M.Sc. DATA SCIENCE

LOCF SYLLABUS – 2021

SCHOOLS OF EXCELLENCE

WITH CHOICE BASED CREDIT SYSTEM (CBCS)

DEPARTMENT OF DATA SCIENCE
ST. JOSEPH'S COLLEGE (AUTONOMOUS)
Special Heritage Status Awarded by UGC
Accredited at A^{++} Grade (IV Cycle) by NAAC
College with Potential for Excellence by UGC
DBT-STAR & DST-FIST Sponsored College
Tiruchirappalli - 620 002, Tamil Nadu, India

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)
POSTGRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to maintain and uphold the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014 – 15, to meet and excel the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system enhances the optimal utilization of both human and infrastructural resources. It also enhances academic mobility and enriches employability. The School system preserves the identity, autonomy and uniqueness of every department and reinforces Student centric curriculum designing and skill imparting. These five schools adhere to achieve and accomplish the following objectives.

Optimal utilization of resources both human and material for the academic flexibility leading to excellence.

Students experience or enjoy their choice of courses and credits for their horizontal mobility.

The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice based credit system.

Human excellence in specialized areas

Thrust in internship and / or projects as a lead towards research and

The multi-discipline nature of the School System caters to the needs of stake-holders, especially the employers.

Credit system:

Weightage to a course is given in relation to the hours assigned for the course. Generally one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The credits and hours of each course of a programme is given in the table of Programme Pattern. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses, a student must earn a minimum of 110 credits as mentioned in the programme pattern table. The total number of minimum courses offered by the Department is given in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

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. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability

Outcome –Based Education (OBE): is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs):

PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Programme Educational Objectives (PEOs): The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

Some important terminologies repeatedly used in LOCF.

Core Courses (CC)

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Specific Elective Courses (DSE)

Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

DSE: Four courses are offered, one course in each semester.

Note: To offer **one DSE**, a minimum of two courses of equal importance / weightage is a must.

One DSE Course in semester two is offered as interdisciplinary/common course among the departments in a School (Common Core Course) at the PG level.

Generic Elective Courses

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Generic Elective courses are designed for the students of **other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Two GE Courses are offered, one each in semesters II and III. The GE course offered in semester II is within the school level and the GE in semester III is Between Schools level

The Ability Enhancement Courses (AEC)

One Main discipline related Ability Enhancement Course for 3 credits is offered for a PG programme by the Department.

Skill Enhancement Courses (SECs)

These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme.

One SEC is offered in semester II as a compulsory course on Soft Skills, offered by the Department of Human Excellence, common to all the students of PG programme.

Self–paced Learning: It is a course for two credits. It is offered to promote the habit of independent/self learning of Students. Since it is a two credit course, syllabus is framed to complete within 45 hours. It is not taught in the regular working hours.

Comprehensive Examinations: A detailed syllabus consisting of five units to be chosen from the courses offered over the five semesters which are of immense importance and those portions which could not be accommodated in the regular syllabus.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL and etc.

Course Coding:

The following code system (10 alphanumeric characters) is adopted for Post Graduate courses:

21	PXX	N	XX	NN/NNX
Year of Revision	PG Department Code	Semester number.	Part Category	running number/with choice

N:- Numerals X :- Alphabet

Part Category

CC - Core Theory

CP- Core Practical

IS- Internship

SP- Self Paced Learning

CE- Comprehensive Examination

PW- Project Work & viva-voce

Electives Courses

ES – Department Specific Electives

EG- Generic Electives

EC - Additional core Courses for Extra Credits (If any)*

Ability Enhancement Courses

AE – Ability Enhancement Course

SE – Skill Enhancement Course – Soft skills

CW - SHEPHERD & Gender Studies (Outreach)

CIA AND SEMESTER EXAMINATION

Continuous Internal Assessment (CIA):

Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	100

MID-SEM & END-SEM TEST

Centralised – Conducted by the office of COE

1. Mid-Sem Test & End-Sem Test: (2 Hours each); will have Objective and Descriptive elements; with the existing question pattern PART-A; PART-B; PART-C and PART D.
2. One of the CIA Component II/III for UG & PG will be of 15 marks and compulsorily a online objective multiple choice question type.
3. The online CIA Component must be conducted by the Department / faculty concerned at a suitable computer centre.
4. The one marks of PART-A of Mid-Sem and End-Sem Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.

Duration of Examination must be rational; proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

WEIGHTAGE of K – LEVELS IN QUESTION PAPER

(Cognitive Level)	Lower Order Thinking			Higher Order Thinking			Total
K- LEVELS	K1	K2	K3	K4	K5	K6	%
SEMESTER EXAMINATIONS	15	20	35	30			**100**
MID / END Semester TESTS	12	20	35	33			**100**

QUESTION PATTERN FOR SEMESTER EXAMINATION	
SECTION	**MARKS**
SECTION–A (No choice ,One Mark) **THREE** questions from each unit **(**15x1 =15)	**15**
SECTION-B (No choice ,2-Marks) **TWO** questions from each unit (10x2 =20)	**20**
SECTION-C (Either/or type) (7- Marks) **ONE** question from each unit (5x7 =35)	**35**
SECTION-D (3 out of 5) (10 Marks) **ONE** question from each unit (3x10 =30)	**30**
Total	**100**

BLUE PRINT OF QUESTION PAPER FOR SEMESTER EXAMINATION							
DURATION: 3. 00 Hours.							**Max Mark : 100**
K- LEVELS / **SECTIONS**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION–A (One Mark, No choice) (15x1 =15)	15						**15**
SECTION-B (2-Marks, No choice) (10x2=20)		10					**20**
SECTION-C (7- Marks) (Either/or type) (5x7=35)			5				**35**
SECTION-D (10 Marks) (3 out of 5) (3x10=30) Courses having only **K4** levels				3			**30**
Courses having **K4** and **K5** levels **One K5 level question is compulsory**				2	1		
(Courses having **all the 6** cognitive levels **One K5 and K6 level questions can be compulsory**				1	1	1	
Total	**15**	**20**	**35**	**30**			**100**

