NEHRU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

(Affiliated to Bharathiar University Reaccredited with "A+" Grade by NAAC,
ISO 9001:2015 (QMS) Certified, Recognized by UGC with 2(f) &12(B),
Under Star College Scheme by DBT, Govt. of India)
Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105, Tamil Nadu, India.
E-mail: nascoffice@nehrucolleges.com. Web Site: www.nehrucolleges.net.

REGULATIONS, CURRICULUM & SYLLABUS

M. Sc. DATA SCIENCE

Effective from 2023 - 2024

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DEPARTMENT OF COMPUTER SCIENCE

PROGRAMME: M. Sc. DATA SCIENCE

PROGRAMME OUTCOMES

PO1	**Critical Thinking**	Demonstrate advanced proficiency in critical thinking skills, evidenced by their ability to analyze complex datasets, and identify patterns.
PO2	**Research Skill**	Showcase exemplary research skills, adapt at conducting thorough literature reviews, designing robust experiment and employing advanced methodologies to contribute meaningfully to the field of data science.
PO3	**Usage of Technology**	Exhibit a mastery of cutting – edge technologies, harnessing advanced tools and platforms to manipulate, analyze and visualize complex datasets.
PO4	**Effective Communication**	Demonstrate proficiency in presenting data – driven insights through compelling visualizations and articulatedocumentation, fostering collaboration and facilitating informed decision - making in diverse professional settings.
PO5	**Individual and Team Work**	Excel in collaborative team environments, effectively contributing their expertise to interdisciplinary projects, thereby fostering a synergetic approach to addressing complex challenges in the field of data science.
PO6	**Project Management**	Demonstrate the ability to lead multidisciplinary teams, applying project management principles to optimize resources and successfully navigate the dynamic landscape of data – driven initiatives.
PO7	**Ethics and Values**	Integrate ethical considerations into decision – making processes, emphasizing the responsible and respectful use of data to address societal challenges and contribute positively to the evolving field of data science.
PO8	**Life Long Learning**	Proactively engage in continuous professional development, fostering adaptability and a thirst for knowledge to remain at the forefront of advancements in data science throughout their careers.

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DEPARTMENT OF COMPUTER SCIENCE

PROGRAMME: M. Sc. DATA SCIENCE

PROGRAMME SPECIFIC OUTCOMES

PSO 1	Make the students to effectively employ statistical and machine learning techniques to analyze complex datasets, extract meaningful insights, and make data-driven decisions across diverse domains.
PSO 2	Gain proficiency in utilizing programming languages and relevant tools/frameworks to preprocess, clean, and manipulate large-scale datasets efficiently for analysis and modeling purposes.
PSO 3	Expertise in applying data science methodologies in practical scenarios, showcasing their ability to solve real-world problems across industries through project-based learning, internships, or capstone projects.
PSO 4	Build the students with strong understanding of ethical considerations, privacy concerns, and legal regulations pertaining to data collection, storage, and usage. They will exhibit ethical decision-making skills in handling sensitive data and complying with industry standards and regulations.
PSO 5	Improve the ability of students to communicate complex findings and insights derived from data analysis effectively. They will be proficient in creating visualizations, reports, and presentations to convey technical information in a clear and understandable manner to diverse audiences.

REGULATIONS

NEHRU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
REGULATIONS FOR POSTGRADUATE DEGREE COURSES

Choice Based Credit System blended with Outcome based Education

Regulations with effect from the Academic Year 2022-2023

Definition

a) Programme – A course of study leading to the award of a degree in a discipline. (E.g.: M. Sc. / M. Com.)

b) Branch – Discipline of study (e.g. M.Sc. Microbiology)

c) Curriculum – The various courses (subjects) a student must study in a particular branch.

d) Course – The theory & practical subject offered under each curriculum.

e) Credit – A unit of measurement based on the duration of the contact hours, content and quality of the subject matter.

1. PG Curriculum

The PG Curriculum follows CBCS pattern and the medium of instruction is English.

2. Eligibility for Admission to the Course

A candidate who has passed the Degree Examination as main subject of study of this University or an examination of some other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to the Master Degree of this College.

3. Duration of the Programme

This Course of Study shall be based on Semester System. This Course shall consist of four Semesters covering a total of two Academic years. For this purpose, each academic year shall be divided into two Semesters; the first and third Semesters; July to November and the second and the fourth Semesters; December to April. The Practical Examinations shall be conducted at the end of odd / even Semester. Each semester have 90 working days consists of 5 teaching hours per working day. Thus, each semester has 450 teaching hours and the whole programme has **1800 teaching hours**.

4. Choice Based Credit System (CBCS)

All Postgraduate Programmes offered by the University shall be under Choice Based Credit System (CBCS). Choice based credit system is introduced with the aim of offering flexibility in the choice of courses to the students.

Objectives of the Choice Based Credit System :

- To facilitate the students to have greater flexibility in their choice of courses.
- To revamp the curriculum, to impart entrepreneurial skills and placement potentials qualities.
- To incorporate need based knowledge in tune with the location and neighborhood of the institution.
- To allocate credit points to each paper of the study based on the weightage of the contact hours, content and quality.
- To extend opportunities to fast learners in order to earn Extra credit from advanced as well as additional courses.
- To maintain the total credit points of each programme on par with international standards.

5. Outcome Based Education (OBE)

OBE is an **educational** theory that bases each part of an **educational** system around goals (**outcomes**). By the end of the **educational** experience, each student should have achieved the goal.

Objectives of Outcome based curriculum :

- The programme outcomes and Programme specific outcomes are clearly identified and unambiguously specified regarding the content, context and competence.
- The expected outcome should be defined by setting bench marks for each level of the programme. Benchmark should tackle and define specifically, the goals of the curriculum and verify ways to access whether the students have reached these goals at the level of study;
- OBE is driven by assessments that focus on well defined learning outcomes and not by other factors such as what is taught, the duration taken by the student to achieve the outcomes or which path the students take to achieve their targets. In OBE, assessment techniques must be with clear description of expected performance.

Definitions

Outcome : An outcome of an educational Programme is what the student should be able to do at the end of a Programme/ course/ instructional unit.

Levels of Outcomes

- Programme Outcomes: POs are statements that describe what the students graduating from any of the educational Programmes should be able to do.
- Programme Specific Outcomes: PSOs are statements that describe what the graduates of a specific educational Programme should be able to do.
- Course Outcomes: COs are statements that describe what students should be able to do at the end of a course

Learning Outcomes : It describes levels of achievement that can be attained across the domains of learning. Here **K1** representing Remember; **K2** -Understanding; **K3** - Apply; **K4** - Analyze; **K5**- Evaluate, **K6** – Create are used to measure the levels of achievement in learning.

6. CBCS Curriculum

6.1. Part A : Core Components:

Core Courses : Each programme has a group of core courses. The syllabus of the core courses will facilitate the students in the acquisition of the basic concepts of their respective disciplines, besides getting exposure to the recent developments. This exposure will suitably guide the students towards their vertical mobility in their higher studies. Core courses will last till the fourth semester. **It is mandatory for all PG students to complete an online course under SWAYAM / NPTEL platform between 2nd and 3rd semester.**

6.2. Part B: Optional Courses - Advanced Learner's Courses : (ALC)

Students are offered the opportunity to undertake optional papers, additional to their compulsory papers, in order to gain additional credit that would boost their grades. These are not mandatory. The course will be a self study nature and the concerned departments will offer guidance. Other Advanced Learner's Courses shall be decided during the conduct of Board of Studies. The Examination will be of Open Book Examination model.

7. Requirement to appear for the examinations

Attendance Requirements for the Students appearing for ESE

- The guidelines of attendance requirement issued by Bharathiar University are adopted by the College. Attendance shall be considered semester- wise (not annually).
- A candidate shall be permitted to appear for the Semester Examinations in any semester, if he / she secures not less than 75% of attendance in the total number of working days during the semester and if his / her progress has been satisfactory, and his / her conduct has been satisfactory.

- Those who have obtained below 75% and above 65% of attendance shall pay condonation fee and shall write the examination in the same semester with due permission from the Principal.
- Those who have below 65% and above 50% of attendance are not eligible to write the examination in current semester subjects but are permitted to continue their studies in the next semester provided that this is the first time that the candidate earned attendance between 50% and 65%. Else the candidates have to discontinue the course and re-join in the same semester subjects in the next year with proper approval of the Principal. However, the candidates are eligible to write arrear subjects if any.
- Those who have below 50% of attendance have to redo the semester.

8. Restrictions to appear for the examinations

a) Any candidate having arrear paper(s) shall have the option to appear in any arrear paper along with the regular semester papers.

b) Candidates who fail in any of the course of PG degree examinations shall complete the course concerned **within 5 years** from the date of admission to the said programme, and if they fail to do so, they shall take the examination in the texts / revised syllabus prescribed for the immediate next batch of candidates. If there is no change in the texts / syllabus they shall appear for the examination in that course with the syllabus in vogue until there is a change in the texts or syllabus. In the event of removal of that course consequent to change of regulation and / or curriculum after 5 year period, the candidates shall have to take up an equivalent course in the revised syllabus as suggested by the Chairman of the concerned board of studies and fulfill the requirements as per the regulation curriculum for the award of the degree.

9. Medium of Instruction and examinations

The medium of Instruction and the medium of Examination is English.

10. Distribution

The following are the distribution of marks for examination & evaluation pattern. Distribution of Marks between End Semester Exam (Theory) and Internal Assessment is 75:25. The following table gives the distribution.

PG - PROGRAMMES (CBCS)

Table 16: Total credit points and tenure of study for M.A., M.Com, M. Sc. and MSW

Part	Courses	Semesters	Credit Points	Marks / Grade
III	Components Core / Electives / Internship / Project / Online course	I to IV	94	2350

11. Additional Credits

Students are given the opportunity to undertake optional papers, additional to their compulsory papers, in order to gain additional credit that would boost their grades. These are not mandatory. Students can earn to a maximum of 15 credits.

S. No.	Subject	Credit / Course	Total Credits
1.	Presentation of Research papers in International Conferences	1	1
2.	Publication of Research Papers in reputed Journals	1	1
3.	Advanced Learners Course	2	4
4.	MOOC Courses / Swayam prescribed by the Departments	2	4
5.	Visits Abroad for Participation in International Academics events	1	1
6.	Representation - Sports / Social Activities / Co curricular / Extracurricular Activities at University / District / State / National / International levels	1	2
7.	Swachh Bharath Summer Internship Programme	2	2
		Total	**15**

12. Continuous Internal Assessment (CIA)

Three CIA's shall be conducted at regular Intervals. CIA I and II shall be a 2 hours written test for a maximum of 50 marks each and CIA III shall be conducted as Model Examination for ESE.

13. OBE Evaluation - Assignment / Seminar / Role play, etc.

Three OBE Assessment parameters are decided for each course to evaluate the achievement of course outcomes which shall be assessed by the concerned course teacher. The marks allotted to this component will be awarded based on the performance of the candidate. The Rubrics for awarding the marks shall be maintained by the Course Teacher concerned.

14. Distribution of Marks

Table 17 : Distribution of marks for External and Internal for theory papers of PG courses

Total Marks	External		Internal	Overall Passing Minimum for Total Marks (Internal + External)
	Max. Marks	Passing Minimum for External alone	Max. Marks	
100	75	38	25	50
75	55	28	20	38
50	40	20	10	25

Table 18 : Distribution of Internal marks for theory papers of PG courses

S. No.	For Theory - PG courses	Distribution of Marks		
01.	CIA I	5	4	2
02.	CIA II	5	4	2
03.	CIA III	6	5	4
04.	OBE Evaluation – Tool 01	3	2	1
05.	OBE Evaluation – Tool 02	3	2	1
06.	OBE Evaluation – Tool 03	3	3	-
	TOTAL MARKS	**25**	**20**	**10**

Table 19 : Distribution of marks for External and Internal for Practical papers of PG Courses

Total Marks	External		Internal	Overall Passing Minimum for total marks (Internal + External)
	Max. Marks	Passing Minimum for External alone	Max. Marks	
100	60	30	40	50
75	45	23	30	38
50	30	15	20	25

Table 20 : Distribution of Internal marks for PG practical papers

S. No.	For PG Practical Courses	Distribution of Marks		
01.	Laboratory Performance - Assessment Tool 01*	5	4	3
02.	Laboratory Performance - Assessment Tool 02*	5	4	3
03.	Laboratory Performance - Assessment Tool 03*	5	4	3
04.	Test 1 : During Mid semester	10	7	4
05.	Test 2 : As model test at the end of the semester	10	7	4
06.	Observation Note Book	5	4	3
Total Marks		**40**	**30**	**20**

Table 21 : Distribution of External marks for PG practical papers

S. No.	For - UG practical courses	Distribution of Marks		
1.	Experiment-I	20	15	10
2.	Experiment-II	20	15	10
3.	Record	10	10	5
4.	Viva Voce	10	5	5
	TOTAL MARKS	**60**	**45**	**30**

Table 22 : Distribution of marks for Project and Viva Voce examinations and Continuous Internal Assessments and passing minimum marks for the Project / Industrial Training courses of PG programmes

Total Marks	External		Internal	Overall Passing Minimum for Total Marks (Internal + External)
	Max. Marks	Passing Minimum for External alone	Max. Marks	
250	150	75	100	125
200	120	60	80	100
150	90	45	60	75
100	60	30	40	50

Table 23 : Distribution of marks for the Continuous Internal assessment in PG Project / Industrial Training Courses

S. No.	For - PG Project courses	Distribution of Marks			
1.	Review-I	20	15	10	10
2.	Review-II	20	15	10	10
3.	Review-III	20	15	10	10
4.	Document, Preparation and Implementation	25	20	15	10
5.	Research Paper Publication in Journals**	15	15	15	-
	TOTAL MARKS	**100**	**80**	**60**	**40**

**Wherever it is not possible, an equivalent Assessment tool shall be prescribed by the Board Chairperson.

Table 24 : Distribution of marks for the External Examination in PG Project / Industrial Training courses

S. No.	For - PG Project courses	Distribution of Marks			
1.	Record Work and Presentation	100	80	60	40
2.	Viva Voce	50	40	30	20
	TOTAL MARKS	**150**	**120**	**90**	**60**

15. Passing Minimum:

A candidate who secures **not less than 50%** in the End Semester Examination and 50% marks in the External examination and Continuous Internal Assessment put together in any courses shall be declared to have passed the examination in the subject (Theory and Practical). Thus the minimum pass mark is 38 out of 75 in ESE and 50 marks out of 100 (CIA+ESE).

A candidate who passes the examination in all the courses shall be declared to have passed, the whole examination. Thus to obtain PG degree, a student should pass in all the courses prescribed in the concerned programme and also he / she should earn 94 credits.

16. Grade:

Table 25 : Classification of Grade for PG Students based on the Percentage of marks

Range of Marks	Grade Point	Letter Grade	Description
90 – 100	9.0 – 10.0	O	OUTSTANDING
80 – 89	8.0 – 8.9	D+	EXCELLENT
75 – 79	7.5 – 7.9	D	DISTINCTION
70 – 74	7.0 – 7.4	A+	VERY GOOD
60 – 69	6.0 – 6.9	A	GOOD
50 – 59	5.0 – 5.9	B	AVERAGE
00 – 49	0.0	C	RE-APPEAR
ABSENT	0.0	AA	ABSENT

17. Grade Point Average (GPA)

Grade point average (GPA) is calculated for each part taking into account all the courses studied. Calculation of grade point average semester-wise and part-wise is as follows:

$$\text{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

$$\textbf{GPA} = \frac{\sum_i (C_i * G_i)}{\sum_i C_i}$$

Where C_i = Credit earned for course i in any semester.

