Random Variable - Transformation of a Discrete Random Variable.

Unit – III

Multiple Random Variables: Vector Random Variables - Joint Distribution Function - Properties of Joint Distribution - Marginal Distribution Functions - Conditional Distribution and Density – Point Conditioning - Conditional Distribution and Density – Interval conditioning - Statistical Independence - Sum of Two Random Variables - Sum of Several Random Variables - Central Limit Theorem (Proof not expected) - Unequal Distribution - Equal Distributions. Operations on Multiple Random Variables: Expected Value of a Function of Random Variables: Joint Moments about the Origin - Joint Central Moments - Joint Characteristic Functions - Jointly Gaussian Random Variables: Two Random Variables case - N Random Variable case - Properties - Transformations of Multiple Random Variables - Linear Transformations of Gaussian Random Variables.

Unit – IV

Stochastic Processes – Temporal Characteristics: The Stochastic Process Concept - Classification of Processes - Deterministic and Nondeterministic Processes - Distribution and Density Functions - Concept of Stationarity and Statistical Independence - First-Order Stationary Processes - Second-Order and Wide-Sense Stationarity - Nth Order and Strict-Sense Stationarity - Time Averages and Ergodicity - Mean Ergodic Processes - Correlation-Ergodic Processes - Autocorrelation Function and its Properties - Cross-Correlation Function and its Properties - Covariance and its Properties - Linear System Response of Mean and Mean-squared Value - Autocorrelation Function - Cross-Correlation Functions - Gaussian Random Processes - Poisson Random Process.

Unit – V

Stochastic Processes – Spectral Characteristics: Power Spectrum: Properties - Relationship between Power Spectrum and Autocorrelation Function - Cross-Power Density Spectrum - Properties - Relationship between Cross-Power Spectrum and Cross-Correlation Function - Spectral Characteristics of System Response: Power Density Spectrum of Response - Cross-Power Spectral Density of Input and Output of a Linear System.

Textbooks

1. Probability - Random Variables & Random Signal Principles – Peyton Z. Peebles - 4Ed. - 2001 - TMH.

2. Probability and Random Processes – Scott Miller - Donald Childers - 2 Ed - Elsevier - 2012.

Reference Books

1. Probability - Random Variables and Stochastic Processes – Athanasios Papoulis and S. Unnikrishna Pillai - 4 Ed. - TMH.
2. Theory of Probability and Stochastic Processes- Pradip Kumar Gosh - UniversityPress
3. Probability and Random Processes with Application to Signal Processing – Henry Stark and John W. Woods - 3 Ed. - PE
4. Probability Methods of Signal and System Analysis – George R. Cooper - Clave D. MC Gillem - 3 Ed. - 1999 - Oxford.
5. Statistical Theory of Communication – S.P. Eugene Xavier - 1997 - New Age Publications.

Course outcome:

On successful completion of the course, the students will

CO1:	Recognize the basics of probability, the difference between time averages and statistical averages	**K1, K2**	**LO**
CO2:	Apply the probabilistic principles to signal processing and Communication Engineering	**K3**	**HO**
CO4:	Assess the characteristics of the stochastic process and create models to solve real-time problems	**K4, K5, K6**	**IO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	-	L	L	-	-	L	L	L	-
CO2	M	M	-	M	M	-	M	-	M	M	M	M
CO3	S	S	S	S	S	-	S	S	S	S	-	-

S- Strong; M-Medium; L-Low

COURSE CODE – 19UPCSC3E15 **CREDITS- 4**

LINEAR PROGRAMMING

Course Objective:

- To learn effective problem-solving methodologies in Computing applications
- To introduce methods of optimization to engineering students.
- To know numerous applications in civil - environmental - electrical (control) engineering - and industrial engineering.
- To maintain a balance between theory - numerical computation - problem setup for solution by optimization software - and applications to engineering systems.