QUESTION PATTERN FOR MID/END TEST		
SECTION		**MARKS**
SECTION–A (No choice, One Mark)	(7x1 =7)	**7**
SECTION-B (No choice , 2-Marks)	(6x2 =12)	**12**
SECTION-C (Either/or type) (7- Marks)	(3x7 =21)	**21**
SECTION-D (2 out of 3) (10 Marks)	(2x10=20)	**20**
	Total	**60**

BLUE PRINT OF QUESTION PAPER FOR MID/END TEST							
DURATION: 2. 00 Hours.							**Max Mark: 60.**
K- LEVELS / **SECTIONS**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION –A (One Mark, No choice) (7 x 1 = 7)	7						**07**
SECTION-B (2-Marks, No choice) (6 x 2 = 12)		6					**12**
SECTION-C (Either/or type) (7-Marks) (3 x 7 =21)			3				**21**
SECTION-D (2 out of 3) (10 Marks) (2x10=20) Courses having only **K4** levels				2			**20**
Courses having **K4** and **K5** levels **One K5 level question is compulsory**				1	1		
Courses having **all the 6** cognitive levels **One K6 level question is compulsory**					1	1	
Total Marks	**07**	**12**	**21**	**20**			**60**
Weightage for 100 %	**12**	**20**	**35**	**33**			**100**

Assessment pattern for two credit courses.

S. No.	Course Title	CIA	Semester Examination	Total Marks
1	Self Paced Learning Course	25 + 25 = 50	50 Marks MCQ (COE)	100
2	Comprehensive Examinations	25 +25 = 50	50 Marks (MCQ) (COE)	100
3	Internship	100	--	100
4	Field Visit	100	--	100
5	Ability Enhancement Course (AEC) for PG (3 credits)	50 (Three Components)	50 (COE) Specific Question Pattern	100
Assessment Pattern for Courses in Part - IV				
6	Value Education Courses and Environmental Studies	50	50 Marks (For 2.00 hours) (COE)	100
7	Skill Enhancement Courses(SECs)	50 marks (by Course in-charge) 50 Marks (by an External member from the Department)		100
8	SEC: SOFT SKILLS (For UG and PG)	100	(Fully Internal)	100

EVALUATION

GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$	$WAM\,(Weighted\,Average\,Marks) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$
Where, C_i is the Credit earned for the Course i G_i is the Grade Point obtained by the student for the Course i M_i is the marks obtained for the course i and n is the number of Courses **Passed** in that semester.	

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

CLASSIFICATION OF FINAL RESULTS:

i) The classification of final results shall be based on the CGPA, as indicated in Table-2.

ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii) A Pass in SHEPHERD will continue to be mandatory although the marks will not count for the calculation of the CGPA.

iv) Absence from an examination shall not be taken an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	**10**	**O**
80 and above and below 90	**9**	A+
70 and above and below 80	**8**	**A**
60 and above and below 70	**7**	**B+**
50 and above and below 60	**6**	**B**
Below 50	**0**	**RA**

Table-2: Final Result

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	**O**	**Outstanding**
8.00 to 8.99	A+	Excellent
7.00 to 7.99	**A**	**Very Good**
6.00 to 6.99	**B+**	**Good**
5.0 0 to 5.99	**B**	**Above Average**
Below 5.00	**RA**	**Re-appearance**

Credit based weighted Mark System is adopted for the individual semesters and cumulative semesters in the column 'Marks secured' (for 100)

Declaration of Result

Mr./ MS. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured is _____ by completing the minimum of 110 credits.

The candidate has also acquired _____ (if any) extra by attending MOOC courses.

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

The Programme Outcomes(POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment in done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight 3 and the weakest is 1. This relation is defined by using the following table.

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

Mean Scores of COs = $\frac{\text{Sum of values}}{\text{Total No.of POs \& PSOs}}$		**Mean Overall Score =** $\frac{\text{Sum of Mean Scores}}{\text{Total No.of COs}}$	
Result	**Mean Overall Score**	**< 1.2**	**# Low**
		≥ 1.2 and < 2.2	**# Medium**
		≥ 2.2	**# High**

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

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The Programme Outcomes (POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment in done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight 3 and the weakest is 1. This relation is defined by using the following table.

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		≥ 1.2 and < 2.2	**# Medium**
		≥ 2.2	**# High**

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

VISION

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

MISSION

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value-driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- Graduates will be able to accomplish professional standards in the global environment.
- Graduates will be able to uphold integrity and human values.
- Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

PROGRAMME OUTCOMES (POs) PG

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbibed with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

Programme Specific Outcomes (PSOs)	
PSO1	Graduates will be able to apply data analytical skills that rely on mathematical and statistical methods to solve problems in a data-driven world
PSO2	Graduates will be able to analyse and interpret complex data to produce actionable insights
PSO3	Graduates will be able to understand the nuances of data analytical skills to evolve innovative ideas and communicate the social relevance and impact of their analytical findings
PSO4	Graduates will become analytical experts and data entrepreneurs with exemplary behaviour safeguarding the public interest
PSO5	Graduates will uphold professional ethics, values, standards and social responsibilities to attain a better and more sustainable future