G_i = Grade points obtained for course i in any semester.

18. Cumulative Grade Point Average (CGPA)

For the entire program CGPA is calculated in the following manner.

$$\textbf{CGPA} = \frac{\sum_n \sum_i C_{ni} * G_{ni}}{\sum_n \sum_i C_{ni}}$$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme under each part}}{\text{Sum of the Credits of the Courses of the entire programme under each part}}$$

19. Classification of CGPA

A candidate who has passed all the examinations under different parts is eligible for the following part wise computed final grades based on the range of CGPA.

Table 26 : Classification of performance of PG Students based on the Cumulative Grade Points Average

CGPA	Grade	Classification of Final Result
9.5 – 10.0	O+	First Class – Exemplary *
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	

a) A candidate who has passed all the subjects examinations in the first appearance within the prescribed duration of the PG programmes and secured a CGPA of 9 to 10 and equivalent grades “O” or “O+” in Core and Electives subjects shall be placed in the category of “First Class – Exemplary”.

b) A candidate who has passed all the subjects examinations in the first appearance within the prescribed duration of the PG programmes and secured a CGPA of 7.5 to 9 and equivalent grades “D” or “D+” or “D++” in Core and Electives subjects shall be placed in the category of “First Class with Distinction”.

c) A candidate who has passed all the subjects examinations of the PG programmes and secured a CGPA of 6 to 7.5 and equivalent grades “A” or “A+” or “A++” shall be declared to have passed in “First Class”.

d) A candidate who has passed all the subjects examination of the PG programmes and secured a CGPA of 5.0 to 6 and equivalent grades “B” or “B+” shall be declared to have passed in “Second Class”.

20. Ranking

A candidate who qualifies for the PG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme from the date of admission to the programme and secures First or Second Class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks. However the Programmes will be considered for ranking only when there are minimum of 10 students completing that Programme. The improved marks will not be taken into consideration for ranking.

21. Improvement of Marks in the subjects already passed

Candidates desirous of improving the marks awarded in a passed subject in their first attempt shall reappear in the subsequent semester only. The improved marks shall be considered for classification but not for ranking. When there is no improvement, there shall not be any change in the original marks already awarded.

22. Conferment of the Degree

No candidate shall be eligible for conferment of the Degree unless he / she has undergone the prescribed programme of Study for a period of not less than four Semesters in the Institution or has been exempted there from in the manner prescribed and has passed the Examinations as have been prescribed.

23. Question Paper Pattern

A: Question Paper Pattern

Time: 3 Hours **Max Marks: 75**

Knowledge Level	Q. No.	Section	Marks	Description
K1, K2, K3	1 – 10	A(Answer all the questions)	10 x 1 = 10	MCQ
K2, K3	11 – 15	B (Either or pattern)	5 x 5 = 25	Short Answers
K3, K4	16 – 21	C (Answer 3 out of 6)	3 x 10 = 30	Descriptive/ Detailed
K4, K5	22	D (Compulsory Question)	1 x 10= 10	Application Based/ HOTS

B. Question Paper Pattern

Time: 3 Hours **Max Marks: 55**

Knowledge Level	Q. No.	Section	Marks	Description
K1, K2, K3	1 – 10	A(Answer all the questions)	10 x 1 = 10	MCQ
K2, K3	11 – 15	B (Either or pattern)	5 x 4 = 20	Short Answers
K3, K4	16 – 21	C (Answer 3 out of 6)	3 x 6 = 18	Descriptive/ Detailed
K4, K5	22	D (Compulsory Question)	1 x 7 = 7	Application Based/ HOTS

C. Question Paper Pattern –Advanced Learners Course

Time: 3 Hours **Max Marks: 50**

Knowledge Level	Q. No.	Section	Marks	Description
K2, K3	1 – 5	A (Answer all the Questions)	5 × 4 = 20	Short Answers
K3 , K4	6 – 10	B (Either or pattern)	5 × 6 = 30	Descriptive/ Detailed

NOTE: The questions should be numbered continuously running through the Sections A, B and C.

Questions should be evenly distributed among the unit in the syllabus in all the sections of the question paper. While framing questions with internal choice the questions must be identified as (a) or (b). (e.g. 11. a or b). Further, the internal choice must be from the same unit.

The Controller of the Examinations shall arrange for the setting of question papers on the basis the syllabus and the pattern of question paper duly certified by the Chairpersons of the respective Board of Studies.

24. Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The Board may revise / amend / change the Regulations and Scheme of Examinations, if found necessary.

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SYLLABUS

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Scheme of Examination

M. Sc. Data Science

Programme Code: MDT

(Applicable to the students admitted during the year 2023-2024 onwards)

Semester	Subject Code	Name of the Subject	Instruction hours/week	Duration of Examination	Examination Marks			Credits
					CIA	ESE	Total	
I	23PGDTC101	Paper I : Data Analytics with R Programming	5	3	25	75	100	4
	23PGDTC102	Paper II : Advanced Database Management Systems	5	3	25	75	100	4
	23PGDTC103	Paper III: Descriptive Statistics	5	3	25	75	100	4
	23PGDTQ101	Practical I : Data Analytics with R Programming	5	3	40	60	100	4
	23PGDTQ102	Practical II : Advanced Database Management Systems	5	3	40	60	100	4
	23PGDTE101 / 23PGDTE102 / 23PGDTE103	Elective Paper – I	5	3	25	75	100	4
			30				**600**	**24**
II	23PGDTC204	Paper IV : Deep Learning for Data Science	5	3	25	75	100	4
	23PGDTC205	Paper V : Data Visualization Techniques using Tableau	5	3	25	75	100	4
	23PGDTC206	Paper VI: Linear Algebra	5	3	25	75	100	4
	23PGDTQ203	Practical III : Deep Learning With Python	5	3	40	60	100	4
	23PGDTQ204	Practical IV : Data Visualization using Tableau	5	3	40	60	100	4
	23PGDTE204 / 23PGDTE205 / 23PGDTE206	Elective Paper – II	5	3	25	75	100	4
	23PGDTONLC	Online Course	-	-	-	-	-	-
			30				**600**	**24**

III	23PGDTC307	Paper VII : Information Retrieval Techniques	4	3	25	75	100	4
	23PGDTC308	Paper VIII : Exploratory Data Analysis	4	3	25	75	100	4
	23PGDTC309	Paper IX: Data Privacy and Security	4	3	25	75	100	4
	23PGDTC310	Paper X : Probability and Inferential Statistics	5	3	25	75	100	4
	23PGDTQ305	Practical V : Exploratory Data Analysis	4	3	40	60	100	4
	23PGDTQ306	Practical VI : Data Visualization using Power BI	5	3	40	60	100	4
	23PGDTE307 / 23PGDTE308 / 23PGDTE309	Elective Paper – III	4	3	25	75	100	4
	23PGDTCP301	Internship	-	-	50	-	50	2
	23PGDTONLC	Online Course	-	3	-	-	100	4
			30				**850**	**34**
IV	23PGDTC411	Paper XI: IoT Analytics	5	3	25	75	100	4
	23PGDTV401	Project Work and Viva - Voce	25	3	80	120	200	8
			30				**300**	**12**
						Total	**2350**	**94**

Elective Paper - I Subjects	
Subject Code	**Name of the Elective Subject**
23PGDTE101	Principles of Data Science
23PGDTE102	Text Analytics
23PGDTE103	Artificial Intelligence for Data Science

Elective Paper - II Subjects	
Subject Code	**Name of the Elective Subject**
23PGDTE204	Web Analytics
23PGDTE205	Social Media Analytics
23PGDTE206	Business Intelligence

Elective Paper - III Subjects	
Subject Code	**Name of the Elective Subject**
23PGDTE307	Natural Language Processing
23PGDTE308	Time Series Analysis
23PGDTE309	Healthcare Analytics

Self-Study Paper offered by Computer Science Department

S.No.	Semester	Course Code	Course Title
1	II, III & IV	23PGDSSS01	Cloud Computing
2		23PGDSSS02	Data Analysis using MS-Excel
3		23PGDSSS03	Optimization Techniques
4		23PGDSSS04	Distributed Computing
5		23PGDSSS05	Data Mining

Chairman

9/9/2023

BoS - Chairman
Department of Computer Science
Nehru Arts and Science College
(Autonomous)
Coimbatore - 641 105.

Course Code	Title		
23PGDTC101	Paper I : Data Analytics with R Programming		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To learn the concepts of Data Analytics using R Programming
Course Category	Skill Development
Development Needs	Global
Course Description	Study of roles in Data Science and Data Visualization in R.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understanding about R environment and datasets	Lecture / Video Lectures	Assignment
CO 2	Implement graphs and knowledge on basic data management	Lectures / Video Lessons	Seminar
CO 3	Analyze various advanced data management techniques and implement more visualization graphs	Lectures / Video Lessons	Quiz
CO 4	Acquire knowledge about regression and linear models	Tutorial / Lecture	Seminar
CO 5	Create applications based on the concepts of clustering and classification	Lecture / Video Lectures	Quiz

Offered by	**Data Science**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	Introduction to R: Why use R – Obtaining and Installing R – Working with R – Packages – Batch Processing – Using Output as Input – Working with Large Datasets –Creating a Dataset: Understanding datasets – Data Structures – Data Input – Annotating Datasets – Useful Functions for Working with Data Objects	1	1, 2
Instructional Hours			**15**
Suggested Learning Methods : Video lectures			
II	Working with Graphs: A Simple Example – Graphical Parameters – Adding Text, Customized Axes, and Legends – Combining Graphs. Basic Data Management: A Working Example – Creating New Variables – Recording Variables – Renaming Variables – Missing Values – Date Values – Type Conversions – Sorting Data – Merging Datasets	1	3, 4
	Instructional Hours		15
Suggested Learning Methods : Case Study			
III	Advanced Data Management: A Data Management Challenge – Numerical and Character Functions – A Solution to the Data – Management Challenge – Control Flow – User written Functions – Aggregation and Reshaping. Basic Graphs: Bar Plots – Pie Charts	1	5, 6, 11

	– Histogram – Kernel Density Plots – Box Plots – Dot Plots. Intermediate Graphs: Scatter Plots – Line Charts – Corrgrams – Mosaic Plots		
		Instructional Hours	15
Suggested Learning Methods : Group Discussion			
IV	Regression: OLS Regression – Corrective Measures – Selecting the "best" Regression Model. Generalized Linear Models: Generalized Linear Models and the glm( ) function – Logistic Regression – Poisson Regression. Principal Components and Factor Analysis: Factor Analysis in R – Principal Components – Exploratory Factor Analysis	1	8, 13, 14
		Instructional Hours	15
Suggested Learning Methods : Assignment			
V	Cluster Analysis: Common Steps in Cluster Analysis – Calculating Distances – Hierarchical Cluster Analysis – Partitioning Cluster Analysis – Avoiding Nonexistent Clusters. Classification: Preparing the Data – Decision Trees – Random Forest – Support Vector Machines.	1	16
		Instructional Hours	15
Suggested Learning Methods : Laboratory practice			
		Total Hours	**75 Hrs**

Text Book	1. Robert I. Kabacoff, "R in Action – Data Analysis and Graphics with R", DreamTech Press, Second Edition, 2015.
Reference Books	1. V.Bhuvaneswari, "Data Analytics with R – Step by Step", SciTechPublications,2016. 2. O'Neil Rachel Schutt , "Doing Data Science", Shroff Publishers, 2013.
Web. URLs	https://www.geeksforgeeks.org/data-analysis-using-r/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. N. Kavitha	Dr. N. Kavitha

Course Code	Title		
23PGDTC102	**Paper II : Advanced Database Management Systems**		
Semester: I	**Credits: 4**	**CIA: 25 Marks**	**ESE: 75 Marks**
Course Objective	To learn the Concepts of Advanced Database Management Systems		
Course Category	Skill Development		
Development Needs	Global		
Course Description	This course explores essential as well as advanced topics in database design, implementation and certain advanced concepts		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand the concepts of DBMS, E-R model and enhanced E-R models	Lecture / Video Lectures	Assignment
CO 2	Acquire knowledge on RDBMS concepts, data normalization and essentials of SQL	Lectures / Video Lessons	Seminar
CO 3	Understanding of tables, views, indexes, subqueries and aggregate functions	Lectures / Video Lessons	Quiz
CO 4	Understanding of joins, unions, transaction management and concurrency control concepts	Tutorial / Lecture	Seminar
CO 5	Acquire knowledge of database backup, recovery, distributed databases, temporal databases, spatial databases, and multimedia databases	Lecture / Video Lectures	Quiz

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 5**

Unit	**Description**	**Text Book**	**Chapters**
I	Introduction to database management systems: information – data and data management – file-based data management – database systems – organization of a database – database management systems – functions of DBMS – components of a DBMS – data dictionary – database users. E-R modelling: components of an E-R model – attributes – relationships – E-R diagrams – E-R modelling symbols. Enhanced Entity Relationship model (EER): superclass and subclass entity types – attribute inheritance – specialization – generalization – specialization / generalization constraints – categorization.	1	1, 2
Instructional Hours			**15**
Suggested Learning Methods : Video lectures			
II	Relational Database Management Systems – RDBMS terminology – the relational data structure – relational data manipulation – Codd's rules. Relational data integrity and database constraints – integrity constraints. Data normalization: Pitfalls in relational database design – first normal form – second normal form – third normal form – Boyce-Codd normal form –	1	4, 5, 6

	fourth normal form – fifth normal form. Structured Query Language (SQL): characteristics of SQL – advantages of SQL – types of SQL commands - SQL operators.		
		Instructional Hours	15
Suggested Learning Methods : Case Study			
III	Tables, Views and Indexes: tables – views – indexes. Queries and Subqueries – queries – subqueries. Aggregate functions – general rules – COUNT ( ) and COUNT (*) – SUM ( ) – AVG ( ) – MAX ( ) and MIN ( ) – Insert, Update and Delete operations – Insert statement – Update statement – Delete statement	1	9, 11, 12
		Instructional Hours	15
Suggested Learning Methods : Group Discussion			
IV	Joins and Unions – joins – unions. Programming with SQL: Query Processing – Embedded SQL – Cursors – Triggers – Dynamic SQL. Indexing and Hashing: Indexing – Hashing. Transaction Management and Concurrency Control: Transaction Properties – Transaction States – Concurrency Control – Serializability – Recoverability – Concurrency Control Schemes – The COMMIT command – The ROLLBACK command – The SAVEPOINT command	1	13, 15
		Instructional Hours	15
Suggested Learning Methods : Assignment			
V	Backup and Recovery: Database Backups – Causes of Failures – Why Plan Backups – Transaction Logs – Importance of Backups – Database Recovery – Recovery Techniques – Recovery in Multi – Database Systems – Database Recovery from Catastrophic Failures. Client / Server Databases: Benefits of C/S computing. Distributed Databases: Homogeneous and Heterogeneous Distributed Databases – Advantages of Distributed Databases – Temporal Databases – Spatial Data – Multimedia Databases	1	16, 17
		Instructional Hours	15
Suggested Learning Methods : Laboratory practice			
		Total Hours	**75 Hrs**