Unit - I

Linear Programming: Standard form of a linear programming problem – Geometry of linear programming problems – Definitions and theorems – Solution of a system of linear simultaneous equations – Pivotal reduction of a general system of equations – Motivation to the simplex method – Simplex algorithm.

Unit - II

Non-Linear Programming: Unconstrained Non-Linear Programming- 1-dimensional minimization methods- Classification - Fibonacci method and Quadratic interpolation method -Constrained Non-Linear Programming: Characteristics of a constrained problem – Classification - The basic approach of Penalty Function method- Basic approaches of Interior and Exterior penalty function methods- Introduction to convex Programming Problem.

Unit - III

Transportation Problem: Finding initial basic feasible solution by north – West corner rule - least-cost method and Vogel's approximation method – Testing for optimality of balanced transportation problems.

Unit - IV

Unconstrained Optimization Techniques: Analytical method -Newton's method- Golden-section search method - Univariate method - Powell's method - Steepest descent method.

Unit - V

Dynamic Programming: Dynamic programming multistage decision processes – Types – Concept of sub-optimization and the principle of optimality – Computational procedure in dynamic programming – Examples illustrating the calculus method of solution - Examples illustrating the tabular method of solution.

Text Books

1. S.Rao - "Engineering optimization: Theory and practice" - 4th Edition – New Age International - 2009.
2. H.S. Kasene& K.D. Kumar - "Introductory Operations Research" -3rd Edition -Springer India Pvt .LTd. - 2002.
3. H.A. Taha - "Operations Research: An Introduction" - 6th Edition - PHI Pvt. Ltd - 2004.

Course outcome

On successful completion of the course, the students will

CO1:	Understand LPP and Non-Linear programming principles	**K1, K2**	**LO**
CO2:	Apply transportation methods to find feasible solutions	**K3**	**HO**
CO4:	Assess the characteristics of Unconstrained Optimization Techniques to solve problems	**K4, K5, K6**	**IO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	-	L	-	L	L	L	-	L	L	L	L
CO2	M	M	-	M	M	M	M	-	M	M	M	M
CO3	S	S	S	S	S	S	S	S	-	S	-	-

S- Strong; M-Medium; L-Low

ELECTIVE – IV

COURSE CODE – 19UPCSC3E16 **CREDITS- 3**

BIG DATA ANALYTICS

Course Objective:

- To get familiar with the Concepts, Terminology, Characteristics and Life Cycle of Big Data Analytics
- To Analyze the Benefits and Challenges of core components of Hadoop and apply File System Shell Commands for HDFS.
- To Select Key and Value Types for MapReduce Jobs and analyze the Hadoop Distributed File System
- To Examine the Apache Hive and HBase Environment for Create Table, Insert Data and Alter Data in Apache Server
- To Develop and Test Pig Latin Scripts and Writing Evaluation and Filter Functions

Unit – I Fundamentals of Big Data

Understanding Big Data: Concepts and Terminology – Big Data Characteristics – Types of Data – Case Study Background – Drivers for Big Data Adoption: Information and Communication Technology – Big Data Analytics Lifecycle

Unit – II Fundamentals of Hadoop

Core components of Hadoop- Apache Hadoop – HDFS Daemons – MapReduce Daemons – HDFS High Availability Daemons – Benefits and Challenges of HDFS – File Sizes, Block Sizes and Block Abstraction in HDFS – Data Replication – How does HDFS Store, Read, and Write Files? – Data Serialization Options – File System Shell Commands for HDFS

Unit – III HDFS and MapReduce

Choosing Key and Value Types for MapReduce Jobs – The Relationship of Input Keys to Output Keys – Sorting Keys and Values – Sort and Shuffle Process – MapReduce Job Configuration and Submission

Hadoop Distributed File System – MapReduce Framework – Setting the Environment – Hadoop Cluster Modes – Running a MapReduce Job with the MR1Framework - Running a MapReduce Job with the Yarn Framework – Running Hadoop Streaming