M. Sc. DATA SCIENCE					
PROGRAMME STRUCTURE					
Sem	**Specification**	**No. of Courses**	**No. of Hours**	**Credits**	**Total Credits**
I-IV	Core Courses : Theory	10	43	43	43
I-IV	Core Courses : Practicals	05	20	10	10
II	Self-paced learning	1	-	02	02
IV	Comprehensive Examination	1	-	02	02
IV	Project work & Viva Voce	1	21	19	19
I- IV	Discipline Specific Elective	4	20	16	16
I	Ability Enhancement Course	1	04	03	03
II	Skill Enhancement Course (Soft Skills)	1	04	03	03
III	Generic Elective IDC (WS)	1	04	03	03
IV	Generic Elective IDC (BS)	1	04	03	03
III	Internship	1	-	02	02
I - III	Online courses (MOOC)	3	-	(2)	(06)
I-IV	Outreach Programme	1	-	04	04
I-IV	Total	30	120	110	110(6)

M.Sc. DATA SCIENCE							
PROGRAMME PATTERN							
Course Details					**Scheme of Exams**		
Sem	**Code**	**Course Title**	**Hrs**	**Cr**	**CIA**	**SE**	**Final**
I	21PDS1CC01	Statistical Computing	5	5	100	100	100
	21PDS1CC02	Data Science and Big Data Analytics	4	4	100	100	100
	21PDS1CC03	Advanced Database Management Systems	4	4	100	100	100
	21PDS1CP01	Software Lab-1: R Programming	4	2	100	100	100
	21PDS1CP02	Software Lab-2: Databases	4	2	100	100	100
	21PDS1ES01A	**DSE-1:** Design and Analysis of Algorithms	5	4	100	100	100
	21PDS1ES01B	**DSE-1:** Object Oriented System Development					
	21PDS1AE01	**AEC:** Artificial Intelligence	4	3	50	50	50
		Extra Credits courses (MOOC)-1	-	**(2)**			
		Total	**30**	**24 (2)**			
II	21PDS2CC04	Multivariate Techniques for Data Analytics	5	5	100	100	100
	21PDS2CC05	Advanced Web Technology	4	4	100	100	100
	21PDS2CP03	Software Lab-3: Advanced Web Technology	4	2	100	100	100
	21PDS2CP04	Software Lab-4: Machine Learning	4	2	100	100	100
	21PDS2SP01	**Self- Paced Learning**: Python for Data Science	-	2	50	50	50
	21PDS2ES02A	**DSE -2**: Machine Learning	5	4	100	100	100
	21PDS2ES02B	**DSE-2:** WAP and XML					
	21PSS2SE01	**SEC: Soft skills**	4	3	100	-	100
	21PDS2EG01	**GE-1(WS):** Internet of Things	4	3	100	100	100
		Extra Credits courses (MOOC)-2	-	(2)			
		Total	**30**	**25(2)**			
III	21PDS3CC06	Time Series and Sampling Theory	5	5	100	100	100
	21PDS3CC07	Software Project Management	4	4	100	100	100
	21PDS3CC08	Cloud Computing	4	4	100	100	100
	21PDS3CC09	Digital Image Processing	4	4	100	100	100
	21PDS3CP05	Software Lab-5: Image Processing	4	2	100	100	100
	21PDS3IS01	Internship	-	2	100	-	100
	21PDS3ES03A	**DSE-3:** Cryptography and Network Security	5	4	100	100	100
	21PDS3ES03B	**DSE-3:** Natural Language Processing					
	21PDS3EG02	**GE-2 (BS):** Deep Learning	4	3	100	100	100
		Extra Credits courses (MOOC)-3	-	**(2)**			
		Total	**30**	**28(2)**			
IV	21PDS4PW24	**Project work**& Viva Voce	21	19	100	100	100
	21PDS4CE01	Comprehensive Examination	-	2	50	50	50
	21PDS4CC10	Business Intelligence	4	4	100	100	100
	21PDS4ES04A	**DSE-4:** Sentiment Analysis	5	4	100	100	100
	21PDS4ES04B	**DSE-4:** Soft Computing					
		TOTAL	**30**	**29**			
I-IV	21PCW4OR01	Outreach Programme (SHEPHERD)		**4**			
		Total (Four Semesters)	**120**	**110(6)**			

*The courses with a scheme of Exam 50 in CIA and SE will be converted to 100 for grading.

GENERIC ELECTIVE -1: 2nd Semester Within school (WS)- Offered to students belong to other Departments in the School							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
SBS	21PBI2EG01	Herbal Technology	4	3	100	100	100
	21PBT2EG01	Medical Biotechnology	4	3	100	100	100
	21PBO2EG01	Medicinal Botany	4	3	100	100	100
SCS	21PCA2EG01	Applied Statistics using R	4	3	100	100	100
	21PMA2EG01	Mathematical Foundations	4	3	100	100	100
	21PCS2EG01	Mobile Adhoc Networks (MANET)	4	3	100	100	100
SLAC	21PEN2EG01A	Indian Literature in Translation	4	3	100	100	100
	21PEN2EG01B	English Literature For Competitive Examinations					
SMS	21PCO2EG01	Supply Chain Management	4	3	100	100	100
	21PEC2EG01	Labour Economics	4	3	100	100	100
	21PHR2EG01	Organizational Behaviour	4	3	100	100	100
	21PCC2EG01	Stress Management	4	3	100	100	100
SPS	21PCH2EG01	Industrial Products	4	3	100	100	100
	21PPH2EG01A	Solar Energy and Utilization	4	3	100	100	100
	21PPH2EG01B	Renewable Energy Resources	4	3	100	100	100

GENERIC ELECTIVE -2: 3rd Semester Between schools (BS)- Offered to students in the Departments belong to other Schools (Except the school offering the course)							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
SBS	21PBI3EG02	First Aid Management	4	3	100	100	100
	21PBT3EG02	Food Technology	4	3	100	100	100
	21PBO3EG02	Horticulture and Landscaping	4	3	100	100	100
SCS	21PCA3EG02	Web Design	4	3	100	100	100
	21PMA3EG02	Operations Research	4	3	100	100	100
	21PCS3EG02	Advances in Computer Science	4	3	100	100	100
	21PDS3EG02	Deep Learning	4	3	100	100	100
SLAC	21PEN3EG02	English for Effective Communication	4	3	100	100	100
SMS	21PCO3EG02	Basics of Taxation	4	3	100	100	100
	21PEC3EG02	Managerial Economics	4	3	100	100	100
	21PHR3EG02	Counselling and Guidance	4	3	100	100	100
	21PCC3EG02	Dynamics of Human Behaviour in Business	4	3	100	100	100
SPS	21PCH3EG02	Health Science	4	3	100	100	100
	21PPH3EG02A	Physics for Competitive Exam	4	3	100	100	100
	21PPH3EG02B	Nano Science	4	3	100	100	100