Text Book	1. Alexis Leon & Mathews Leon, "Essentials of Database Management Systems", Vijay Nicole Imprints Private Limited, 2009.
Reference Books	1. Abraham Silberschatz, Hemry F. Korth, S. Sudarshan, "Database System Concepts", McGraw Hill Publication, 7th Edition, 2008. 2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw-Hill, 2000.
Web. URLs	https://www.javatpoint.com/postgresql-tutorial

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping													
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H
H-High; M-Medium; L-Low													

Course designed by	**Verified by Chairman**
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTC103	Paper III : Descriptive Statistics		
Semester: I	Credits: 4	CIA: 25 Marks	ESE:75 Marks
Course Objective	To Understand the basic principles of statistical methods and procedures used for data analysis.		
Course Category	Employability		
Development Needs	Global		
Course Description	This course helps in acquiring, cleaning, analyzing, exploring, and visualizing data; making data-driven inferences and decisions; and effectively communicating results.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	To visualize the data	Lecture	Group Discussion
CO 2	To understand the difference between correlation and regression	Lecture	Quiz
CO 3	To compare the data between two periods of time	Video Lessons	Seminar
CO 4	To ensure the reliability of a sample	Tutorial / Video Lessons	Seminar
CO 5	To understand various parametric tests for testing samples	Video Lessons	Assignment

Offered by | **Mathematics**

Course Content | **Instructional Hours / Week : 5**

Unit	Description	Text Book	Chapters
I	**Introduction:** Meaning- Definition- Nature and object of Statistics, limitations of statistics - Types of data: primary and secondary data, **Classification of data:** Meaning and Types. Tabulation of data: Construction of Tables with one or more factors of classification. **Diagrammatic representations:** - Line diagram, bar diagram, pie diagram and sub-divided bar diagram. **Graphical representations:** frequency Distribution, Frequency polygon, histogram, ogives, frequency curves, Time series.	1	1,2,4,6,7,8
		Instructional Hours	**15**
Suggested Learning Methods: Seminar			
II	**Correlation** – Definition – Significance, Types, Karl Pearson's Coefficient of correlation, Properties, Interpretation of Correlation, Rank correlation – Spearman's rank correlation-Merits and demerits. **Regression** – Introduction - Definition – regression equations of X on Y and Y on X – regression equation in terms of correlation table – standard error of Estimate.	1	12,13
		Instructional Hours	15
Suggested Learning Methods: Problem solving			
III	**Analysis of Time Series:** Definition- Uses - Models – Components of Time Series - Secular trend – Seasonal Variation – Cyclical Variation – Irregular Variation - Preparation of Data for analysis – Measurement of Secular Trend – Graphic Method – Semi Average Method – Moving Average Method – Method of Simple Average – Ratio to trend Method – Ratio to moving Average Method.	1	15
		Instructional Hours	15

Suggested Learning Methods :Group Discussion			
IV	**Sampling Design:** Introduction – Censes method, Sample method - Essentials of Sampling – Methods of Sampling – Random Sampling and Non Random sampling – Statistical Laws – Statistical error – Biased and Unbiased errors – Measurement of errors -Test of reliability of Samples.	1	5
		Instructional Hours	15
Suggested Learning Methods :Video Presentation and Assignment			
V	**Statistical Decision Theory:** Hypothesis Testing- **Parametric Tests:** Tests of significance for small samples – Assumption of Normality – Student's t- distribution – Test the significance of mean of random sample, difference between means of two samples - Chi-square test and goodness of fit – F test and analysis of variance.	2	3
		Instructional Hours	15
Suggested Learning Methods : Problem solving			
		Total Hours	**75 Hrs**

Text Books	1. R.S.N. Pillai, Bagavathi, **Statistics Theory and Practice**, S.Chand & Company,8th Edition, 2016 Unit- I: Chapter 1 - Pg. No : 1-11 ; Chapter 2 - Pg. No : 17-18 Chapter 4 - Pg. No : 27-37; Chapter 6 - Pg. No : 50-80 Chapter 7 - Pg. No : 81-91; Chapter 8 - Pg. No : 100-113 Unit- II: Chapter 12 - Pg. No : 396-420 ; Chapter 13 - Pg. No : 465-525 Unit- III: Chapter 15 - Pg. No : 591- 602,615- 621,623-625. Unit- IV: Chapter 5 - Pg. No : 38 – 49 2. Statistical Methods, S. P. Gupta, Sultan Chand and sons, 46th Edition,2021 Unit- V: Vol II - Chapter 3 - Pg. No : 3.2-3.10,3.27-3.39 Chapter 4- Pg. No : 4.2 – 4.17; Chapter 5- Pg. No : 5.2 – 5.37
Reference Books	Charles E. Roberts, Jr, "Introduction to Mathematical Proofs A Transition to Advanced Mathematics" Denny Gulick, 4th Edition, Published by Pearson, 2018
Web. URLs	**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** 1. https://youtu.be/L3wQw0wva3g (Sampling Distribution) 2. https://youtu.be/F9lk8tlkDXI(Statistical Hypothesis) 3. https://www.mygreatlearning.com/blog/inferential-statistics-an-overview/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Case Study	Total
5	5	6	3	3	3	25

Mapping

CO \PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	M	M	M	H	M	M	M	M	H
CO2	H	H	M	M	M	M	M	M	M	M	M	M	M
CO3	H	H	H	M	M	H	M	H	M	M	H	M	H
CO4	H	M	M	M	M	M	M	M	M	M	M	M	M
CO5	H	H	M	M	M	M	M	M	M	M	M	M	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. T. Chandrapushpam	Dr. N. Kavitha

Course Code	Title		
23PGDTQ101	**Practical I : Data Analytics with R Programming**		
Semester: I	**Credits: 4**	**CIA : 40 Marks**	**ESE: 60 Marks**
Course Objective	To learn the Concepts of Data Analytics with R Programming		
Course Category	Skill Development		
Development Needs	Global		
Course Description	Study of roles in data science and Data Visualization using R.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Implement the basic concepts of R Programming	Demonstration	Assignment
CO 2	Understand the Data Visualization in R Programming	Demonstration	Seminar
CO 3	Perform Data Manipulations	Demonstration	Quiz
CO 4	Implement the concept of Regression using R	Demonstration	Seminar
CO 5	Create program for solving real world problems	Demonstration	Quiz

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 5**

Unit	Description
1.	Create a basics of R programming such as data types, operators, matrices, lists and functions
2.	Write a R Program to perform some Built-in mathematical functions
3.	Write a R program to perform Graphs
4.	Calculate exploratory data analysis in R a. Graphical representation of variables b. Dealing with Continuous and Categorical variables
5.	Data manipulation in R a. Manipulating in rows and columns (Filtering and sorting) b. Merging datasets c. Reshaping data
6.	Write a R Program for Reading data from csv files
7.	Write a R program to Read data from Excel files
8.	Solve real-world problem using machine learning algorithm of Linear (Multiple)
9.	Solve the problem using Decision Tree for the given dataset
10.	Cluster the target variable using the K-means clustering algorithm
11.	Calculate the Radom Forest to find the optimum value of model parameters
12.	Solve the classification problem using Logistic Regression for the given dataset
	Total Hours **75 Hrs.**

Text Book	1. Nina Zumel, John Mount, "Practical Data Science with R Programming",2014
Reference Books	1. V Bhuvaneswari, Data Analytics with R Programming, SciTech Publications, 2016. 2. Hadley Wickham, Garrett Grolemund, "R for Data Science", O'Reilly Media, 2016.
Web. URLs	https://www.w3schools.com/r/

Tools for Assessment (40 Marks)

Laboratory Performance – Application Logic	Laboratory Perfromance – Program Creativity	Laboratory Performance – Program Debugging	Test - 1	Test - 2	Observation Note Book
5	5	5	10	10	5

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. K. Sumathi	Dr. N. Kavitha

Course Code	Title		
23PGDTQ102	Practical II : Advanced Database Management Systems		
Semester: I	Credits: 4	CIA: 40 Marks	ESE: 60 Marks
Course Objective	Learn to implement advanced database management using PostgreSQL		
Course Category	Skill Development		
Development Needs	Global		
Course Description	This course develops skills in working with database schema, concurrency control, functions, triggers, backup, restore, transaction management in PostgreSQL		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Implement database schema and use functions	Lecture / Video Lectures	Assignment
CO 2	Apply concurrency control and stored procedures	Lectures / Video Lessons	Seminar
CO 3	Perform trigger and perform logical backup operations	Lectures / Video Lessons	Quiz
CO 4	Conduct sorting and file handling operations	Tutorial / Lecture	Seminar
CO 5	Implement transaction management and also work with large objects	Lecture / Video Lectures	Quiz

Offered by	Data Science

Course Content	Instructional Hours / Week: 5

Unit	Description
1.	Database schema for ticket booking system. Insert sufficient number of records in each table. Use various functions, sub queries and SELECT statements
2.	Database schema for library management system. Insert sufficient number of records in each table. Use joins and retrieve data from more than one table.
3.	Aggregating data using functions like COUNT, AVG, MAX, and MIN to calculate various metrics
4.	Concurrency control using PostgreSQL. Showcase with a real time scenario
5.	Working with stored procedures in PostgreSQL
6.	Create a table, insert sufficient records, and implement a trigger in PostgreSQL
7.	Implement B-Tree index in PostgreSQL
8.	Create a logical backup using pg_dump. Then, perform restoring from the backup
9.	Sorting in PostgreSQL
10.	File handling in PostgreSQL
11.	Working with large objects in PostgreSQL
12.	Transaction management in PostgreSQL
	Total Hours: 75

Text Book	1. Alexis Leon & Mathews Leon, "Essentials of Database Management Systems", Vijay Nicole Imprints Private Limited, 2012.
Reference Books	1. Abraham Silberschatz, Hemry F. Korth, S. Sudarshan, "Database SystemConcepts", McGraw Hill Publication, 2000. 2. Mukesh Negi, "Fundamentals of Database Management System", BPB Publications, 2010.
Web. URLs	**https://www.javatpoint.com/postgresql-tutorial**

Tools for Assessment (40 Marks)

Laboratory Performance – Application Logic	Laboratory Performance – Program Creativity	Laboratory Performance – Program Debugging	Test - 1	Test - 2	Observation Note Book
5	5	5	10	10	5

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTE101	**Elective Paper I A: Principles of Data Science**		
Semester: I	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To understand the principles of Data Science		
Course Category	Entrepreneurship		
Development Needs	Global		
Course Description	Data Science Principles gives you an overview of data science with a code- and math-free introduction to prediction, causality, data wrangling, privacy, and ethics.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand Data Sources, Data from various domains	Lecture	Group Discussion
CO 2	Learn Big Data Characteristics,Limitation of traditional Approaches and models. Map Big Vs to Data Domains	Lecture	Quiz
CO 3	Exposure to Big Data Processing platform, frameworks, Hadoop, Spark, storage models – Hbase	Video Lessons	Seminar
CO 4	Analyze the Role of Big Data and Artificial Intelligence – Ethics – AI Applications	Tutorial / Video Lessons	Seminar
CO 5	Interpret various domains of Big Data Characteristics, Platform, Programming Model and many more	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week :5**

Unit	**Description**	**Text Book**	**Chapters**
I	**Introduction to Data Evolution & Sources:** Big Data in Industry 4.0 - Data Evolution: Data Development Time Line – ICT Advancement - a Perspective – Data Growth - a Perspective – IT Components - Business Process – Landscape - Data to Data Science – Understanding data: Introduction – Type of Data: Numeric – Categorical – Graphical – High Dimensional Data – Data Classification - Data Formats: Structured, Semi-Structured and Un-Structured – Data Science: Data Science A Discipline – Data Science vs Statistics – Mathematics - Programming Language – Database - Machine Learning - Data Analytics Relation: Data Science, Analytics, Big Data Analytics	1	1,2
		Instructional Hours	**15**
Suggested Learning Methods: Tutorial			

II	**Big Data Towards Data Science:** Big Data: Introduction To Big Data: - Evolution – Data as Economy - What is Big Data – Sources of Big Data. – Big Data Myths - Characteristics of Big Data – Big Data Use cases - Big data-Challenges of Conventional Systems – Data Processing Models – Limitation of Conventional Data Processing Approaches -Data Discovery-Traditional Approach, Big Data Technology: Big Data Exploration - Data Augmentation– Operational Analysis – 360 View of Customers – Security and Intelligence – Data Analytics – Classification – Descriptive – Diagnostic – Predictive – Prescriptive – Augmented – Pervasive Analytics- Data Science Components: Data Engineering, Data Analytics-Methods and Algorithm, Data Visualization – P's of Data Science – Process – People – Platform	1	4,5
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
III	**Big Data Frame work and Components:** Big Data Technologies - Hadoop: Basic Concepts - An Overview of Hadoop - The Hadoop Distributed File System - Anatomy of a Hadoop Cluster - Hadoop Ecosystem Components. SPARK – in Architecture – SPARK Advantages - HBASE: HBase Architecture - HBase API - Managing large datasets with HBase-Map Reduce Framework Phases-Map Reduce Input and Output Formats - Advanced Concepts - Sample Applications – Combiner – Joining datasets in Map reduce jobs – Map-side join – Reduce-Side join - Map reduce – customization	2	3,4
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
IV	**Big Data and AI: Roles and Skills:** AI: Cognitive Computing: Learning Perceptions – Terminologies - Machine Learning – Neural Networks – Deep Learning - NLP – Speech Processing – Big Data and AI – Ethics in AI Research - Advanced Applications – AI Myths – Data Science Roles Data Scientist, Data Architect, Data Analyst – Machine Learning Engineer- Skills	2	5,6
		Instructional Hours	**15**
Suggested Learning Methods :Video Presentation			
V	**Data Science Use cases:** Data Science& Big Data Use Cases Specifications and Discussion – Data Sources Identification –Data Types –Data Classification – Data Characteristics of Big V's – Data Science P's – Big Data Frameworks– Data Analytics Classification– Applications of AI: Domains: Customer Insights – Behavioral Analysis – Marketing – Retails – Insurance – Risk and Security–Healthcare – Supply Chain Logistics	3	4,5
		Instructional Hours	**15**
		Total Hours	**75 Hrs.**

Text Books	1.V.Bhuvaneswari, T. Devi, "Big Data Analytics: A Practitioner's Approach",Sci-Tech Publications, 2016. 2.Han Hu,YonggangWen,Tat- Seng, Chua,XuelongLi, "Toward Scalable Systems for Big Data", 2017. 3.Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2016.
Reference Books	1. Field Cady, "The Data Science Handbook", John Wiley & Sons, 2017. 2. Hu Hana Fer, "Data Science Primer", SCD Publications, 2002.
Web. URLs	https://builtin.com/data-science

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. D. Vimal Kumar	Dr. N. Kavitha

Course Code	Title		
23PGDTE102	Elective Paper I B: Text Analytics		
Semester: I	Credits: 4	CIA: 25 Marks	ESE:75 Marks