Unit – IV Hive and HBase

Apache Hive: Setting the Environment – Configuring Hadoop, Hive – Starting HDFS, Hive Server, CLI – Creating and Using a Database– Creating a Managed Table – Loading Data into a Table – Creating a Table using LIKE – Adding Data into a Table from Queries – Adding Data using INSERT INTO TABLE - Adding Data using INSERT OVERWRITE – Creating a table using CREATE TABLE AS SELECT – Altering, Truncating and Dropping a Table– Creating an External Table – Apache HBase: Setting the Environment - Configuring Hadoop, Hive and HBase – Starting the HBase and HBase Shell – Creating HBase Table – Adding Data to a Table – Listing all Tables – Getting a Row of Data – Scanning a Table – Counting the Number of Rows in a Table – Altering a Table – Deleting a Table Row, Column – Disabling and Enabling a Table – Truncating and Dropping a Table – Determining If Table Exists – Creating a Hive External Table stored by HBase

Unit – V Pig

Introduction – Installing and Running Pig – Grunt – Pig's Data Model – Introduction to Pig Latin – Advanced Pig Latin – Developing and Testing Pig Latin Scripts – Making Pig Fly – Writing Evaluation and Filter Functions – Writing and Loading Store Function

Text Books

1. Alan Gates, "Programming Pig", Oreilly Publication, 2011.
2. Deepak Vohra, "Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-related Frameworks and Tools", Apress, 2016.
3. Thomas Erl, WajidKhattak, Paul Buhler, "Big Data Fundamentals Concepts, Drivers & Techniques", Service Tech Press, 2015.

Reference Books

1. Noreen Burlingame , "The little book on Big Data", New Street publishers, 2012.
2. Anil Maheshwari, " Data Analytics", McGraw Hill Education, 2017.

Course Outcomes

CO1:	Recognize the Big Data Analytics Concepts, Terminology, Characteristics and Life Cycle of Big Data Analytics	**K1,K2**	**LO**
CO2:	Evaluate the different core components of Hadoop and apply File System Shell Commands in HDFS. Analyze the Mapper and Reducer Key/Value Types for MapReduce Jobs and perform the Mapreduce job in MR1Framework and Yarn Framework	**K3**	**IO**
CO3:	Apply Query Statements for Create Table, Insert Data and Alter Data in the Apache Hive and HBase Environment . Apply Pig Latin Scripts for Writing, Evaluation and Filter Functions	**K4,K5,K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	-	L	-	L	L	L	-	L	L	L	L
CO2	M	M	-	M	M	M	M	-	M	M	M	M
CO3	S	S	S	S	S	S	S	S	-	S	-	-

S- Strong; M-Medium; L-Low

COURSE – 19UPCSC3E17 **CREDITS- 1**

BIG DATA ANALYTICS LAB

1. Implement File System Shell Commands for HDFS in Hadoop Environment
2. Write a MapReduce program using single reduce function for finding Maximum and Minimum Number
3. Write a MapReduce program using multiple reduce function for Word Count in a given Text Document
4. Write a MapReduce program for Matrix Multiplication
5. Write a MapReduce program using multiple reduce function for Matrix Multiplication
6. Implement the following using Pig Latin
   6.1 Input and Output Operations
   6.2 Relational Operations
7. Implement the following using Pig Latin
   a. User-Defined Functions
   b. Advanced Relational Operations
8. Implement the following using Hive commands
   a. Handling the Database
   b. Creating and Manipulating Table
9. Implement the following using Hbase commands
   a. Creation of Tables
   b. Table Manipulation
10. Create a Hive External Table stored by HBase in Hive

COURSE – 19UPCSC3E18 **CREDITS- 4**

INFORMATION RETRIEVAL

Course Objective:

- To understand the basics of the information retrieval process.
- To evaluate the performance of the IR system.
- To explore information sharing on the semantic web.
- To understand the various applications of Information Retrieval giving emphasis to multimedia and distributed IR - web Search.