Semester	Course Code	Title of the Course	Hours	Credits
I	**21PDS1CC01**	**CORE-1: STATISTICAL COMPUTING**	**5**	**5**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the basics of statistics and correlation techniques	**K1**
CO-2	demonstrate the applications of various regression methods	**K2**
CO-3	identify the probability distribution and analyse variables	**K3**
CO-4	examine the data and assess the shape of the distribution of data	**K4**
CO-5	determine and test various hypotheses and their implications using r	**K5&K6**

Unit – I **(15 Hours)**

Data Measurement, Collection and Classification: Statistical unit and population – Data - Data measurement- Collection of Data – Classification of Data - Introduction to Skewness, Moments and Kurtosis – Difference between variation and skewness – Measures of skewness – Karl Pearson' coefficient of Skewness –Moments and skewness– Kurtosis – Concept of kurtosis – Types of curves

Unit – II **(15 Hours)**

Correlation :Definition of Correlation- Scatter Diagram- Karl Pearson's Coefficient of Linear Correlation- Coefficient of Correlation and Probable Error of r- Coefficient of Determination - Merits and Limitations of Coefficient of Correlation- Spearman's Rank Correlation

Unit – III **(15 Hours)**

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

Unit – IV **(15 Hours)**

Probability Distribution: Probability Distribution and mathematical Expectation- Random Variable- Defined - Probability Distribution of a Random Variable- Expectation of Random Variable- Properties of Expected Value and Variance

Unit – V **(15 Hours)**

Statistics with R- Hypothesis testing and distributions: Probability in R - Distributions - Hypothesis Tests in R - One Sample t-Test: Review - One Sample t-Test: Example - Two Sample t-Test: Review - Two Sample t-Test: Example – Simulation - Paired Differences - Distribution of a Sample Mean

Books for Study

1. K.L.Sehgal, "Quantitative Techniques and Statistics", Himalaya Publishing House,2014
   Unit-I - Chapter 7 (Sec 7.1,7.4, 7.5-7.7,7.9,7.10)
   Unit-II - Chapter 8 (Sec 8.1 – 8.8)
   Unit-III - Chapter 12 (Sec 12.1 -12.4)
   Unit-IV - Chapter 14 (Sec 14.1 – 14.16)
2. David dalpiaz, "Applied Statistics with R", University of Illinois, 2020.
   Unit-V- Chapter 5 (Sec: 5.1,5.2, 5.3)

Books for Reference

1. Debbie L. Hahs-Vaughn, Richard G. Lomax, "Statistical Concepts - A First Course", Taylor & Francis Publication, 2020
2. Jay Lehmann,"A Pathway to Introductory Statistics", Pearson Publications, 2020
3. Cheryl Ann Willard, "Statistical Methods An Introduction to Basic Statistical Concepts and Analysis",Taylor & Francis Publication, 2020

Relationship matrix for Course outcomes, Programme Outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course								Hours	Credits
I	21PDS1CC01	CORE-1: STATISTICAL COMPUTING								5	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	2	2	2	3	3	3	2	2	2.5
CO-2	3	3	2	2	2	3	3	2	2	2	2.4
CO-3	3	3	2	2	2	3	3	2	2	2	2.4
CO-4	3	3	3	2	2	3	3	3	2	2	2.6
CO-5	3	3	3	2	2	3	3	3	2	2	2.6
Mean Overall Score											2.5 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1CC02	CORE-2: DATA SCIENCE AND BIG DATA ANALYTICS	4	4

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the basic and advanced methods of data science and big data technology	K1
CO-2	demonstrate the data analytics techniques using r	K2
CO-3	make use of the data by deploying r statistical tool	K3
CO-4	examine the usage of various regression methods	K4
CO-5	asses and build the data science and big data analytics projects	K5&K6

Unit – I **(12 Hours)**

Introduction to Data Science: AI, Machine Learning and Data Science - Introduction to Data Science - Case for Data Science - Data Science Classification - Data Science Algorithms - Data Science Process: Prior Knowledge - Data Preparation - Modelling - Application – Knowledge - Data Exploration: Objective of Data Exploration - Datasets - Descriptive Statistics - Data Visualization - Roadmap for Data Exploration

Unit – II **(12 Hours)**

Introduction to Data Science Process: The roles in a data science project - Stages of a data science project - Setting expectations. - Loading Data into R: Working with data from files - Working with relational databases.

Unit – III **(12 Hours)**

Exploring Data using R: Using summary statistics to spot problems - Spotting problems using graphics and visualization - Managing Data: Cleaning data - Sampling for modelling and validation. - Choosing and evaluating models: Mapping problems to machine learning tasks - Evaluating models - Validating models

Unit – IV **(12 Hours)**

Regression: Understanding linear& logistic regression - Building a linear& logistic regression model - Making predictions – Finding relations and extracting advice from linear& logistic models - Reading the model summary and characterizing coefficient quality.

Unit – V **(12 Hours)**

Unsupervised Methods: Cluster Analysis - Distances - Preparing the data – Hierarchical clustering with hclust() - The k-means algorithm - Assigning new points to clusters – Clustering takeaways. Association Rules - Overview of association rules - The example problem - Mining association rules with the arules package - Association rule takeaways.