Course Objective	1. To understand the text mining and NLP techniques 2. To understand and apply probabilistic models, clustering and classification for text analytics. 3. To understand and apply text analytics approaches in different domains
Course Category	Entrepreneurship
Development Needs	Global
Course Description	Text analysis helps businesses analyze huge quantities of text-based data in a scalable, consistent and unbiased manner.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the text mining and text preprocessing techniques	Lecture	Group Discussion
CO 2	Understand the concepts of text mining in information retrieval and extraction	Lecture	Quiz
CO 3	Apply the probabilistic models, clustering and classification for text analytics	Video Lessons	Seminar
CO 4	To apply the text analytics approaches in different domains	Tutorial / Video Lessons	Seminar
CO 5	Design a text analytic framework to analyze text data for domain specific applications	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	Instructional Hours / Week :5

Unit	Description	Text Book	Chapters
I	Text Preprocessing and Wrangling - Removing HTML Tags - Text Tokenization - Removing Accented Characters - Expanding Contractions - Removing Special Characters - Case Conversions - Text Correction - Stemming - Lemmatization - Removing Stopwords - Building a Text Normalizer	1	3
		Instructional Hours	**15**
Suggested Learning Methods: Tutorial			
II	Understanding Text Syntax and Structure - Installing Necessary Dependencies - Important Machine Learning Concepts - Parts of Speech Tagging - Shallow Parsing or Chunking - Dependency Parsing - Constituency Parsing	1	3
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
III	Understanding Text Data - Building Text Corpus - Preprocessing Our Text Corpus - Traditional Feature Engineering Models: Bag of Words Model - Bag of N-Grams Model - TF-IDF Model - Extracting Features for New Documents - Document Similarity - Topic Models.	1	4
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			

IV	Advanced Feature Engineering Models: Word2Vec Model - Robust Word2Vec Models with Gensim - Applying Word2Vec Features for Machine Learning Tasks - The GloVe Model - Applying GloVe Features for Machine Learning Tasks - The FastText Model	1	4
		Instructional Hours	**15**
Suggested Learning Methods : Video Presentation			
V	Text Classification: Formal Definition - Major Text Classification Variants. Automated Text Classification: Formal Definition - Text Classification Task Variants. Text Classification Blue Print - Data Retrieval - Data Preprocessing and Normalization - Building Train and Test Datasets	1	5
		Instructional Hours	**15**
Suggested Learning Methods : Video Presentation			
		Total Hours	**75 Hrs.**

Text Book	1. Dipanjan Sarkar, "Text Analytics with Python", APress, Second Edition,2019.
Reference Books	1. Steven Struhl, "Practical Text Analytics", Kogan Page, 2015. 2. Jens Albrecht, Sidharth Ramachandran, Christian Winkler, "Blueprints for Text Analytics Using Python", O'Reilly Media, 2010.
Web. URLs	https://www.listendata.com/2015/09/text-mining-basics.html

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTE103	**Elective Paper I C: Artificial Intelligence for Data Science**		
Semester: I	**Credits: 4**	**CIA: 25 Marks**	**ESE: 75 Marks**
Course Objective	To understand Artificial Intelligence theoretical aspects that suits for data science		
Course Category	Entrepreneurship		
Development Needs	Global		
Course Description	This course emphasizes various artificial intelligence techniques that can be applied to data science and analytics		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the concepts of artificial intelligence and problem solving	Lecture	Group Discussion
CO 2	Understand the concepts of optimization problems and stochastic games	Lecture	Quiz
CO 3	Apply the knowledge representation and reasoning systems	Video Lessons	Seminar
CO 4	To apply software agents in real world applications	Tutorial / Video Lessons	Seminar
CO 5	To obtain exposure on AI applications	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 5**

Unit	Description	Text Book	Chapters
I	Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.	I	1,2
		Instructional Hours	**15**
Suggested Learning Methods : Tutorial			
II	Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems -Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games	I	3,4
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
III	Knowledge Representation First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories -Reasoning with Default Information	I	4,5

		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			
IV	Software Agents Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	I	7,8
		Instructional Hours	**15**
Suggested Learning Methods : Video Presentation			
V	Applications AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning	I	9,10
		Instructional Hours	**15**
Suggested Learning Methods : Video Presentation			
		Total Hours	**75 Hrs**

Text Book	1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach,Prentice Hall, Third Edition, 2019.
Reference Books	1. I. Bratko, ―Prolog: Programming for Artificial Intelligence, Fourth Edition,Addison-Wesley Educational Publishers Inc., 2015. 2. M. Dhivya, S. Kanimozhi Suguna, Sara Paiva, "Artificial Intelligence (AI)", CRC Press, 2011.
Web. URLs	https://www.mygreatlearning.com/blog/artificial-intelligence-tutorial/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; M-Mow

Course designed by	Verified by Chairman
Dr. Juliet Rozario	Dr. N. Kavitha

Course Code	Title		
23PGDTC204	**Paper IV : Deep Learning for Data Science**		
Semester: II	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	Equip students with deep learning skills to solve complex data science problems through practical applications and model interpretation.		
Course Category	Skill Development		
Development Needs	Global		
Course Description	This course explores the theory and practical applications of deep learning in data science. Students learn to build and interpret deep neural networks for tasks such as image recognition, natural language processing, and generative modeling.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand the basic concepts of Deep learning and tools	Lecture	Group Discussion
CO 2	Learn the foundation of various types of deep learning algorithms including CNN	Lecture	Quiz
CO 3	Recollect the concepts and working of RNN, LSTM and Named Entity Recognition	Video Lessons	Seminar
CO 4	Demonstrate various deep learning algorithms including VAEs, GANs and other techniques	Tutorial / Video Lessons	Seminar
CO 5	Illustrate several types of attention mechanisms in deep learning and understand emerging trends of deep learning.	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week :5**

Unit	**Description**	**Text Book**	**Chapters**
I	Introduction to Artificial Intelligence and Machine Learning - Foundations of Deep Learning - Neural Networks and Perceptrons. Activation Functions and Network Architectures: Deep Learning Libraries (TensorFlow, PyTorch) - Training Deep Neural Networks - Gradient Descent and Backpropagation. Overfitting and Regularization - Model Evaluation and Metrics - Deep Learning Frameworks and Tools.	1	1, 2, 3
		Instructional Hours	**15**
Suggested Learning Methods: Tutorial			
II	Introduction to Convolutional Neural Networks (CNNs) - Convolutional Layers and Feature Maps - Pooling Layers and Spatial Reduction - CNN Architectures (LeNet, AlexNet, VGG,	1	4, 5

	ResNet) - Transfer Learning with Pretrained CNNs - Object Detection and Localization with CNNs - Image Classification and Recognition - Semantic Segmentation - Generating Adversarial Examples - Ethical Considerations in Computer Vision		
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
III	RNN Architecture and Vanishing Gradient Problem - Long Short-Term Memory (LSTM) Networks - Gated Recurrent Unit (GRU) Networks - Sequence-to-Sequence Models. Text Preprocessing and Tokenization - Sentiment Analysis and Text Classification. Named Entity Recognition - Machine Translation with RNNs.	1	6, 7, 8
		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			
IV	Introduction to Generative Models - Autoencoders for Feature Learning - Variational Autoencoders (VAEs) - Generative Adversarial Networks (GANs) - Conditional GANs and Image Generation - Anomaly Detection with Autoencoders - Clustering Techniques (K-Means, DBSCAN) - Principal Component Analysis (PCA). Self-Organizing Maps (SOMs) - Unsupervised Learning Applications - Generative Models for Creativity.	1	10, 11, 12
		Instructional Hours	**15**
Suggested Learning Methods :Video Presentation			
V	Attention Mechanisms in Deep Learning - Reinforcement Learning Basics - Deep Reinforcement Learning - Policy Gradients and Actor-Critic. Transfer Learning Strategies - Explainable AI in Deep Learning. Ethical AI and Bias Mitigation - Federated Learning and Privacy - Deep Learning in Healthcare - Deep Learning for Time Series Data - Emerging Trends and Future of Deep Learning.	1	15, 16, 17
		Instructional Hours	**15**
		Total Hours	**75 Hrs**

Text Book	1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning",2016.
Reference Books	1. Adam Gibson and Josh Patterson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017. 2. Antonio Gulli, Amita Kapoor, "TensorFlow 1.x Deep Learning Cookbook", Packt Publishing, 2017.
Web. URLs	https://www.geeksforgeeks.org/deep-learning-tutorial/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping													
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H
H-High; M-Medium; L-Low													

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTC205	**Paper V: Data Visualization Techniques using Tableau**		
Semester: II	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To equip students with the knowledge and skills necessary to effectively visualize complex data sets, enabling them to communicate insights, patterns, and trends to diverse audiences for informed decision-making		
Course Category	Skill Development		
Development Needs	Global		
Course Description	This course provides a comprehensive exploration of data visualization techniques, emphasizing the principles of data design, visualization tools, and best practices. Students will learn how to transform raw data into compelling insights effectively.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the foundational overview of Tableau and the platform	Lecture	Group Discussion
CO 2	Learn about various data sources, its integration into Tableau environment	Lecture	Quiz
CO 3	Demonstrate several data visualization mechanism using Tableau	Video Lessons	Seminar
CO 4	Illustrate various mathematical calculations using aggregate functions	Tutorial / Video Lessons	Seminar
CO 5	Analyze various tools such as maps and building interactive dashboards	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week :5**

Unit	Description	Text Book	Chapters
I	Introduction and getting started with Tableau: The advantages of modern analytics platform - The Tableau application suite - Installing Tableau desktop - Data preparation - The sample dataset - The Tableau workspace - Working with measures and dimensions - Working with marks - Saving, opening, and sharing your workbooks.	1	1
		Instructional Hours	**15**
Suggested Learning Methods: Tutorial			
II	Adding data sources in Tableau: Setting up a data connector - Selecting data tables - Joins - Unions - Data extracts and live connections - Editing the model's metadata - Datatypes - Adding hierarchies, calculated fields, and table calculations - Checklist for increasing performance.	1	2
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
III	Creating data visualizations: Chart types - Ready, set, show me - Bar charts, legends, filters, and hierarchies - Line charts - Highlight tables - Heatmaps - Bullet charts - Cumulative sums	1	3

	with waterfall charts - Reflection: The anatomy of Tableau visualization.		
		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			
IV	Aggregate functions and calculated fields : Aggregate functions - Calculated fields - Aggregations in calculated fields - Text operators - Date fields - Logical functions. Table calculations and level of detail calculations: Quick table calculations - Customized table calculations - Level of detail expressions	1	4, 5
		Instructional Hours	**15**
Suggested Learning Methods :Video Presentation			
V	Maps: Symbol maps - Filled maps - Density maps - Map layers - Maps with pie charts - Mapbox maps - Spatial data. Advanced analytics, trends, forecasts, clusters and other statistical tools: Constant, average, and reference lines - Trend lines - Forecasts - Cluster analysis. Interactive dashboards: Creating new dashboard - The dashboard pane - Dashboard titles - Navigation buttons and dashboard actions.	1	6, 7, 8
		Instructional Hours	**15**
		Total Hours	**75 Hrs**

Text Book	1. Alexander Loth, "Visual Analytics with Tableau", Wiley, 2019.
Reference Books	1. Scott Murray, “Interactive data visualization for the web”, O“Reilly Media, Inc., 2013. 2. Elijah Meeks , D3.js in Action, Second Edition: Data visualization with JavaScript, Publisher: Manning Publications, 2017.
Web. URLs	https://www.geeksforgeeks.org/python-data-visualization-tutorial/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. K. Sumathi	Dr. N. Kavitha

Course Code	Title		
23PGDTC206	Paper VI: Linear Algebra		
Semester: II	Credits: 4	CIA:25 Marks	ESE: 75 Marks
Course Objective	To learn the fundamental concepts and basic ideas involved in matrix theory.		
Course Category	Employability		
Development Needs	Global		
Course Description	Linear algebra is the study of System of linear equations, vector spaces, and linear transformations		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Demonstrate the applications of Linear systems.	Lecture / Video Lectures	Assignment
CO 2	Review the matrix algebra and use the Invertible Matrix Theorem.	Lectures / Video Lessons	Seminar
CO 3	Analyze the geometric interpretation of determinant	Lectures / Video Lessons	Quiz
CO 4	Discuss the kernel and range of a Linear transformation	Tutorial / Lecture	Seminar
CO 5	Application of Eigen values and Eigen vectors to Dynamical System	Lecture / Video Lectures	Assignment

Offered by	Mathematics

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Linear Equations in Linear Algebra:** Systems of linear equations - Row reduction and Echelon form - Vector Equations - Matrix equations Ax = b - Solution set of linear systems - Applications of linear systems - Linear Independence. Introduction to Linear transformations -The matrix of Linear transformation	1	1
		Instructional Hours	**17**
Suggested Learning Methods: Assignment			
II	**Matrix Algebra:** Matrix operations -The inverse of a matrix - Characterizations of Invertible Matrices - Partitioned Matrices - Matrix factorizations -Subspaces of R^n - Dimension and Rank.	1	2
		Instructional Hours	**18**
Suggested Learning Methods: Problem Solving			
III	**Determinants:** Introduction - Properties of the Determinant - Crammer's rule, Volume, and Linear Transformations.	1	3
		Instructional Hours	**10**
Suggested Learning Methods : Group Discussion			
IV	**Vector Spaces:** Vector spaces and subspaces -Null spaces, Column spaces and linear transformations - Linearly independent sets - Bases- Coordinate systems -The dimension of a vector space-Rank.	1	4
		Instructional Hours	**15**
Suggested Learning Methods : Problem solving			

V	**Eigen values and Eigenvectors:** Eigenvectors and Eigen values - The Characteristic equations – Diagonalization - Eigenvectors and linear transformations - Complex Eigen values.	1	5
		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			
		Total Hours	75 Hrs

Text Book	David C. Lay, Steven R. Lay, Judi. J. McDonald, "**Linear Algebra and its Applications**" Pearson Publications, Fifth Ed., 2016 Unit – I: Chapter 1 : Sections 1.1-1.9 Unit – II: Chapter 2 : Sections 2.1- 2.5, 2.7-2.9 Unit – III: Chapter 3 : Sections 3.1- 3.3 Unit – IV: Chapter 4 : Sections 4.1-4.6 Unit – VI: Chapter 5: Sections 5.1-5.5
Reference Book	Gilbert Strang, **"Linear Algebra and its Applications",** Cengage Publications, Fourth Edition, 2022.
Web. URLs	1. https://nptel.ac.in/courses/111104137 2. https://nptel.ac.in/courses/111106051 3. https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Unit Test	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	M	L	M	H	H	M	M	H	H
CO2	H	H	M	M	M	L	M	H	H	M	M	H	M
CO3	H	H	M	M	M	L	M	H	M	M	H	H	H
CO4	H	H	M	M	M	L	M	H	H	H	H	M	H
CO5	H	H	M	M	M	L	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. T. Chandrapushpam	Dr. N. Kavitha

Course Code	Title		
23PGDTQ203	**Practical III: Deep Learning with Python**		
Semester: II	**Credits: 4**	**CIA : 40 Marks**	**ESE: 60 Marks**

Course Objective	Equip students with deep learning practical skills to solve complex data science problems through practical applications and model interpretation
Course Category	Skill Development
Development Needs	Global
Course Description	To learn practical applications of deep learning in data science and able to build and interpret deep neural networks for tasks such as image recognition, natural language processing, and generative modeling.