Unit - I

Introduction: Basic Concepts of IR - Data Retrieval & Information Retrieval - IR system block diagram. Automatic Text Analysis: Luhn's ideas - Conflation Algorithm - Indexing and Index Term Weighing - Probabilistic Indexing - Automatic Classification. Measures of Association - Different Matching Coefficient - Classification Methods - Cluster Hypothesis - Clustering Algorithms - Single-Pass Algorithm - Single Link Algorithm - Rocchio's Algorithm.

Unit - II

Storage and Searching Techniques: Storage: Inverted file - Suffix trees & suffix arrays - Signature Files - Scatter storage or hash addressing - Clustered files.IR Models: Basic concepts - Boolean Model - Vector Model Searching strategies: Boolean Search - Serial search - cluster-based retrieval - Query languages - Types of queries - Patterns matching - structural queries.

Unit - III

Retrieval Performance Evaluation and Ontology: Performance evaluation: Precision and recall - alternative measures Ontology: Ontology-based information sharing - Ontology languages for semantic web - Ontology creation.

Unit - IV

Distributed and Multimedia IR: Distributed IR: Introduction - Collection Partitioning - Source Selection - Query Processing - web issues. MULTIMEDIA IR: Introduction - Data Modeling - Query languages - Generic multimedia indexing approach - One-dimensional time series - two-dimensional color images - Automatic feature extraction.

Unit - V

Web Searching and Web Recommendation: Searching the Web: Challenges - Characterizing the Web - Search Engines - Browsing - Meta-searchers - Web crawlers - Meta-crawler - Web data mining - Finding a needle in the Haystack - Searching using Hyperlinks - Page ranking algorithms. Collaborative Filtering and Content-Based Recommendation of Documents and Products - Information

Extraction and Integration: Extracting Data from Text. Semantic Web - Collecting and Integrating Specialized Information on the web.

Text Books

1. Yates &Neto - "Modern Information Retrieval" - Pearson Education - ISBN 81-297-0274-6.
2. C.J. Rijsbergen - "Information Retrieval" - (www.dcs.gla.ac.uk).
3. Heiner Stuckenschmidt - Frank van Harmelen - “Information Sharing on the Semantic Web” - Springer International Edition-ISBN 3-540-20594-2.

Reference Books

1. Christopher D. Manning - PrabhakarRaghavan and HinrichSchutze “Introduction to Information Retrieval” - Cambridge University Press - ISBN 978-0-521-86571-5
2. Mark leven - “Introduction to search engines and web navigation” - John Wiley and sons Inc. - ISBN 9780-170-52684-2.
3. V. S. Subrahamanian - Satish K. Tripathi “Multimedia information System” - Kulwer Academic Publisher.
4. ChabaneDjeraba -”Multimedia mining A highway to intelligent multimedia documents” - Kulwer Academic Publisher - ISBN 1-4020-7247-3.
5. Ricci - F - Rokach - L. Shapira - B.Kantor - “Recommender Systems Handbook” - First Edition - 2011.
6. Stefan Buttcher - Charles L. A. Clarke - Gordon V. Cormack - Information Retrieval Implementing and Evaluating Search Engines - The MIT Press - Cambridge - Massachusetts London - England - 2010.

Course Outcomes

CO1:	Recognize the basic Concepts of information retrieval, and the distributed and multimedia IR	**K2**	**IO**
CO2:	Apply and Analyze various storage and searching techniques	**K3, K4, K6**	**LO**
CO3:	Evaluate the performance of information retrieval and ontology	**K3**	**HO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	-	L	L	-	L	L	-	L	L
CO2	M	M	M	-	M	-	M	-	M	M	-	M
CO3	S	-	S	-	S	S	-	S	S	-	S	S

S- Strong; M-Medium; L-Low

COURSE – 19UPCSC3E19 **CREDITS- 3**

NATURAL LANGUAGE COMPUTING

Course objective

- To get introduced to language processing technologies for processing the text data.
- To understand the role of Information Retrieval and Information Extraction in Text Analytics.
- To acquire knowledge on text data analytics using language models.