Books for Study

1. Kotu, V., Deshpande, B, "Data Science: Concepts and Practice". Elsevier Science Publisher, 2018.
   Unit 1 - Chapter 1 (Sec: 1.1 – 1.5), Chapter 2 (Sec: 2.1-2.5), Chapter 3 (Sec: 3.1-3.5)
2. Zumel, Nina, and Mount, John, "Practical Data Science with R", Manning Publications, 2019.

Unit 2 - Chapter 1 (Sec: 1.1 – 1.3), Chapter 2 (Sec: 2.1,2.2)
Unit 3 - Chapter 3 (Sec: 3.1, 3.2), Chapter 4 (Sec: 4.1,4.2), Chapter 5 (Sec: 5.1-5.3)
Unit 4 - Chapter 7 (Sec: 7.1, 7.2)
Unit 5 - Chapter 7 (Sec: 8.1, 8.2)

Books for Reference

1. Richard Hurley, "Data Science A Comprehensive Guide to Data Science, Data Analytics, Data Mining, Artificial Intelligence, Machine Learning, and Big Data", Ationa Publications, 2020
2. Thomas A. Runkler, "Data Analytics Models and Algorithms for Intelligent Data Analysis", Springer Vieweg, 2020.
3. Shah, Chirag,"A Hands-On Introduction to Data Science",Cambridge University Press,2020.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
I	21PDS1CC02	CORE-2: DATA SCIENCE AND BIG DATA ANALYTICS							4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	2	2	3	1	2	3	3	3	2	2.4
CO-2	2	3	2	3	3	2	2	2	3	1	2.3
CO-3	3	2	3	3	2	3	2	3	3	3	2.7
CO-4	2	3	3	2	3	3	3	2	2	3	2.6
CO-5	3	2	3	2	3	2	3	2	2	2	2.4
Mean Overall Score											2.48 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	**21PDS1CC03**	**CORE-3: ADVANCED DATABASE MANAGEMENT SYSTEMS**	**4**	**4**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	define database models and database management skills.	**K1**
CO-2	explain the applications of database models.	**K2**
CO-3	experiment with various database languages.	**K3**
CO-4	distinguish the acid properties and data consistency.	**K4**
CO-5	appraise and adopt the NoSQL databases for the recent technologies.	**K5&K6**

Unit – I **(12 Hours)**

Data Management: Information Systems and Data Databases – SQL Databases – Big Data – No SQL Databases – Organizing of Data Management.

Unit – II **(12 Hours)**

Data Modeling: From Data Analysis to Database – The Entity-Relationship Model – Implementation in the Relational Model – Implementation in the Graph Model – Enterprise wide Data Architecture – Formula for Database Design

Unit – III **(12 Hours)**

Database Languages: Interacting with Databases – Relational Algebra – Relationally Complete Languages – Graph based Languages – Embedded Languages – Handling NULL Values – Integrity Constraints – Data Protection Issues.

Unit – IV **(12 Hours)**

Ensuring Data Consistency: Multi-user Operation – Transaction Concept – Consistency in Massive Distributed Data – Comparing ACID and BASE.

Unit – V **(12 Hours)**

System Architecture: Processing of Homogeneous and Heterogeneous Data – Storage and Access Structure – Translation and Optimization of Relational Queries – Parallel Processing with MapReduce – Layered Architecture – Use of Different Storage Structures -NoSQL Databases: Development of Non-relational Technologies – Key-value stores – Column-Family Stores – Document Stores – XML Databases – Graph Databases.

Books for Study

1. Andreas Meier and Michael Kaufmann, “SQL & NoSQL Databases”, Springer, MORGAN KAUFMANN, 2019.
   Unit – I - *Chapter1*
   Unit – II - *Chapter2*

Unit – III - *Chapter 3*

Unit – IV- *Chapter 4*

Unit – V - *Chapter 5& 7*

Books for Reference

1. Abraham Silberschatz, Henry F Korth , S Sudarshan, "Database System Concepts", 6th edition , McGraw-Hill International Edition , 2015.
2. Ramez Elmasri, Shamkant B Navathe, "Fundamental of Database Systems", Pearson, 7th edition, 2016.
3. C.J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education Reprint 2016

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
I	**21PDS1CC03**		**CORE-3: ADVANCED DATABASE MANAGEMENT SYSTEMS**							**4**	**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	3	3	2	3	1	3	3	2	3	2	2.5
CO-2	3	2	3	2	2	3	3	2	3	3	2.6
CO-3	1	2	3	3	3	2	3	2	2	2	2.3
CO-4	1	2	1	1	3	2	3	2	3	3	2.1
CO-5	1	2	1	1	2	3	3	2	2	3	2
Mean Overall Score											**2.3 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
I	**21PDS1CP01**	**Software Lab-1: R Programming**	**4**	**2**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the features and basic constructs in r programming	**K1**
CO-2	show how to transform the raw data into cleansed dataset by employing pre-processing techniques	**K2**
CO-3	apply different predictive modelling approaches in r to disentangle real time analytics problems	**K3**
CO-4	analyse and interpret the visualization results effectively	**K4**
CO-5	determine and elaborate how to link data, statistical methods, and actionable questions	**K5&K6**

Lab Exercises

1. **R Basics**
   - a) R & R Studio Installation
   - b) Data types
   - c) Operators in R
   - d) Decision Making and Looping
2. **Data Pre-processing**
   - a) Raw data
   - b) Tidy data
   - c) Clean data
3. **Statistical Concepts**
   - a) Descriptive Statistics
   - b) Inferential Statistics
   - c) Hypothesis Testing
4. **Predictive Modelling**
   - a) Linear Regression
   - b) Multiple Regression
   - c) Logistic Regression
5. **Data Visualisation in R using GGPlot**
   - Sa) Box Plot
   - b) Histograms
   - c) Scatter Plot
   - d) Line chart
   - e) Bar Chart
   - f) Heat maps