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Implement feed forward neural networks and variational encoders	Demonstration	Assignment
CO 2	Implement Generative Adversarial Networks and model deployment	Demonstration	Seminar
CO 3	Implement Long Short Term Memory and Recurrent Neural Network	Demonstration	Quiz
CO 4	Implement Convolutional Neural Network, and Hyperparameter Tuning	Demonstration	Seminar
CO 5	Implement Reinforcement Learning and also use Autoencoders	Demonstration	Quiz

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 5**

Unit	**Description**
1.	Write a program in Python for demonstrating feed forward neural networks.
2.	Demonstrate Hyperparameter Tuning in deep learning neural network.
3.	Create a Convolutional Neural Networks and apply in any image dataset for pattern recognition.
4.	Write a program for establishing a model deployment and serving with a dataset.
5.	Write a basic autoencoder program with any dataset.
6.	Write a program for demonstrating Variational Autoencoders.
7.	Implement Gated Recurrent Unit (GRU) in any time series dataset.
8.	Create a Long Short-Term Memory (LSTM) Networks and elucidate its working in a classification problem.
9.	Create a Recurrent Neural Network and use a dataset to perform classification task.
10.	Create a Generative Adversarial Networks (GANs) for a simple binary classification problem.
11.	Write a Gated Recurrent Unit (GRU) neural network for Anomaly Detection.
12.	Demonstrate Reinforcement Learning (RL) with a simple dataset.

Instructional Hours	**75**
Suggested Learning Methods : Video lectures	
Total Hours	**75 Hrs**

Text Book	1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning",2016.
Reference Books	1. Adam Gibson and Josh Patterson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017. 2. Antonio Gulli, Amita Kapoor, "TensorFlow 1.x Deep Learning Cookbook", Packt Publishing, 2017.
Web. URLs	https://www.geeksforgeeks.org/deep-learning-tutorial/

Tools for Assessment (40 Marks)

Laboratory Performance – Application Logic	Laboratory Performance – Program Creativity	Laboratory Performance – Program Debugging	Test - 1	Test - 2	Observation Note Book
5	5	5	10	10	5

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTQ204	**Practical IV: Data Visualization using Tableau**		
Semester: II	**Credits: 4**	**CIA : 40 Marks**	**ESE: 60 Marks**
Course Objective	To equip students with the practical skills to visualize complex data sets, enabling them to communicate insights, patterns, and trends to diverse audiences for informed decision-making		
Course Category	Skill Development		
Development Needs	Global		
Course Description	This course provides a practical exposure of data visualization techniques, emphasizing the principles of data design, visualization tools, and best practices. Students will learn how to transform raw data into compelling visual narratives, gaining the ability to communicate data-driven insights effectively.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Learn to implement data connection, importing data and use chart types	Demonstration	Assignment
CO 2	Implement data cleaning, data transform and shaping data	Demonstration	Seminar
CO 3	Work with string functions, number functions and formatting options	Demonstration	Quiz
CO 4	Create dashboard for attendance management system and library management system	Demonstration	Seminar
CO 5	Create dashboard for bus depot information and contact information system	Demonstration	Quiz

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 5**

Unit	**Description**
1.	Demonstrate data connection capabilities using Tableau.
2.	Demonstrate on importing data from several sources in Tableau.
3.	Import data from a data source and use at least 3 appropriate chart types.
4.	Demonstrate how data cleaning can be performed in imported data using Tableau.
5.	Demonstrate how data transform can be performed in imported data using Tableau.
6.	Demonstrate how shaping data can be performed in imported data using Tableau.
7.	Import a dataset and demonstrate string functions and number functions in Tableau.
8.	Import a dataset and make use of font, alignment, shading and borders in Tableau environment.
9.	Create a dashboard in tableau for student attendance management system.
10.	Create a dashboard in tableau for library management system.
11.	Create a dashboard in tableau for bus depot management system.
12.	Create a dashboard in tableau for contact information system.
Instructional Hours	**15**

Suggested Learning Methods : Video lectures		
	Total Hours	75 Hrs
Text Book	1. Ben Fry, "Visualizing Data", O"Reilly Media, Inc., 2007.	
Reference Books	1. Scott Murray, "Interactive data visualization for the web", O"Reilly Media,Inc., 2013. 2. Elijah Meeks , D3.js in Action, Second Edition: Data visualization withJavaScript, Publisher: Manning Publications, 2017.	
Web. URLs	https://www.geeksforgeeks.org/tableau-data-visualization-tutorial/	

Tools for Assessment (40 Marks)

Laboratory Performance – Application Logic	Laboratory Performance – Program Creativity	Laboratory Performance – Program Debugging	Test - 1	Test - 2	Observation Note Book
5	5	5	10	10	5

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. N. Kavitha	Dr. N. Kavitha

Course Code	Title		
23PGDTE204	**Elective Paper II A: Web Analytics**		
Semester: II	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To provide an overview and the importance of web analytics and helps to understand role of Web analytics.		
Course Category	Employability		
Development Needs	Global		
Course Description	Web analytics explores the effective of Web analytic strategies and implementation		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand web analytics, its analysis and google analytics	Lecture	Group Discussion
CO 2	Implement performance indicators and segmentation	Lecture	Quiz
CO 3	Analyze key performance indicators in Google analytics	Video Lessons	Seminar
CO 4	Acquire qualitative analytics, KPIs and its integration.	Tutorial / Video Lessons	Seminar
CO 5	Create visual analytics using graph visualization and network relationships	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week :5**

Unit	**Description**	**Text Book**	**Chapters**
I	Introduction to Web analytics: Web analytics Approach – A model of Analysis – Context matters – Data contradiction – working of Web analytics: Log file analysis- Page tagging – Metrics and Dimensions – Interacting with data in Google analytics	1	1,2
		Instructional Hours	**15**
Suggested Learning Methods: Tutorial			
II	**Learning about users through Web analytics:** Goals: Introduction – Goals and conversions – conversion rate – Goal reports in Google Analytics – Performance Indicators – Analyzing web users: Learning about users – Traffic Analysis – Analysing user content – click – path analysis – Segmentation.	1	3,4
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
III	**Google Analytics -** Different analytical tools – Key features and capabilities of Google analytics – How Google analytics works – Implementing Google analytics- Getting up and Running with Google analytics – Navigating Google analytics – Using Google analytics reports – Google metrics – Using visitor data to drive website improvement – Focusing on key performance indicators – Integrating Google analytics with third party applications.	2	2,3

		Instructional Hours	**15**
Suggested Learning Methods :Group Discussion			
IV	**Overview of Qualitative Analysis**: Lab usability testing – Heuristic evaluations – Site visits – Surveys (Questionnaires) – Testing and Experimentation: A/B Testing and Multivariate testing – Competitive Intelligence – Analysis search Analytics: Performing Internal Site Search Analytics, Search Engine Optimization(SEO) and pay per Click(PPC) - Website Optimization against KPIs – Content Optimization – Text Analytics: Natural Language Processing(NLP) – Supervised Machine Learning(ML) Algorithms	2	3,4
		Instructional Hours	**15**
Suggested Learning Methods :Video Presentation			
V	**Visual Analytics :** Drill down and hierarchies – Sorting – Grouping – Additional ways to Group – Creating sets – Analysis with cubes and MDX – Filtering for Top and Top N – Using the Filter Shelf – The Formatting Pane – Trend Lines – Forecasting – Formatting – Parameters – Social Network Analysis: Types of Social Network – Graph Visualization – Network Relationships	2	5,6
		Instructional Hours	**15**
		Total Hours	**75 Hrs.**

Text Book	1. Beasley M, "Practical Web Analytics for user experience: How analyticscan help you understand users", CRC Press, 2016. 2. Clifton B, "Advanced Web Metrics with Google Analytics", John Wiley &Sons, VND Publications, 2017.
Reference Books	1. Peterson E T, "Web Analytics Demystified: A Marketer's Guide tounderstanding How your website affects your business", CRC Press, 2004. 2. Pedro Sostre, Jennifer LeClaire, "Web Analytics For Dummies", Wiley, 2007.
Web. URLs	https://builtin.com/web-analytics

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. Juliet Rozario	Dr. N. Kavitha

Course Code	Title		
23PGDTE205	Elective Paper II B: Social Media Analytics		
Semester: II	Credits: 4	CIA: 25 Marks	ESE:75 Marks
Course Objective	Familiarize the learners with different tools of social media analytics.		
Course Category	Entrepreneurship		
Development Needs	Global		
Course Description	Social Media Analytics focuses on analyzing and measuring the engagement levels and influence of social media content and profiles.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand social media and its analytics cycle	Lecture	Group Discussion
CO 2	Implement social network structure and measures	Lecture	Quiz
CO 3	Analyze hyperlink analytics	Video Lessons	Seminar
CO 4	Acquire search engine analytics and relevant tools	Tutorial / Video Lessons	Seminar
CO 5	Create privacy policies, data ownership and maintenance	Video Lessons	Assignment

Offered by	Data Science

Course Content	Instructional Hours / Week :5

Unit	Description	Text Book	Chapters
I	**An Overview -** Core Characteristics of Social Media, Types of Social Media, Social media landscape, Need for Social Media Analytics (SMA), SMA in small & large organizations. Purpose of Social Media Analytics, Social Media vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle	1	2,3
	Instructional Hours		**15**
Suggested Learning Methods: Tutorial			
II	**Social Network Structure, Measures & Visualization :** Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust Network Visualization - Graph Layout, Visualizing Network features, Scale Issues. Social Media Network Analytics - Common Network Terms, Common Social Media Network Types	1	4,5
	Instructional Hours		**15**
Suggested Learning Methods: Group Discussion			
III	**Social Media Text, Action & Hyperlink Analytics:** Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text 8 Analysis Tools Social Media Action Analytics - What Is Actions Analytics? Common Social Media Actions, Actions Analytics Tools Social Media Hyperlink Analytics - Types of Hyperlinks,	1	6

	Types of Hyperlink Analytics, Hyperlink Analytics Tools.		
		Instructional Hours	**15**
Suggested Learning Methods :Group Discussion			
IV	**Social Media Location & Search Engine Analytics:** Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools Search Engine Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools	1	7
		Instructional Hours	**15**
Suggested Learning Methods :Video Presentation			
V	**Social Media Analytics Applications and Privacy:** Social media in public sector - Analyzing public sector social media, analyzing individual users, case study. Business use of Social Media - Measuring success, Interaction and monitoring, case study. Privacy - Privacy policies, data ownership and maintaining privacy online.	1	1
		Instructional Hours	**15**
		Total Hours	**75 Hrs**

Text Book	1. Gohar F. Khan, "Seven Layers of Social Media Analytics: Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, SearchEngine, and Location Data", Wiley, 2017.
Reference Books	1. Matthew Ganis, Avinash Kohirkar, "Social Media Analytics, Techniques and Insights for Extracting Business Value Out of Social Media", IBM Press, 2010. 2. Gabor Szabo, Gungor Polatkan, P. Oscar Boykin, Antonios Chalkiopoulos, "Social Media Data Mining and Analytics", Wiley, 2009.
Web. URLs	https://cse.iitkgp.ac.in/~pawang/courses/SC16.html

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. D. Vimal Kumar	Dr. N. Kavitha

Course Code	Title		
23PGDTE206	**Elective Paper II C: Business Intelligence**		
Semester: II	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To impart a comprehensive understanding of BI fundamentals, emphasizing data collection, integration, and warehousing. Learners can delve into analysis using BI tools, learning to generate reports and derive actionable insights.		
Course Category	Employability		
Development Needs	Global		
Course Description	The course intends to equip learners with the skills to harness data effectively, drive informed decisions, and contribute strategically to organizational success.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand BI concepts for informed business decisions, yielding significant benefits.	Lecture	Group Discussion
CO 2	Comprehend BI dimensions, aligning with business needs for comprehensive insights.	Lecture	Quiz
CO 3	Analyze and explore BI tech: data handling, analytics, AI integration, deployment complexities.	Video Lessons	Seminar
CO 4	Acquire BI culture: align human aspects, integrate informing for organizational growth.	Tutorial / Video Lessons	Seminar
CO 5	Understand Soft BI factors: focus, sense dynamics, trust, fostering informed processing.	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week :5**

Unit	**Description**	**Text Book**	**Chapters**
I	Business Intelligence Definition and Problem Space: The Activities of Business Intelligence - Definitions - Expected Results and Benefits - Advanced Informing and Insights. Business Intelligence Information Needs: Information Needs - Business Intelligence Cycle - Business Intelligence and Related Informing Activities.	1	2, 3
	Instructional Hours		**15**
Suggested Learning Methods: Tutorial			
II	Business Intelligence Dimensions: The Notion of BI Dimensionality - Business Dimensions - Relations of Business and BI Dimensions - BI Dimensions: Internal and External Orientation - Centralized and Decentralized BI - Question Complexity - Functional Scope - Automation - Initiative - Velocity - Tired Approaches - The Encompassing Potential of BI	1	4
	Instructional Hours		**15**
Suggested Learning Methods: Group Discussion			
III	Business Intelligence Technologies: Overview of BI	1	7

	Technologies - Data Collection and Storage - Multidimensional Analysis, Online Analytical Processing - Use of Simple Service Tools - Business Analytics - Modeling and Simulation - Text Analytics - The Role of AI - Communication and Collaboration Platforms - BI Technology Deployment Issues		
		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			
IV	Business Intelligence Culture: Human Factors in Business Intelligence - Relation of Organizational, Information, and Business Intelligence Cultures - The Importance of Informing Activities for Organizational Culture - The Most Common Features of Business Intelligence Culture - Research on Business Intelligence Adoption in Lithuanian Companies.	1	9
		Instructional Hours	**15**
Suggested Learning Methods :Video Presentation			
V	Soft Business Intelligence Factors: Common Issues for Soft Factors - Attention: Importance for BI - Important Attention Issues - Attention Management Tools - Sense: Sense Dynamics - Sense Metrics - Trust: Trust in Elements of Informing Process - Processing Methods and Systems Design - Contributors - Metrics - Relations between Soft Factors - Possible Research Directions	1	10
		Instructional Hours	**15**
		Total Hours	**75 Hrs**

Text Book	1. Rimvydas Skyrius, "Business Intelligence - A Comprehensive Approach toInformation Needs, Technologies and Culture", Springer, 2021.
Reference Books	1. J. Mark Munoz, "Global Business Intelligence", Taylor and Francis, 2018. 2. S. Shenghai Wu, "Business Intelligence", Wiley, 2015.
Web. URLs	https://corporatefinanceinstitute.com/course/introduction-to-business-intelligence/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTC307	**Paper VII: Information Retrieval Techniques**		
Semester: III	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To equip students with comprehensive knowledge of information retrieval techniques, spanning text search algorithms and multimedia information retrieval.		
Course Category	Skill Development		
Development Needs	Global		
Course Description	This course delves into the principles and methods of retrieving information from vast data repositories. The course explores various text search algorithms and the intricacies of multimedia information retrieval, covering spoken language audio, non-speech audio, graph, imagery, and video retrieval.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand information retrieval systems and its search capabilities	Lecture	Group Discussion
CO 2	Implement cataloging and indexing techniques	Lecture	Quiz
CO 3	Analyze automatic indexing mechanisms, clustering and hierarchy of clusters	Video Lessons	Seminar
CO 4	Acquire knowledge on user search techniques and information search	Tutorial / Video Lessons	Seminar
CO 5	Create information retrieval systems using text search techniques and make use of multimedia information retrieval methods	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 4**