Unit-I

Natural Language Processing – Linguistic Background -– Mathematical Foundations - Morphological Analysis-Tokenization- Stemming-Lemmatization – Boundary Determination.

Unit-II

Reading unstructured data - Representing text data - Part of speech tagging – Syntactic representation - Text similarity - WordNet-based similarity- Shallow parsing –Semantic representation.

Unit-III

Information retrieval and Information extraction - Named Entity Recognition – Relation Identification-Template filling.

Unit-IV

Language model - Probabilistic Models - n-gram language models- Hidden Markov Model- Topic Modelling - Graph Models -Feature Selection and classifiers -Rule-based Classifiers - Maximum entropy classifier – Clustering-Word and Phrase-based Clustering.

Unit-V

Tools – Natural Language Tool kit, Apache OpenNLP. Applications of Text Analytics – Applications in Social media - Life science - Legal Text–Visualization -Case studies.

Text Books

1. Christopher D. Manning and HinrichSchutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
2. Steven Struhl, “Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence”, Kogan Page, 2015.
3. Matthew A. Russell, “Mining the Social Web”, O'Reilly Media, 2013.
4. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, 1st Edition, O'Reilly Media, 2009.

Course Outcomes

CO1:	Analyze role of Information Retrieval and Information Extraction in Text Analytics.	**K1,K2,K4**	**LO**
CO2:	Understand the concept of text data analytics using language models	**K2**	**IO**
CO3:	Analyze the text content to provide predictions related to a specific domain using language model	**K4,K5,K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	L	L	L	L	-	-	-	-	L	-
CO2	M	M	M	M	M	-	M	M	-	-	M	M
CO3	S	S	S	S	S	-	-	-	-	-	S	-

S- Strong; M-Medium; L-Low

COURSE – 19UPCSC3E20 **CREDITS- 1**

NATURAL LANGUAGE COMPUTING LAB

Implement the following in Python

1. Word Tokenization
2. Sentence Tokenization
3. Stop Word Removal
4. Stemming
5. Frequencies of distinct words
6. Remove digits from a given sentence
7. Identify and remove special characters from a given sentence
8. Word n-gram generation from a given sentence
9. Identification of keywords from a given document
10. Document Classification

COURSE – 19UPCSC3E21 **CREDITS- 4**

IMAGE AND VIDEO ANALYTICS

Course objectives:

- To teach the fundamentals of digital image processing, image and video analysis.
- To understand the real time use of image and video analytics.
- To demonstrate real time image and video analytics applications and others.

Unit-I

Digital image representation- Visual Perception- Sampling and Quantization. Basic Relations between Pixels- Mathematical Tools Used in Digital Image Processing: Fundamental Operations –Vector and Matric Operations- Image Transforms (DFT, DCT, DWT, Hadamard).

Unit-II

Fundamentals of spatial filtering: spatial correlation and convolution smoothing blurring- sharpening- edge detection - Basics of filtering in the frequency domain: smoothing-blurring- sharpening--Histograms and basic statistical models of image.

Unit-III

Colour models and Transformations – Image and Video segmentation-Image and video demonizing- Image and Video enhancement- Image and Video compression.

Unit-IV

Object detection and recognition in image and video-Texture models Image and Video 25 classification models- Object tracking in Video.

Unit-V

Applications and Case studies- Industrial- Retail- Transportation & Travel Remote sensing-Video Analytics in WSN: IoT Video Analytics Architectures.