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours	Credits			
I	21PDS1CP01	Software Lab-1: R Programming					4	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	1	2	1	2	2	1	2	3	2	3	1.9
CO-2	3	2	3	3	2	2	2	3	2	2	2.4
CO-3	3	2	3	3	2	3	2	3	3	3	2.7
CO-4	2	3	3	3	3	3	3	3	2	2	2.7
CO-5	3	2	2	2	2	3	3	2	1	3	2.3
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1CP02	Software Lab-2: Databases	4	2

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall database models and develop database management skills.	K1
CO-2	explain the applications of database models and emerging trends.	K2
CO-3	choose various data models and develop database architectures.	K3
CO-4	distinguish object oriented databases and advanced databases.	K4
CO-5	infer and interpret the ideas on how to design databases and classify them.	K5&K6

Lab Exercises

1. DDL Statements
2. Basic DML: Selection, Filtering and Join
3. Built-in Functions
4. Advanced Insert Commands and Bulk Load of Data
5. Creating Stored Procedures
6. Creating Triggers
7. PL/SQL Array
8. NoSQL Create Database and Collection.
9. MongoDB Stitch & Atlas.
10. MongoDB Compass

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course						Hours	Credits
I	21PDS1CP02	Software Lab-2: (Databases)						4	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	1	3	3	2	3	3	3	2	3	2.6
CO-2	3	2	3	2	2	3	3	2	3	3	2.6
CO-3	3	1	2	3	3	3	2	3	3	3	2.6
CO-4	2	3	3	3	3	3	3	3	2	2	2.7
CO-5	3	2	2	2	2	3	3	2	1	3	2.3
Mean Overall Score											2.6 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1ES01A	DSE-1: DESIGN AND ANALYSIS OF ALGORITHMS	5	4

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	choose the algorithmic procedure to determine the computational complexity of algorithms	K1
CO-2	explain the stepwise procedure to solve the sorting problems	K2
CO-3	utilize effective analytical skills in computing applications using greedy algorithms	K3
CO-4	analyse how to break down problems into small pieces for program development applications using dynamic programming techniques	K4
CO-5	select and develop efficient traversal and search approaches for Computational Modelling	K5&K6

Unit – I **(15 Hours)**

Introduction to Algorithm: Algorithm Definition – Algorithm Specification –Performance Analysis: Time Complexity – Asymptotic Notations - Performance Measurement. Elementary Data Structures: Stacks and Queues – Trees – Sets and Disjoint Set Union-Union and Find Operations - Graphs.

Unit – II **(15 Hours)**

Basic sorting algorithms: Bubble Sort- selection sort- Insertion Sort-Heap Sort - Divide and Conquer: Binary Search – Finding the Maximum And Minimum – Merge Sort – Quick Sort.

Unit – III **(15 Hours)**

The Greedy Method: Knapsack Problem - Job Sequencing with Deadlines - Minimum COst Spanning Trees - Optimal Storage on Tapes - Single Source Shortest Paths

Unit – IV **(15 Hours)**

Dynamic Programming: Multistage Graphs – All-Pairs Shortest Paths – Optimal Binary Search Trees - 0/1-knapsack - Reliability Design - The Traveling Salesperson Problem - Flow Shop Scheduling**.**

Unit – V **(15 Hours)**

Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees. Backtracking: The 8-Queens Problem – Sum of Subsets – Graph Coloring

Books for Study

1. Ellis Horowitz, SatrajSahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2nd Edition, 2009.

   Unit-I - *Chapter 1,2 (Sec 1.1-1.3,2.1,2.2,2.5,2.6)*

Unit-II - *Chapter 3 (Sec 3.1-3.6)*
Unit-III - *Chapter 4 (Sec 4.1 ,4.2,4.4,4.5,4.6,4.8)*
Unit-I V - *Chapter 5 (Sec 5.2,5.3,5.5,5.7,5.8,5.9,5.10)*
Unit-V - *Chapter 6,7(Sec 6.1,6.2, 6.3,7.2,7.3,7.4)*

Books for Reference

1. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press, 2015.
2. Rajesh K.Shukla, "Analysis and Design of Algorithms, A Beginner's Approach", Wiley,2015
3. Anany Levitin, "Introduction to design and Analysis of Algorithms", Pearson, 2011.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
I	21PDS1ES01A	DSE-1: DESIGN AND ANALYSIS OF ALGORITHMS							5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	2	2	2	3	3	2	2	2	2.4
CO-2	3	3	2	2	2	3	3	2	2	2	2.4
CO-3	3	3	2	2	2	3	3	3	2	2	2.5
CO-4	3	3	2	2	2	3	3	3	2	2	2.5
CO-5	3	3	2	2	2	3	2	2	2	2	2.3
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1ES01B	DSE-1: OBJECT ORIENTED SYSTEM DEVELOPMENT	5	4

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the object-oriented design concepts and understand the fundamentals of OOSD life cycle and familiarize with evolution of object-oriented model, classes and its notations	K1
CO-2	explain UML in order to express the design of software projects	K2
CO-3	identify how the object-oriented analysis approach differs from the traditional approach in system analysis and design	K3
CO-4	examine the storage and interoperability of objects	K4
CO-5	assess and build OOAD testing and quality assurance strategies to ensure the quality of software products	K5&K6

Unit – I **(15 Hours)**

Fundamentals of OOSD: Overview of Object-Oriented Systems Development: Two orthogonal view of the software - OOSD methodology – Need for an object orientation. Object basics: Object Oriented Philosophy- Objects – Attributes – Object respond to messages – Encapsulation and information hiding – class hierarchy Polymorphism – Object relationship and associations. OOSD life cycle: Software development process – OOSD Use case Driven Approach – Reusability