Unit	**Description**	**Text Book**	**Chapters**
I	Introduction to Information Retrieval Systems: Definition and Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses. Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities	1	3, 4
		Instructional Hours	**12**
Suggested Learning Methods: Tutorial			
II	Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction. Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures	1	5, 6, 7
		Instructional Hours	**12**
Suggested Learning Methods: Group Discussion			
III	Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext	1	9, 11

	Linkages. Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.		
		Instructional Hours	**12**
Suggested Learning Methods : Group Discussion			
IV	User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext.	1	13, 15, 16
		Instructional Hours	**12**
Suggested Learning Methods :Video Presentation			
V	Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems. Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval.	1	17, 18
		Instructional Hours	**12**
		Total Hours	**60 Hrs.**

Text Books	1. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schutze, "Introduction to Information Retrieval", Cambridge University Press, 2017.
Reference Books	1. Prabhakar Raghavan, "Retrieval Techniques", PHI, 2015. 2. J. Camberson, "Information Retrieval Story", Wiley, 2014.
Web. URLs	https://www.geeksforgeeks.org/what-is-information-retrieval/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTC308	**Paper VIII: Exploratory Data Analysis**		
Semester: III	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To equip learners with comprehensive skills in Exploratory Data Analysis (EDA) using various visual aids and transformation techniques. Students will explore into data transformation methods.		
Course Category	Skill Development		
Development Needs	Global		
Course Description	Focuses on single-variable analysis, discussing distributions, numerical summaries, scaling, and inequalities, while addressing relationships between two variables using percentage tables, scatterplots, and transformations.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand fundamentals of EDA, transformation techniques and cross tabulations.	Lecture	Group Discussion
CO 2	Implement three-dimensional plotting, visualization and seaborn.	Lecture	Quiz
CO 3	Analyze single variable and perform smoothing time series data for EDA.	Video Lessons	Seminar
CO 4	Acquire knowledge on relationships, batch handling and perform transformations.	Tutorial / Video Lessons	Seminar
CO 5	Create time-based indexing, visualizing and resampling.	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 4**

Unit	**Description**	**Text Book**	**Chapters**
I	EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques - Grouping Datasets - data aggregation – Pivot tables and cross-tabulations.	1	3, 4
		Instructional Hours	**12**
Suggested Learning Methods: Tutorial			
II	Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.	1	5, 6, 7
		Instructional Hours	**12**
Suggested Learning Methods: Group Discussion			

III	Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.	1	9, 11
		Instructional Hours	**12**
Suggested Learning Methods : Group Discussion			
IV	Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.	1	13, 15, 16
		Instructional Hours	**12**
Suggested Learning Methods :Video Presentation			
V	Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.	1	17, 18
		Instructional Hours	**12**
		Total Hours	**60 Hrs.**

Text Book	1. John W. Tukey, "Exploratory Data Analysis", Addison-Wesley PublishingCompany, 2022. (Reprint 12th Edition)
Reference Books	1. Andrew Gelman and Jennifer Hill, "Exploratory Data Analysis Using Regression and Multilevel/Hierarchical Models", Cambridge University Press,2017. 2. Wendy L. Martinez, Angel R. Martinez, Jeffrey Solka, "Exploratory Data Analysis with MATLAB", CRC Press, 2017.
Web. URLs	https://www.simplilearn.com/tutorials/data-analytics-tutorial/exploratory-data-analysis

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. N. Kavitha	Dr. N. Kavitha

Course Code	Title		
23PGDTC309	**Paper IX: Data Privacy and Security**		
Semester: III	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To understand the importance of data privacy and security and to learn about the privacy preservation methods for protecting various kinds of data.		
Course Category	Skill Development		
Development Needs	Global		
Course Description	This course will equip students with the knowledge and skills necessary to navigate the complex landscape of safeguarding sensitive information in today's digital age.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand the need for data sharing.	Lecture	Group Discussion
CO 2	Analyze the necessity of different privacy-preserving methods	Lecture	Quiz
CO 3	Apply the privacy-preserving methods for various types of data and evaluate their performance	Video Lessons	Seminar
CO 4	Remember and evaluate the security policies and identify the system vulnerabilities	Tutorial / Video Lessons	Seminar
CO 5	Assess the security by applying the information security policies and standards for device management	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week :4**

Unit	**Description**	**Text Book**	**Chapters**
I	Data Privacy and its Importance - Need for Sharing Data - Methods of Protecting Data – Importance of Balancing Data Privacy and Utility – Introduction to Anonymization Design Principles - Nature of Data in the Enterprise Static Data Anonymization on Multidimensional Data: Introduction - Classification of Privacy Preserving Methods - Classification of Data in a Multidimensional Data Set - Group-Based Anonymization	1	1, 2
		Instructional Hours	**12**
Suggested Learning Methods: Tutorial			
II	Introduction - Privacy Preserving Graph Data - Privacy Preserving Time Series Data – Privacy Preservation of Longitudinal Data - Privacy Preservation of Transaction Data - Static Data Anonymization: Threats to Anonymized Data - Threats to Data Structures - Threats by Anonymization Techniques.	1	3, 4
		Instructional Hours	**12**

Suggested Learning Methods: Group Discussion			
III	Introduction - UK Data Protection Act 1998. - Federal Act of Data Protection of Switzerland 1992 - Payment Card Industry Data Security Standard (PCI DSS) - The Health Insurance Portability and Accountability Act of 1996 (HIPAA): Effects of Protection - Anonymization Considerations - Anonymization Design for HIPAA - Explicit Identifiers - Quasi-Identifiers - Sensitive Data. - Anonymization Design Checklist.	1	9
		Instructional Hours	**12**
Suggested Learning Methods : Group Discussion			
IV	Securing Unstructured Data: Structured Data vs. Unstructured Data – At Rest, in Transit and in Use – Approaches to secure Unstructured Data – Newer Approaches to Secure Unstructured Data. Information Rights Management: Overview – IRM Technology Details – Getting Started with IRM.	2	4
		Instructional Hours	**12**
Suggested Learning Methods :Video Presentation			
V	Storage Security: Evolution – Modern Storage Security – Risk Remediation – Best Practices. Database Security: General Concepts – Database Security Layers – Database-Level Security – Database Backup and Recovery – Database Auditing and Monitoring	2	5
		Instructional Hours	**12**
		Total Hours	**60 Hrs.**

Text Books	1. Venkataramanan, Nataraj, and Ashwin Shriram, "Data Privacy: Principlesand Practice", CRC Press, 2019. 2. Rhodes-Ousley, Mark. Information Security: The Complete Reference,McGraw-Hill, 2018.
Reference Books	1. William Stallings, Lawrie Brown, "Computer Security: Principles andPractice", Pearson, 2014. 2. James L Schaub, Ken D Biery, "Ultimate Computer Security", CRC Press, 2013.
Web. URLs	https://www.ibm.com/topics/data-security

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. N. Kavitha	Dr. N. Kavitha

Course Code	Title		
23PGDTC310	Paper X: Probability and Inferential Statistics		
Semester: III	Credits: 4	CIA: 25 Marks	ESE:75 Marks

Course Objective	To Understand the Probability theory and to forecast the future events using the principles of statistical methods.
Course Category	Employability
Development Needs	Global
Course Description	This course helps in making predictions or generalizations about a larger data set based on the smaller one.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the principles of probability theory	Lecture /Video Lessons	Assignment
CO 2	Demonstrate the conceptual knowledge of different distributions.	Lecture	Seminar
CO 3	Establish the effect of independent variable on dependent variable using experimental designs	Lecture/Video Lessons	Seminar
CO 4	Analyze the business forecasting techniques	Tutorial / Video Lessons	Seminar
CO 5	Perform multi variable Regression analysis.	Lecture	Assignment

Offered by	**Mathematics**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Probability and Expected value:** Introduction to Probability Theory: Sample space and events, axioms of Probability, conditional probability, Baye's theorem, Mathematical Expectations.	1	1
	Instructional Hours		**15**
Suggested Learning Methods:Tutorial			**03Hrs**
II	**Theoretical Distributions:** Binominal Distribution - Obtaining Coefficient –Fitting a binomial distribution Poison Distribution - Fitting a Poisson distribution – Poisson distribution as an approximation of binomial distribution - Normal Distribution.	1	2
	Instructional Hours		15
Suggested Learning Methods: Problem solving			**03Hrs**
III	**Experimental Designs and Statistical Quality Control:** **Experimental Designs:** Introduction – Randomized block design – Latin squares - Randomized blocks Vs Latin squares. **Statistical Quality Control:** Introduction – Control charts –Types – Control charts for the Standard deviation - Control charts for C - Control charts for P – Advantages and Limitations – Total Quality management – Acceptance sampling.	1	**6, 7**

		Instructional Hours	15
Suggested Learning Methods :Group Discussion/Video lecture			**03Hrs**
IV	**Business Forecasting and Statistical Decision Theory:** **Business Forecasting:** Introduction – Role of forecasting – steps in forecasting – Methods of forecasting – Theories of Business forecasting – Cautions while using forecasting techniques. **Statistical Decision Theory:** Introduction - Ingredients of decision problems – Optimal decisions.	1	**8, 10**
		Instructional Hours	15
Suggested Learning Methods :Group Discussion/Video Lecture			**03Hrs**
V	**Partial and Multiple Correlations:** Partial Correlation – Multiple Correlation - Multiple Regression Analysis (upto 3 variables) – Reliability of estimates.	1	9
		Instructional Hours	15
Suggested Learning Methods : Problem Solving			**03 Hrs**
		Total Hours	**75 Hrs**

Text Book	1. Statistical Methods, S. P. Gupta, Sultan Chand and Sons, New Delhi, 2021.
Reference Books	1. R.S.N. Pillai, Bagavathi, "Statistics Theory and Practice, S. Chand & Company, 2013.
Web. URLs	**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]**

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Unit Test	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	M	L	M	H	H	M	M	H	H
CO2	H	H	M	M	M	L	M	H	H	M	M	H	M
CO3	H	H	M	M	M	L	M	H	M	M	H	H	H
CO4	H	H	M	M	M	L	M	H	H	H	H	M	H
CO5	H	H	M	M	M	L	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. T. Chandrapushpam	Dr. N. Kavitha

Course Code	Title		
23PGDTQ305	**Practical V: Exploratory Data Analysis**		
Semester: III	**Credits: 4**	**CIA : 40 Marks**	**ESE: 60 Marks**
Course Objective	To perform exploratory data analysis by identifying the right tool		
Course Category	Skill Development		
Development Needs	Global		
Course Description	Students will learn and gain practical exposure to exploratory data analysis using Python.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Learn to implement coorelation, scatter plots and linear regression	Demonstration	Assignment
CO 2	Learn to conduct T-Test, categorical features and MLR	Demonstration	Seminar
CO 3	Learn to implement OLS, Univariate, Bivariate and Multivariate analysis	Demonstration	Quiz
CO 4	Learn to implement univariate statistics	Demonstration	Seminar
CO 5	Learn to implement one-way ANOVA using Python tools	Demonstration	Quiz

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 4**

Unit	Description
1.	Program to demonstrate Correlation and P-value concepts
2.	Program to display Scatterplots
3.	Program to demonstrate Linear Regression
4.	Program to conduct T-Test
5.	Program to elucidate Categorical features
6.	Program to demonstrate MLR with dummy codes
7.	Program to demonstrate OLS
8.	Program to demonstrate Univariate analysis
9.	Program to demonstrate Bivariate statistics
10.	Program to demonstrate Multivariate analysis
11.	Program to demonstrate Univariate statistics
12.	Program to demonstrate one - way ANOVA

Suggested Learning Methods : Video lectures	
Total Hours	**60 Hrs**

Text Book	1. Ben Fry, "Visualizing Data", O"Reilly Media, Inc., 2017.
Reference Books	1. Scott Murray, "Interactive data visualization for the web", O"Reilly Media,Inc., 2013. 2. Cole Nussbaumer Knaflic, "Storytelling with Data - A Data Visualization Guide for Business Professionals", Wiley, 2012.
Web. URLs	https://www.geeksforgeeks.org/tableau-data-visualization-tutorial/

Tools for Assessment (40 Marks)

Laboratory Performance – Application Logic	Laboratory Performance – Program Creativity	Laboratory Performance – Program Debugging	Test - 1	Test - 2	Observation Note Book
5	5	5	10	10	5

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTQ306	**Practical VI: Data Visualization using Power BI**		
Semester: III	**Credits: 4**	**CIA : 40 Marks**	**ESE: 60 Marks**
Course Objective	To perform data visualization using Power BI		
Course Category	Skill Development		
Development Needs	Global		
Course Description	Students will learn and gain practical exposure to conduct data visualization experiments using Power BI tool.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Learn to use connect various data sources, cleaning, filtering and formatting operations.	Demonstration	Assignment
CO 2	Understand to manipulate data, handle variouskind of data formats.	Demonstration	Seminar
CO 3	Apply knowledge to combine multiple tables, pivotingand structured formatting.	Demonstration	Quiz
CO 4	Learn to draw several kind of charts	Demonstration	Seminar
CO 5	Create superstore report	Demonstration	Quiz

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 5**

Unit	**Description**
1.	Program using powerquery to connect to various data sources, including databases, Excel files, and web data.
2.	Program using powerquery for cleaning and filtering data to prepare it for analysis.
3.	Program using powerquery for working with text data, including text extraction, splitting, and formatting.
4.	Program using powerquery for manipulating date and time data, including date calculations and formatting.
5.	Program using powerquery for handling numeric data, performing calculations, and aggregating values.
6.	Program using powerquery combining data from multiple tables through joins and merges.
7.	Program using powerquery transforming data by pivoting tables into a more structured format.
8.	Program using powerquery to build automated data transformation workflows and refreshing data.
9.	Import sufficient data and use column chart, stacked column chart, pie chart, donut chart, funnel chart and ribbon chart in Power BI.
10.	Import sufficient data and demonstrate conditional formatting, change aggregations, number formatting in Power BI.
11.	Import appropriate dataset and create a superstore report in Power BI.
12.	Create a dashboard in Power BI for any application of your choice.

Suggested Learning Methods : Video lectures	
Total Hours	**75 Hrs**

Text Book	1. Ben Fry, “Visualizing Data”, O‟Reilly Media, Inc., 2017.