Reference Books

1. R.C. Gonzalez and R.E. Woods.” Digital Image Processing”, 3rd Edition. Addison Wesley, 2007.

2. W. Härdle, M. Müller, S. Sperlich, A. Werwatz, “Nonparametric and Semi parametric Models”, Springer, 2004.

3. Rick Szelisk, “Computer Vision: Algorithms and Applications”, Springer 2011.

4. Jean-Yves Dufour, “Intelligent Video Surveillance Systems”, Wiley, 2013.

5. Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.

6. AsierPerallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola, "Intelligent Transport Systems: Technologies and Applications", Wiley, 2015.

7. Basudeb Bhatta, "Analysis of Urban Growth and Sprawl from Remote Sensing Data", Springer, 2010

Course Outcomes

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

CO1:	Understand the needs of image and video analysis in various domains.	**K1, K2**	**LO**
CO2:	Evaluate different image and video processing models like preprocessing, segmentation, object recognition.	**K3**	**IO**
CO3:	Design and develop different real time applications.	**K4, K5, K6**	**HO**

The mapping of course outcomes with program me outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	-	-	L	L	-	-	L	-	-	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	-
CO3	S	S	S	S	S	S	-	-	S	S	S	S

S- Strong; M-Medium; L-Low

ELECTIVE - V

COURSE - 19UPCSC3E22 **Credits: 4**

SOCIAL NETWORKING AND MINING

Course objectives:

- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network.
- To understand the evolution of the social network.
- To mine the interest of the user.

Unit-I

Introduction- Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

Unit-II

Modeling And Visualization- Visualizing Online Social Network Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce – Ontological representation of social individuals and relationships.

Unit-III

Mining Communities- Aggregating and reasoning with social network data- Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

Unit-IV

Text and Opinion Mining- Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time.

Unit-V

Tools for Social Network Analysis- UCINET – PAJEK – ETDRAW – StOCNET – Splus – R – NodeXL – SIENA and RSIENA – Real world Social Networks (Facebook- Twitteretc.)

Text Books

1. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011.
2. Peter Mika, "Social Networks and the Semantic Web", 1st edition, Springer, 2007.
3. BorkoFurht, "Handbook of Social Network Technologies and Applications", 1st edition, Springer, 2010.
4. GuandongXu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking –Techniques and applications", 1st edition, Springer, 2011.
5. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
6. Ajith Abraham, Aboul Ella Hassanien, VáclavSnáel, "Computational Social
7. Network Analysis: Trends, Tools and Research Advances", Springer, 2009.
8. Toby Segaran, "Programming Collective Intelligence", O'Reilly, 2012.
9. Sule Gündüz-Ogüdücü, A. Şima Etaner-Uyar, "Social Networks: Analysis and Case Studies", Springer, 2014.

Course Outcomes

CO1:	Recognize various aspects of social network analysis and	**K1, K2**	**LO**
CO2:	Analyze Sentiment classification and clustering Techniques	**K4**	**IO**
CO3:	Evaluate Community Mining Algorithms	**K4, K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	-	-	-	L	L	-	-
CO2	M	M	M	M	M	-	-	-	M	M	M	-
CO3	S	S	S	M	S	-	-	S	S	S	-	-

S- Strong; M-Medium; L-Low

COURSE – 19UPCSC3E23 **CREDITS- 4**

WEB INTELLIGENCE

Course objectives:

- To know the importance of qualitative data, get insights and techniques.
- To develop customer-centric approach in dealing with data.
- To know the principles, tools and methods of web intelligence.
- To apply analytics for business situations.

Unit-I

Web Analytics – Basics – Traditional Ways – Expectations – Data Collection – Clickstream Data – Weblogs – Beacons – JavaScript Tags – Packet Sniffing – Outcomes data – Competitive data – Search Engine Data.

Unit-II

Qualitative Analysis – Customer Centricity – Site Visits – Surveys – Questionnaires – Website Surveys – Post visits – Creating and Running-Benefits of surveys – Critical components of successful strategy.