Unit – II **(15 Hours)**

Methodology, Modeling and UML: Object Oriented Methodologies: Rumbaugh et al.'s object modeling technique – The Booch methodology – The Jacobson et al. methodology – Patterns – Frameworks - The Unified approach. Unified Modeling Language: Static and dynamic models – Need for modeling - UML diagrams – UML class diagram – Use case diagram - UML dynamic modeling – packages and model organization

Unit – III **(15 Hours)**

Object Oriented Analysis: Object Oriented Analysis process: Business Object Analysis - Use case driven object oriented analysis – Business process modeling – Use-Case model – Developing effective documentation. Object Oriented Design - Object Oriented Design Process and Design Axioms - OOD process- OOD axioms – Corollaries – Design patterns

Unit – IV **(15 Hours)**

Object Storage and Object interoperability: Database views - Database models - Hierarchical Model-Network model- Relational model-Database interface- Database schema and Data Definition Language -Data Manipulation Language and Query capabilities- Logical and Physical Database Organization and Access control- Share ability and

transactions- Concurrency policy-Distributed databases and client-server computing-distributed and cooperative processing

Unit – V **(15 Hours)**

OOAD Testing and quality assurance: Software Quality Assurance: Quality assurance tests – Testing strategies – Impact of Object Orientation on Testing - Test Cases- Test Plan – Continuous testing - System Usability and Measuring User satisfaction: Usability Testing – User satisfaction test - A tool for analyzing user satisfaction.

Books for Study

1. Ali Bahrami, "Object Oriented Systems Development using UML", McGraw-Hill, 2008
   - **Unit-I** - *Chapter 1,2,3 (Sec 1.2,1.3,2.2,2.3,2.7-2.11,3.2-3.5)*
   - **Unit-II** - *Chapter 4,5 (Sec 4.1-4.8,5.2 -5.9)*
   - **Unit-III** - *Chapter 6,9 (Sec 6.2-6.7, 9.2-9.5)*
   - **Unit-I V** - *Chapter 11 (11.1-11.5)*
   - **Unit-V** - *Chapter 13,14(13.2-13.7 ,14.1,14.2)*

Books for Reference

1. Mahesh P.Matha, "Object-Oriented Analysis and Design Using UML", PHI Learning Private Limited, 2012.
2. RachitaMisra, Chhabi Rani Panigrahi, Bijayalaxmi Panda, "Principles of Software Engineering and System Design", Yesdee Publishing, 2019.
3. Brahma Dathan, SarnathRamnath, "Object Oriented Analysis, Design and Implementation", Universities Press, 2010.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course						Hours	Credits
I	21PDS1ES01B	DSE-1: OBJECT ORIENTED SYSTEM DEVELOPMENT						5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	2	2	2	3	3	2	2	2	2.4
CO-2	3	3	2	2	2	3	3	2	2	2	2.4
CO-3	2	2	2	2	2	3	3	2	2	2	2.2
CO-4	2	2	2	2	2	3	3	2	2	2	2.2
CO-5	2	2	2	2	2	3	3	2	2	2	2.2
Mean Overall Score											2.3 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1AE01	AEC: ARTIFICIAL INTELLIGENCE	4	3

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the basics of linear algebra	K1
CO-2	understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities	K2
CO-3	choose appropriate artificial intelligence functions and components involved in intelligent systems	K3
CO-4	examine the relationship between artificial intelligence and human intelligence	K4
CO-5	select and create logical statements from informal language to propositional logic expressions.	K5&K6

Unit – I **(12 Hours)**

Vectors: Overview – Vectors addition – Scalar-vector Multiplication – Inner Product – Complexity of vector computations -Linear Function: Overview – Taylor Approximation – Regression Model -Norm and Distance – Norm – Distance – Standard Deviation – Angle – Complexity- Linear Independence: Linear dependence – Basis – Orthonormal vectors – Gram- Schmidt Algorithm.

Unit – II **(12 Hours)**

Introduction to Artificial Intelligence: Overview - The Foundations of Artificial Intelligence - The History of Artificial Intelligence – The State of the Art - Intelligent Agents: Agents and Environments -Good Behavior: The Concept of Rationality – The Nature of Environments – The Structure of Agents Solving

Unit – III **(12 Hours)**

Solving Problems by Searching: Problem-Solving Agents – Searching for Solutions - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Heuristic Functions - Beyond Classical Search: Local Search Algorithms and Optimization Problems - Local Search in Continuous Spaces - Searching with Nondeterministic Actions – Searching with Partial Observations - Online Search Agents and Unknown Environments - Adversarial Search: Games – Optimal Decisions in Games - Alpha–Beta Pruning Imperfect Real-Time Decisions – Stochastic Games

Unit – IV **(12 Hours)**

Logical Agents: Knowledge-Based Agents – Logic - Propositional Logic: A Very Simple Logic Propositional Theorem Proving - Effective Propositional Model Checking - Agents Based on Propositional Logic Resolution - First-Order Logic: Representation Revisited - Syntax and Semantics of First-Order Logic – Using First-Order Logic – Knowledge Engineering in First-Order Logic - Inference in First-Order Logic: Propositional vs. First-Order Inference - Unification and Lifting – Forward Chaining- Backward Chaining.