Reference Books	1. Scott Murray, "Interactive data visualization for the web", O"Reilly Media,Inc., 2013. 2. Cole Nussbaumer Knaflic, "Storytelling with Data - A Data Visualization Guide for Business Professionals", Wiley, 2012.
Web. URLs	https://www.geeksforgeeks.org/Power BI-data-visualization-tutorial/

Tools for Assessment (40 Marks)

Laboratory Performance – Application Logic	Laboratory Performance – Program Creativity	Laboratory Performance – Program Debugging	Test - 1	Test - 2	Observation Note Book
5	5	5	10	10	5

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. Juliet Rozario	Dr. N. Kavitha

Course Code	Title		
23PGDTE307	Elective Paper III A: Natural Language Processing		
Semester: III	Credits: 4	CIA: 25 Marks	ESE:75 Marks
Course Objective	To understand algorithms for the processing of linguistic information and computational properties of natural languages.		
Course Category	Entrepreneurship		
Development Needs	Global		
Course Description	This course provides a comprehensive introduction to the key concepts, techniques, and applications of NLP, empowering students to understand, build, and deploy NLP systems effectively.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language	Lecture	Group Discussion
CO 2	Demonstrate understanding of the relationship between NLP and statistics & machine learning	Lecture	Quiz
CO 3	Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis, partsof-speech tagging and syntactic parsing	Video Lessons	Seminar
CO 4	Demonstrate the concept of semantic analysis and word sense disambiguation	Tutorial / Video Lessons	Seminar
CO 5	Understand the components of machine translation process and develop the model for NLP applications	Video Lessons	Assignment

Offered by	Data Science

Course Content	Instructional Hours / Week :4

Unit	Description	Text Book	Chapters
I	Introduction - NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field - N-gram Language Models - The role of language models. Simple N- gram models. Estimating parameters and smoothing. Evaluating language models.	1	
		Instructional Hours	12
Suggested Learning Methods: Tutorial			

II	Part Of Speech Tagging and Sequence Labeling - Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training) - Basic Neural Networks. Any basic introduction to perceptron and backpropagation	1	
		Instructional Hours	**12**
Suggested Learning Methods:Group Discussion			
III	LSTM Recurrent Neural Networks -Syntactic parsing - Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing.	1	
		Instructional Hours	**12**
Suggested Learning Methods :Group Discussion			
IV	Lexical semantics and word - sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing - Syntactic Parsing - Argument Identification - Semantic Representation.	1	
		Instructional Hours	**12**
Suggested Learning Methods :Video Presentation			
V	Information Extraction (IE) - Named entity recognition and relation extraction. IE using sequence labelling. -Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.	1	
		Instructional Hours	**12**
		Total Hours	**60 Hrs.**

Text Book	1. Jurafsky Dan and Martin James H. “Speech and Language Processing” ,3rdEdition, 2018.
Reference Books	1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana,‘Practical Natural Language Processing”, Wiley, 2018. 2. Bernadette Sharp, Florence Sedes, Wieslaw Lubaszewski, “Cognitive Approach to Natural Language Processing”, CRC Press, 2017.
Web. URLs	https://www.tutorialspoint.com/natural_language_processing/index.htm

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. K. Sumathi	Dr. N. Kavitha

Course Code	Title		
23PGDTE308	**Elective Paper III B: Time Series Analysis**		
Semester: III	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To equip students with a comprehensive understanding of the theoretical foundations and practical applications of analyzing sequential data. Through this course, students will explore statistical methods, models, and techniques essential for interpreting and forecasting time-dependent data.		
Course Category	Entrepreneurship		
Development Needs	Global		
Course Description	Learn to identify patterns, trends, and dependencies within time series data, gaining proficiency in model selection, estimation, and validation. Emphasis will be placed on employing these tools to solve real-world problems across various fields such as finance, economics, engineering, and environmental sciences, enabling students to make informed decisions and predictions based on historical time-based data.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand key practical challenges in time series analysis and also forecasting, transfer function estimation, assessing intervention impacts and multivariate analysis.	Lecture	Group Discussion
CO 2	Implement autocorrelation properties, positive definiteness, estimation techniques, standard errors, and spectral properties. Exploring periodograms, spectral density functions and many more.	Lecture	Quiz
CO 3	Analyze Linear Stationary Models, detailing the General Linear Process, Autoregressive and Moving Average processes, and their conditions for stationarity.	Video Lessons	Seminar
CO 4	Acquire concept of Moving Average Processes, autocorrelation functions, and spectrums. It examines Mixed Autoregressive-Moving Average Processes, their stationarity, and the duality between Autoregressive and Moving Average models.	Tutorial / Video Lessons	Seminar
CO 5	Create Linear Nonstationary Models, their general form, difference equation, random shock, and integrated moving average processes of varying orders.	Video Lessons	Assignment

Offered by	**Data Science**

Course Content		Instructional Hours / Week :4	
Unit	**Description**	**Text Book**	**Chapters**
I	Introduction to Time Series: Five Important Practical Problems - Forecasting Time Series - Estimation of Transfer Functions - Analysis of Effects of Unusual Intervention Events to a System - Analysis of Multivariate Time Series - Discrete Control Systems - Stochastic and Deterministic Dynamic Mathematical Models: Stationary and Nonstationary Stochastic Models for Forecasting and Control - Transfer Function Models - Models for Discrete Control Systems - Basic Ideas in Model Building: Parsimony - Iterative Stages in the Selection of a Model.	1	1
		Instructional Hours	**12**
Suggested Learning Methods: Tutorial			
II	Autocorrelation Function and Spectrum of Stationary Processes: Autocorrelation Properties of Stationary Models - Time Series and Stochastic Processes - Stationary Stochastic Processes - Positive Definiteness and the Autocovariance Matrix - Autocovariance and Autocorrelation Functions - Estimation of Autocovariance and Autocorrelation Functions - Standard Errors of Autocorrelation Estimates - Spectral Properties of Stationary Models: Periodogram of a Time Series - Analysis of Variance - Spectrum and Spectral Density Function - Simple Examples of Autocorrelation and Spectral Density Functions - Advantages and Disadvantages of the Autocorrelation and Spectral Density Functions.	1	2
		Instructional Hours	**12**
Suggested Learning Methods: Group Discussion			
III	Linear Stationary Models - 1: General Linear Process - Two Equivalent Forms for the Linear Process - Autocovariance Generating Function of a Linear Process - Stationarity and Invertibility Conditions for a Linear Process - Autoregressive and Moving Average Processes - Autoregressive Processes - Stationarity Conditions for Autoregressive Processes - Autocorrelation Function and Spectrum of Autoregressive Processes - The First-Order Autoregressive Process - Second-Order Autoregressive Process - Partial Autocorrelation Function - Estimation of the Partial Autocorrelation Function - Standard Errors of Partial Autocorrelation Estimates.	1	3
		Instructional Hours	**12**
Suggested Learning Methods : Group Discussion			
IV	Linear Stationary Models - 2: Moving Average Processes - Invertibility Conditions for Moving Average Processes - Autocorrelation Function and Spectrum of Moving Average Processes - First-Order Moving Average Process - Second-Order Moving Average Process - Duality Between Autoregressive and Moving Average Processes. Mixed Autoregressive: Moving Average Processes - Stationarity and Invertibility Properties - Autocorrelation Function and Spectrum of Mixed Processes.	1	3

		Instructional Hours	**12**
Suggested Learning Methods :Video Presentation			
V	Linear Nonstationary Models: Autoregressive Integrated Moving Average Processes - Nonstationary First-Order Autoregressive Process - General Model for a Nonstationary Process Exhibiting Homogeneity - General Form of the ARIMA Model - Three Explicit Forms for the ARIMA Model - Difference Equation Form of the Model - Random Shock Form of the Model - Inverted Form of the Model – Integrated Moving Average Processes – Integrated Moving Average Process of Order (0, 1, 1) – Integrated Moving Average Process of Order (0,2, 2) - General Integrated Moving Average Process of Order (0, d, q)	1	4
		Instructional Hours	**12**
		Total Hours	**60 Hrs**

Text Book	1. George E. P. BOX, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung,"Time Series Analysis", Wiley, 2016.
Reference Books	1. J. J. F. Commandeur, S.J. Koopman, “Time Series Analysis: Forecasting andControl”, Wiley, 2007. 2. James D. Hamilton, “Time Series Analysis”, Princeton University Press, 2012.
Web. URLs	https://www.simplilearn.com/tutorials/statistics-tutorial/what-is-time-series-analysis

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. D. Vimal Kumar	Dr. N. Kavitha

Course Code	Title		
23PGDTE309	**Elective Paper III C: Healthcare Analytics**		
Semester: III	**Credits: 4**	**CIA: 25 Marks**	**ESE:75 Marks**
Course Objective	To explore Healthcare Analytics, encompassing data collection, analysis techniques, and applications in the healthcare industry.		
Course Category	Employability		
Development Needs	Global		
Course Description	This course delves into Healthcare Analytics, focusing on the collection, analysis, and application of data in the healthcare sector. Students will learn to harness data-driven insights to enhance patient care, optimize healthcare operations, and make informed decisions.		

Course Outcomes		**Teaching Methods**	**Assessment Methods**
CO 1	Understand Healthcare Data Analytics, EHR, Coding, Benefits, Barriers, and Phenotyping Algorithms	Lecture	Group Discussion
CO 2	Implement knowledge on Biomedical Image, Sensor Data Mining, Signal Analysis, Genomic Data for Personalized Medicine.	Lecture	Quiz
CO 3	Analyze NLP, Data Mining in Clinical Text, Biomedical Social Media Analytics.	Video Lessons	Seminar
CO 4	Acquire knowledge on Advanced Healthcare Data Analytics, Prediction Models, Temporal Mining, Visual Analytics, Privacy Methods.	Tutorial / Video Lessons	Seminar
CO 5	Create Healthcare Applications, Fraud Detection, Pharmaceutical Discoveries, Decision Support, Image Analysis, Mobile Analytics.	Video Lessons	Assignment

Offered by	**Data Science**

Course Content	**Instructional Hours / Week : 4**

Unit	**Description**	**Text Book**	**Chapters**
I	Introduction: Introduction to Healthcare Data Analytics- Electronic Health Records–Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting EHR- Challenges- Phenotyping Algorithms	1	1,2
		Instructional Hours	**12**
Suggested Learning Methods: Tutorial			
II	Analysis: Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine.	1	4,5
		Instructional Hours	**12**

Suggested Learning Methods: Group Discussion			
III	Analytics: Natural Language Processing and Data Mining for Clinical Text- Mining the Biomedical Social Media Analytics for Healthcare.	1	7,8
		Instructional Hours	**12**
Suggested Learning Methods : Group Discussion			
IV	Advanced Data Analytics: Advanced Data Analytics for Healthcare– Review of Clinical Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy Preserving Data Publishing Methods in Healthcare.	1	11,13,14
		Instructional Hours	**12**
Suggested Learning Methods :Video Presentation			
V	Applications: Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.	1	15,16,17
		Instructional Hours	**12**
		Total Hours	**60 Hrs.**

Text Book	1. Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics",Taylor & Francis, 2019.
Reference Books	1. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge toHealthcare Improvement, Wiley, 2016. 2. Trevor L. Strome, "Healthcare Analytics for Quality and Performance Improvement", Wiley, 2015.
Web. URLs	https://hevodata.com/learn/health-data-analytics/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTCP301	Internship		
Semester: III	Credits: 2	CIA: 50 Marks	ESE: -

Objective:

To give optimum exposure on the practical side of industrial society

Guidelines:

3. Duration of the internship training is **20 Days** during the summer vacation which falls at the **end of the 3rd Semester.**
4. The departments concerned will prepare on exhaustive panel of institutions, industries and practitioners.
5. The individual student has to identify the institution / industry / practitioners of their choice and inform the same to the HOD / staff-in-charge.
6. The student's hereafter will be called as trainees should maintain a work diary in which the daily work done should be entered and the same should be attested by the section in-charge.
7. The departments should prepare an outline of the job to be done, sections in which they have to be attached both in the office as well as in the field.
8. The trainees should strictly adhere to the rules and regulations and office timings of the institutions to which they are attached.
9. The trainees have to obtain a certificate on successful completion of the internship from the chief executive of the organization.
10. Monitoring and inspection by staff on a regular basis.
11. Report writing manual and format should be prepared by the respective departments.
12. All model forms are to be attached wherever it is necessary.
13. Report Evaluation: Internal viva-voce examination will be conducted and the maximum mark awarded is 50.
14. In-Plant Training has to be carried out only in the approved industries by the department/College
15. Report should be submitted in the 4thsemester.

Course Code	Title		
23PGDTC411	Paper XI: IoT Analytics		
Semester: IV	Credits: 4	CIA: 25 Marks	ESE: 75 Marks
Course Objective	Comprehend the foundational principles and challenges of IoT analytics, encompassing data collection, platforms, architectures, and analytics techniques within cloud and edge-based environments.		
Course Category	Employability		
Development Needs	Global		
Course Description	Knowledge on IoT analytics tools and methodologies to address real-world challenges in smart city contexts, integrating cloud-based and edge-based solutions while evaluating the implications of data processing and mobility analytics.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand IoT analytics fundamentals	Lecture	Group Discussion
CO 2	Implement basic IoT deployment and make use of WAZIUP software platform	Lecture	Quiz
CO 3	Analyze sensor metadata streams and usage of search engines	Video Lessons	Seminar
CO 4	Acquire knowledge on development tools for IoT analytics applications	Tutorial / Video Lessons	Seminar
CO 5	Create and study on IoT analytics for smart cities and nearby environments	Video Lessons	Assignment

Offered by	Data Science

Course Content	Instructional Hours / Week :5

Unit	Description	Text Book	Chapters
I	Introducing IoT Analytics: IoT Data and Big Data - Challenges of IoT Analytics Applications - IoT Analytics Lifecycle and Techniques - Cloud-based IoT Platform - IaaS, PaaS and SaaS Paradigms - Requirements of IoT Big Data Analytics Platform - Functional Architecture - Data Analytics for the IoT - Data Collection Using Low-power, Long-range Radios.	1	1,2,3
		Instructional Hours	**15**
Suggested Learning Methods: Tutorial			
II	WAZIUP Software Platform - Main Challenges - PaaS for IoT - Architecture - Deployment - iKaaS Software Platform - Service Orchestration and Resources Provisioning - Advanced Data Processing and Analytics - Service Composition and Decomposition - Migration and Portability in Multi-cloud - Cost Function of Service Migration	1	4,5
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
III	Searching the Internet of Things - A Search Architecture for Social and Physical Sensors - Search engine for MultimediA enviRonment generated contenT (SMART) - Challenges in Building an IoT Search Engine - Local Event Retrieval - Social	1	6,7

	Sensors for Local Event Retrieval - A Framework for Event Retrieval - Using Sensor Metadata Streams to Identify Topics of Local Events in the City.		
		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			
IV	Development Tools for IoT Analytics Applications – The VITALArchitecture for IoT Analytics Applications – VITAL Development Environment –Query systems – Query services – Query sensors – Query observations – Discovery nodes – Discover systems nodes – Discover services nodes – Discover sensors nodes – Filtering nodes – Threshold nodes – Resample nodes	1	8,9
		Instructional Hours	**15**
Suggested Learning Methods :Video Presentation			
V	Internet-of-Things Analytics for Smart Cities - State of the Art - Cloud-based City Platform - Use Case of Cloud-based Data Analytics - New Challenges towards Edge-based Solutions - Edge-based IoT Analytics - State of the Art - Edge-based City Platform - Workflow - Task and Topology - IoT-friendly Interfaces - Use Case of Edge-based Data Analytics - Overview of Crowd Mobility Analytics	1	10,11
		Instructional Hours	**15**
		Total Hours	**75 Hrs**

Text Book	1. John Soldatos, "Building Blocks for IoT Analytics", River Publishers, 2017.
Reference Books	1. John Straw, "IoT Analytics: A Guide for IT and Business Professionals", Wiley, 2017. 2. Prasant Kumar Pattnaik, Raghvendra Kumar, S. N. Panda, Souvik Pal, "IoT and Analytics", CRC Press, 2018.
Web. URLs	https://docs.aws.amazon.com/iotanalytics/latest/userguide/getting-started.html

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDTV401	Project Work and Viva-Voce		
Semester: IV	Credits: 8	CIA: 80 Marks	ESE: 120 Marks

Course Objective	To give project-based learning which makes the students to apply practically what they learned.
Course Category	Skill Development
Development Needs	Global
Course Description	Develop Problem Solving Skills to solve the computer based problems at Global needs.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Remember the fundamental concepts of algorithm and designs	Lecture	Group Discussion
CO 2	Understand the optimal methods and Software Engineering concepts to be applied	Tutorial	Quiz
CO 3	Apply the knowledge and what they learned	Video Lessons	Seminar
CO 4	Analyze the Economical and Technical feasibility	Tutorial / Video Lessons	Seminar
CO 5	Developing a software-based applications and deployment of software	Video Lessons	Assignment

Offered by	**Computer Science(Data Science)**

Course Content	Instructional Hours / Week : 25

PROJECT WORK

Title of the Project

A project report submitted to the Bharathiar University in the partial fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE IN DATA SCIENCE

Submitted by

Name of the Student

(Reg.No.)