Unit-III

Web Analytic concepts – URLS – Cookies – Time on site – Page views – Understand standard reports – Website content quality – Navigation reports (top pages, top destinations, site overlay). – Search Analytics – Internal search, SEO and PPC – Measuring Email and Multichannel Marketing - Competitive intelligence and Web 2.0 Analytics – Segmentation – Connectable reports.

Unit-IV

Google Analytics: Analytics - Cookies - Accounts vs Property - Tracking Code - Tracking Unique Visitors - Demographics - Page Views & Bounce Rate Acquisitions - Custom Reporting.

Unit-V

Goals & Funnels – Filters - Ecommerce Tracking - Real Time Reports - Customer Data Alert - Adwords Linking - Adsense Linking -Attribution Modeling - Segmentation - Campaign Tracking - Multi-Channel Attribution.

References:

1. Avinash Kaushik, “Web Analytics 2.0: The Art of Online Accountability and Science Of Customer Centricity “, 1st edition, Sybex, 2009.
2. Michael Beasley, “Practical Web Analytics for User Experience: How Analytics
   can help you Understand your Users”, Morgan Kaufmann, 2013.
3. Magician El-Nasr, Anders Drachen, Alessandro Canossa, Eds., “Game Analytics: Maximizing the Value of Player Data”, Springer, 2013.
4. Bing Liu, “Web Data Mining: Exploring Hyperlinks, Content, and Usage Data”, 2nd Edition, Springer, 2011.
5. Justin Cutroni, “Google Analytics”, O’Reilly, 2010.
6. Eric Fettman, Shiraz Asif, FerasAlhlou , “Google Analytics Breakthrough”, John Wiley & sons, 2016.

Course Outcomes

CO1:	To Understand importance of qualitative data, terminologies related to web analytics.	**K1,K2**	**LO**
CO2:	Analyze various web analytic concepts	**K4**	**IO**
CO3:	To apply analytics for business situations.	**K1, K2,K3**	**HO**

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

Mapping with Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	L	L	-	-	-	-	-	-	L	-
CO2	M	M	M	M	-	M	-	-	M	-	M	-
CO3	S	S	S	S	-	S	-	-	S	-	S	-

S- Strong; M-Medium; L-Low

COURSE – 19UPCSC3E24 **CREDITS- 4**

DEEP LEARNING TECHNIQUES

Course objectives:

- To understand the evolution of deep architectures
- To apply deep learning principles to Natural Language Processing
- To assess the challenges of multimodality and reinforcement learning

Unit -I

Deep Learning: AI and deep learning - The history and rise of deep learning - Why Deep Learning? - The motivation of deep architecture – Applications - Future potential and challenges.

Getting Yourself Ready for Deep Learning: Basics of linear algebra - Deep learning with GPU - Deep learning software frameworks - Setting up deep learning on AWS

Unit -II

Getting Started with Neural Networks: Multilayer perceptrons - How a network learns - Deep learning models - Practical examples

Deep Learning in Computer Vision: Origins of CNNs- Convolutional Neural Networks -Fine-tuning CNNs - Popular CNN architectures

Unit –III

NLP - Vector Representation: Traditional NLP - Deep learning NLP – Applications.

Advanced Natural Language Processing: Deep learning for text - Recurrent neural networks - Long short-term memory network – Applications

Unit –IV

Multimodality: What is multimodality learning? - Challenges of multimodality learning- Image captioning - Visual question answering - Multi-source based self-driving

Deep Reinforcement Learning: What is reinforcement learning (RL)? - Deep reinforcement learning - Implementing reinforcement learning

Unit – V

Deep Learning Hacks: Massaging your data - Tricks in training - Fine-tuning - Model compression

Deep Learning Trends: Recent models for deep learning - Novel applications

TEXT BOOK:

Anurag Bhardwaj, Wei Di, JianingWei,"**Deep Learning Essentials**", Packt Publishing, 2018. Chapters:1-10

References

Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

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

CO1:	Understand the evolution of deep architectures	**K1,K2**	**LO**
CO2:	Apply deep learning principles to Natural Language Processing	**K4**	**IO**
CO3:	Assess the challenges of multimodality learning	**K5, K6**	**HO**

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

Mapping with Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	L	L	-	-	L	-	-	-	L	L
CO2	M	M	-	M	-	M	-	M	M	-	M	M
CO3	S	S	S	S	S	S	S	-	S	S	S	-

S- Strong; M-Medium; L-Low

COURSE – 19UPCSC3E25 **CREDITS- 4**

BIOINFORMATICS

Course objectives:

- To understand Bioinformatics from computing perspective.
- To comprehend bioinformatics databases, file formats and its applications.
- To understand the applications of Bioinformatics

Unit -I

History of bioinformatics-History of Bioinformatics-role of Bioinformatics in biological sciences- scope of bioinformatics -introduction to internet-WWW-network basics- LAN & WAN standards-network topologies and protocols- FTP-HTTP - division of Bioinformatics- Bioinformatics and internet-challenges in Bioinformatics.

Unit -II

Databases in bioinformatics-Databases in Bioinformatics- Genbank- NCBI-EMBL- DDBJ -UniGene- SGD- EMI Genomes- -protein databases-PIR-SWISSPROT-TrEMBL-PrositePRINTS -structural databases-PDB- SCOP- CATH-PDB_SELECT- PDBSUM- DSSP- FSSPDALI- PRODOM- protein families & pattern databases-Pfam- KEGG - sequence storage sequence accuracy-EST-STS- sequence retrieval systems- Entrez-SRS- sequence query refinement using Boolean operators- limits- preview- history and index.

Unit -III

Sequence submission-Sequence submission tools-BANKIT-SEQUIN-WEBIN-SAKURAliterature databases-PubMed and medline. Data mining and its techniques- data warehousing- Sequence annotation- principles of genome annotation- annotation tools & resources.

Unit -IV

Applications of bioinformatics-Applications of Bioinformatics-phylogenetic analysissteps in phylogenetic analysis-microarrays-DNA and protein microarraysBioinformatics in pharmaceutical industry- informatics & drug-discovery – pharma informatics resources drug discovery and designing-SNP.

Unit -V

File formats-File formats-raw/plain format-NCBI-Genbank flat file format-ASN.1- GCGFASTA- EMBL- NBRF- PIR-swissprot sequence formats- PDB format-Introduction to structure prediction methods.

References:

1. Attwood T.K, Parry-Smith, “Introduction to Bioinformatics”, Addison Wesley Longman, 1999.
2. David W Mount, “Bioinformatics: Sequence and Genome Analysis”, 2nd edition, CBS Publishers, 2004.
3. ArunJagota, “Data Analysis and Classification for Bioinformatics”, Pine Press, 2001.
4. Des Higgins and Willie Taylor, “Bioinformatics Sequence, Structures and Databanks”, Oxford University Press, 2000.
5. Jason T.L.Wang, Mohammed J. Zaki, Hannu T.T. Toivonene and Dennis Shasha, “Data Mining in Bioinformatics”, Springer International Edition, 2005.
6. K. Erciyes, “Distributed and Sequential Algorithms for Bioinformatics”, Springer, 2015.

Course Outcomes

CO1:	Recognize the Bioinformatics from computing perspective and Basic Data mining and its techniques- data warehousing	**K1, K2**	**LO**
CO2:	Evaluate the bioinformatics databases, file formats and its applications	**K3**	**IO**
CO3:	Analyze the DNA and protein microarrays Bioinformatics in pharmaceutical industry and File formats and structure prediction methods	**K4, K5, K6**	**HO**

The mapping of course outcomes with programme outcomes is tabulated as follows.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	-	-	L	-	L	L	-	L	-	L
CO2	M	-	M	-	M	-	M	-	M	-	M	-
CO3	S	S	-	S	S	-	S	S	S	-	S	S

S- Strong ; M-Medium ; L-Low