Under the Guidance of

Guide Name (Designation)

<College emblem>

NEHRU ARTS AND SCIENCE COLLEGE

(Autonomous)

(Reaccredited by NAAC with "A^{+}" Grade, ISO 9001-2008 & ISO 14001 : 2004 Certified)

RECOGNIZED BY UGC & AFFILIATED TO BHARATHIAR UNIVERSITY

"NEHRU GARDENS", T. M. PALAYAM, COIMBATORE – 641 105.

Month & year

TABLE OF CONTENTS

Tools for Assessment (30 Marks)					
Review I	**Review II**	**Review III**	**Document, Preparation and Implementation**	**Research Paper Publication in Journals**	**Total**
15	**15**	**15**	**20**	**15**	**80**

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	M	H	H	H	M	H	H	H
CO2	H	H	H	M	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	M	H	H	H	M	H	H	H
CO4	H	H	H	M	H	M	H	H	H	M	H	H	H
CO5	H	H	H	M	H	M	H	H	H	M	H	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. Narasimhan	Dr. N. Kavitha

Course Code	Title		
23PGDSSS01	Advanced Learners Course: Paper – I Cloud Computing		
Semester: II / III / IV	Credits: 2	CIA: -	ESE: 100 Marks

Course Objective	To enable the students to understand the concepts of cloud computing, IaaS, PaaS, SaaS and its recent advancements

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Explain the underlying concept of cloud computing	Lecture / Video Lectures	Assignment
CO 2	Analyze elastic computing with its advantages and understand the concept of various cloud services	Lectures / Video Lessons	Seminar
CO 3	Determine various types of clouds and cloud providers	Lectures / Video Lessons	Quiz
CO 4	Understand the concept of data center, infrastructure and equipment	Tutorial / Lecture	Seminar
CO 5	Analyze the various approaches of virtualization	Lecture / Video Lectures	Quiz

Offered by	**Data Science**

Course Content

Unit	Description	Text Book	Chapters
I	Motivations for Cloud: Cloud Computing Everywhere - A Facility for Flexible Computing - The Start of Cloud - From Multiple Cores to Multiple Machines - From to Clusters to Web Sites and Load Balancing - Racks of Server Computers.	1	1
II	Elastic Computing and its Advantages: Introduction - Multi-Tenant Clouds - The Concept of Elastic Computing - Using Virtualized Servers for Rapid Change - IaaS - PaaS – SaaS.	1	2
III	Types of Clouds and Cloud Providers: Private and Public Clouds - Private Cloud - Public Cloud - The Advantages of Public Cloud - The Advantages of Private Cloud - Hybrid Cloud - Multi-cloud.	1	3
IV	Data Center Infrastructure and Equipment: Racks, Aisles, and Pods - Pod Size - Exhaust Ducts - Lights-out Data Centers - High Capacity and Link Aggregation - External Internet Connections - Storage in a Data Center.	1	4
V	Virtual Machines: Approaches to Virtualization - Properties of Full Virtualization - Virtual I/O Devices - Virtual Device Details - VM Migration - Running Virtual Machines in an Application.	1	5

Text Book	1. Douglas Comer, "The Cloud Computing Book", CRC Press, 2021.
Reference Books	1. Arshdeep Bahga, Vijay Madisetti, “Cloud Computing - A Hands-on Approach”, Wiley, 2014. 2. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, “Cloud Computing: Concepts, Technology & Architecture”, CRC Press, 2018.
Web. URLs	https://www.simplilearn.com/tutorials/cloud-computing-tutorial

Mapping													
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H
H-High; M-Medium; L-Low													
Course designed by								**Verified by Chairman**					
Dr. N. Kavitha								Dr. N. Kavitha					

Course Code	Title		
23PGDSSS02	Advanced Learners Course: Paper – II Data Analysis using MS-Excel		
Semester: II / III / IV	Credits: 2	CIA: -	ESE: 100 Marks

Course Objective	To learn data analysis using MS - Excel

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the concept of VBA Macros and working with the environment	Lecture / Video Lectures	Assignment
CO 2	Develop window registry, loading data and saving data in MS Excel	Lectures / Video Lessons	Seminar
CO 3	Evaluate numerical calculations using MS Excel	Lectures / Video Lessons	Quiz
CO 4	Design MS Excel VBA for data mining tasks	Tutorial / Lecture	Seminar
CO 5	Demonstrate MS Excel custom worksheets including E-Mail reports	Lecture / Video Lectures	Quiz

Offered by	Data Science

Course Content

Unit	Description	Text Book	Chapters
I	Accessing Data in Excel: A VBA Macro Writer's Perspective: The Worksheet - Ranges in Worksheets - Using Explicit Referencing - Sorting Data - Sorting Data by Absolute Value - Sorting a Range within a Worksheet - Deleting Rows and Columns - Finding Duplicates	1	2
II	Methods of Loading and Saving Data in Excel: Importing Data to a Worksheet - Importing Worksheet from Another Workbook - Writing Log Files - Using the Windows Registry to Save Settings - Determining Files within a Chosen Folder	1	3
III	Utilizing Functions in Excel: Creating and Utilizing VBA Functions in Code - Handling Errors in VBA Functions - Array Formulas - Using Macro Recorder to Capture Processes - Creating a Linear Regression Tool - Correlation Vs Causation	1	5
IV	Data Mining in Excel: Form Reuse in VBA Projects - Creating a Refedit Control from a Textbox - Highlighting and Coloring Cell Fonts and Backgrounds - Creating a Color Font Tool - Creating a Windowing Tool - Linear and Non-linear Mapping	1	6
V	Creating Custom Report Worksheets: Use of Templates When Creating Custom Reports - Preparing of Dual View Reports - Executing Calculations upon Changing Views - Basic Formatting Techniques - Automatically Emailing Reports	1	7

Text Book	1. Brian Bissett, "Automated Data Analysis Using Excel", CRC Press, 2020.
Reference Books	1. Kenneth N. Berk, Patrick Carey, “Data Analysis with Microsoft Excel”,2010. 2. John Walkenbach, “Excel 2016 Bible”, Wiley, 2015.

Web. URLs	https://www.w3schools.com/EXCEL/index.php

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H

H-High; M-Medium; L-Low

Course designed by	**Verified by Chairman**
Dr. N. Kavitha	Dr. N. Kavitha

Course Code	Title		
23PGDSSS03	Advanced Learners Course: Paper – III Optimization Techniques		
Semester: II / III / IV	Credits: 2	CIA: -	ESE: 100 Marks

Course Objective	To learn data analysis using MS - Excel

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the concepts of linear programming and several methods	Lecture / Video Lectures	Assignment
CO 2	Solve single variable non-linear optimization problems	Lectures / Video Lessons	Seminar
CO 3	Design Multivariable Unconstrained Nonlinear Optimization methods	Lectures / Video Lessons	Quiz
CO 4	Illustrate various types of multiobjective optimization methods	Tutorial / Lecture	Seminar
CO 5	Demonstrate the emerging nature inspired optimization algorithms	Lecture / Video Lectures	Quiz

Offered by	Data Science

Course Content

Unit	Description	Text Book	Chapters
I	Linear Programming: Formulation of the Problem - Graphical Method - Simplex Method - Artificial Variable Techniques - Duality Principle - Dual Simplex Method	1	2
II	Single Variable Nonlinear Optimization: Classical Method - Exhaustive Search Method - Bounding Phase Method - Interval Halving Method - Fibonacci Search Method - Bisection Method	1	3
III	Multivariable Unconstrained Nonlinear Optimization: Unidirectional Search Method - Evolutionary Search Method - Simplex Search Method - Conjugate Direction Method - Steepest Descent Method - Newton's Method	1	4
IV	Multiobjective Optimization: Global Criterian Method - Utility Function Method - Inverted Utility Method - Bounded Objective Function Method - Lexicographic Model	1	9
V	Nature Inspired Optimization: Genetic Algorithm - Neural Network based Optimization - Ant Colony Optimization - Particle Swarm Optimization	1	10

Text Book	1. Sukanta Nayak, "Fundamentals of Optimization Techniques withAlgorithms", Elsevier Science, 2020.
Reference Books	1. Chander Mohan, Kusum Deep, “Optimization Techniques”, CRC Press, 2009. 2. Godfrey C. Onwubolu, B. V. Babu, “New Optimization Techniques in Engineering”, Wiley, 2010.
Web. URLs	https://deeplearning.neuromatch.io/tutorials/W1D5_Optimization/student/W1D5_Tutorial1.html

Mapping													
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H
H-High; M-Medium; L-Low													
Course designed by								**Verified by Chairman**					
Dr. B. Narasimhan								Dr. N. Kavitha					

Course Code	Title		
23PGDSSS04	Advanced Learners Course: Paper – IV Distributed Computing		
Semester: II / III / IV	Credits: 2	CIA: -	ESE: 100 Marks

Course Objective	To learn data analysis using MS - Excel

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the basics of computer organizations and standards	Lecture / Video Lectures	Assignment
CO 2	Demonstrate formal approaches to distributed systems design	Lectures / Video Lessons	Seminar
CO 3	Illustrate mutual exclusion and election algorithms	Lectures / Video Lessons	Quiz
CO 4	Design the mechanisms for prevention, detection and avoidance of deadlocks	Tutorial / Lecture	Seminar
CO 5	Solve reliability issues in distributed computing environment	Lecture / Video Lectures	Quiz

Offered by	Data Science

Course Content

Unit	Description	Text Book	Chapters
I	Introduction: Basic Computer Organizations - Definition of a Distributed System - Interconnection Networks - Applications and Standards – Scope.	1	1
II	Formal Approaches to Distributed Systems Design: Introduction to Models - Casually Related Events - Global States - Logical Clocks – Applications.	1	3
III	Mutual Exclusion and Election Algorithms: Mutual Exclusion - Non token based Solutions - Token based Solutions - Election - Bidding - Self stabilization.	1	4
IV	Prevention, Avoidance and Detection of Deadlock: The Deadlock Problem - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection and Recovery - Examples	1	5
V	Reliability in Distributed Systems: Basic Models - Building Blocks of Fault Tolerant System Design - Handling of Node Faults - Issues in Backward Recovery - Handling of Byzantine Faults	1	8

Text Book	1. Jie Wu, "Distributed System Design", CRC Press, 2017.
Reference Books	1. Ajay D. Kshemkalyani, Mukesh Singhal, “Distributed Computing Principles, Algorithms, and Systems”, Cambridge University Press, 2011. 2. Gabriele Kotsis, Péter Kacsuk, “Distributed and Parallel Systems: From Instruction Parallelism to Cluster Computing”, Springer US, 2012.
Web. URLs	https://www.geeksforgeeks.org/distributed-systems-tutorial/

Mapping													
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H
H-High; M-Medium; L-Low													
Course designed by								**Verified by Chairman**					
Dr. B. Narasimhan								Dr. N. Kavitha					

Course Code	Title		
23PGDSSS05	Advanced Learners Course: Paper – V Data Mining		
Semester: II / III / IV	Credits: 2	CIA: -	ESE: 100 Marks

Course Objective	To learn data analysis using MS - Excel

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand data mining, its applications and predictive modelling	Lecture / Video Lectures	Assignment
CO 2	Demonstrate data preprocessing methods and data cleaning	Lectures / Video Lessons	Seminar
CO 3	Illustrate various classification techniques and its types	Lectures / Video Lessons	Quiz
CO 4	Demonstrate cluster analysis with distance metrics	Tutorial / Lecture	Seminar
CO 5	Illustrate various factors to evaluate association mining	Lecture / Video Lectures	Quiz

Offered by	Data Science

Course Content

Unit	Description	Text Book	Chapters
I	Data Mining: Need for Data Mining - Data Mining Applications - Data Mining Process: Predictive Modelling - Database Segmentation - Link Analysis - Deviation Detection.	1	2
II	Data Preprocessing: Need for Data Preprocessing - Data Preprocessing Methods - Data Cleaning - Data Integration - Data Transformation - Data Reduction.	1	4
III	Classification: Introduction - Types of Classifications: Posteriori Classification - Priori Classification - Input and Output Attributes - Working of Classification.	1	5
IV	Cluster Analysis: Introduction of Cluster Analysis - Applications of Cluster Analysis - Desired Features of Clustering - Distance Metrics.	1	7
V	Association Mining: Introduction - Defining Association Rule Mining - The Metrics to Evaluate the Strength of Association Rules - The Native Algorithm for Finding Association Rules.	1	9

Text Book	1. Parteek Bhatia, "Data Mining and Data Warehousing - Principles andPractical Techniques", Cambridge University Press, 2019.
Reference Books	1. Mohammed J. Zaki, Wagner Meira, “Data Mining and Analysis Fundamental Concepts and Algorithms”, Cambridge University Press,2014. 2. N. P. Gopalan, “Data Mining: Techniques and Trends”, Prentice-Hall of India Pvt. Limited, 2015.
Web. URLs	https://www.javatpoint.com/data-mining

Mapping													
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**
CO1	H	H	H	M	H	M	H	H	H	H	H	M	H
CO2	H	H	H	M	H	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	H	H	H	H	H	M	H
CO4	H	H	H	M	H	M	H	H	H	H	H	M	H
CO5	H	H	H	M	H	M	H	H	H	H	H	M	H
H-High; M-Medium; L-Low													

Course designed by	**Verified by Chairman**
Dr. N. Kavitha	Dr. N. Kavitha

9/9/2023
Dr. N. KAVITHA
BoS - Chairman
Department of Computer Science
Nehru Arts and Science College
(Autonomous)
Coimbatore - 641 105.

Academic Council
Dr. B. Arirudhan
Chairman
NEHRU Arts and Science College