Unit – V **(12 Hours)**

Knowledge Representation: Ontological Engineering - Categories and Objects - Events Mental Events and Mental Objects - Reasoning Systems for Categories – Reasoning with Default Information - The Internet Shopping World - Robotics: Introduction to Robotics - Robot Hardware - Robotic Perception - Planning to Move – Planning Uncertain Movements – Moving - Robotic Software Architectures – Application Domains

Books for Study

1. Boyd, Stephen, and Vandenberghe, Lieven. Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares. Cambridge University Press, 2018.
   Unit – I - *Chapter 1,2,3,5*
2. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Prentice Hall Inc, 2010
   Unit – II - *Chapter 1,2*
   Unit - III - *Chapter 3, 4,5*
   Unit - IV - *Chapter 6,8,9*
   Unit - V - *Chapter 12,25*

Books for Reference

1. Anne Leslie, Ivana Bartoletti, Shân M. Millie, Susanne Chishti, The AI Book: The Artificial Intelligence Handbook for Investors, Entrepreneurs and FinTech Visionaries, Wiley Publication, 2020.
2. Chakraborty, Utpal, Artificial Intelligence for All: Transforming Every Aspect of Our Life, India, BPB Publication, 2020.
3. Janet Finlay, An Introduction To Artificial Intelligence, CRC Press, 2020.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
I	21PDS1AE01	AEC: ARTIFICIAL INTELLIGENCE							4	4
Course Outcomes (COs)	Programme Outcomes (POs)				Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	3	2	3	3	3	3	3	2	2.8
CO-2	3	3	3	2	2	3	3	3	3	3	2.9
CO-3	2	3	3	3	2	3	3	2	2	2	2.5
CO-4	3	3	3	3	3	2	2	3	3	3	2.8
CO-5	3	3	2	3	2	3	3	3	2	3	2.7
Mean Overall Score											2.7 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2CC04**	**CORE-4: MULTIVARIATE TECHNIQUES FOR DATA ANALYTICS**	**5**	**5**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the meaning, objectives and applications of various types of multivariate techniques	**K1**
CO-2	demonstrate factoring and clustering techniques	**K2**
CO-3	apply appropriate multivariate techniques on data	**K3**
CO-4	examine canonical correlations and canonical correlation variables	**K4**
CO-5	explain and elaborate discriminant and principal component analysis on data	**K5&K6**

Unit – I **(15 Hours)**

Introduction to Multivariate Techniques: Measurement Scales (Metric and Non-metric Measurement Scales) - Classification of Multivariate Techniques (Dependence and Inter-dependence Techniques) - Applications of Multivariate Techniques in different disciplines.

Unit – II **(15 Hours)**

Canonical Correlations and Canonical Variables: Canonical Correlations and Variates in the Population - Estimation of Canonical Correlations and Variates - Statistical Inference - Factor Analysis: Introduction to Factor Analysis - Meaning, Objectives and Assumptions - Designing a Factor Analysis Study - Deriving Factors - Assessing Overall Factors - Validation of Factor Analysis.

Unit – III **(15 Hours)**

Cluster Analysis: Similarity measures-distances and similarity coefficients for pairs of items, similarities and association measures for pairs of variables-Hierarchical clustering methods-single linkage-complete linkage-average linkage- ward's hierarchical clustering method - Non-hierarchical clustering methods-K-means method

Unit – IV **(15 Hours)**

Discrimination and Classification: Separation and classification of two populations-classification with two multivariate normal populations- Classification of normal populations – scaling -Fisher's Approach to classification with two populations-Evaluating classification functions- Fisher's Method of discriminating among several populations-Using Fisher's discriminants to classify objects

Unit – V **(15 Hours)**

Principal Component Analysis: Definition of Principal Components in the Population- Maximum Likelihood Estimators of the Principal Components and Their Variances- Computation of the Maximum Likelihood Estimates of the Principal Components - Statistical Inference.

Books for Study

1. T. W. Anderson , "An Introduction to Multivariate Statistical Analysis", 3rd Edition, Wiley, 2009
   - **Unit-I** - *Chapter 1 (Sec 1.1-1.2)*
   - **Unit-II** - *Chapter 12 ,14 (Sec 12.1-12.4)*
   - **Unit-V** - *Chapter 11(Sec 11.2-11.4,11.6)*
2. Johnson ,"Applied Multivariate Statistical Analysis",Prentice Hall India Learning, 2012
   - **Unit-III** - *Chapter 12 (Sec 12.2-12.4)*
   - **Unit-IV** - *Chapter 11 (Sec 11.2-11.4)*

Books for Reference

1. Alan J. Izenman, "Modern Multivariate Statistical Techniques: Regression, Classification, and Manifold Learning", Springer, 2013
2. Naresh K Malhotra, Satyabhusan Dash, "Marketing Research An applied Orientation", pearson , 2011
3. Joseph F Hair, William C Black et al , "Multivariate Data Analysis" , Pearson Education, 7th edition, 2013.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours	Credits			
II	21PDS2CC04	CORE-4: MULTIVARIATE TECHNIQUES FOR DATA ANALYTICS					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	2	2	2	3	3	2	2	2	2.4
CO-2	3	3	3	2	2	3	3	3	2	2	2.6
CO-3	3	3	3	2	2	3	3	2	2	2	2.4
CO-4	3	3	2	2	2	2	2	2	2	2	2
CO-5	2	3	2	2	2	2	2	2	2	2	2
Mean Overall Score											2.3 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2CC05**	**CORE-5: ADVANCED WEB TECHNOLOGY**	**4**	**4**

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	define the forms with files and databases	**K1**
CO-2	demonstrate Django handlers, CSS and JavaScript integration	**K2**
CO-3	build the routes or views using Django framework.	**K3**
CO-4	explain the process of web application development and manipulating the objects	**K4**
CO-5	determine and develop secured web applications through various testing models	**K5&K6**

Unit – I **(12 Hours)**

Django Overview: The Big Picture of Django Structure - Django Models -Django Templates - Django Views – URL configuration - Installing Python and Django - Installing Python - Installing a Python Virtual Environment - Installing Django - Starting a Project - Creating a Database - The Development Server - Text Editor

Unit – II **(12 Hours)**

Django Application: Django Project Structure - Django Settings - Django Applications - Creating the Pages App - Django App Structure - First View - Configuring the URLs-Creating the Page Model: The Page Model - A First Look at the Django Admin - Using the Admin Site

Unit – III **(12 Hours)**

Django Templates: Template Settings - Site Template and Static Files - Updating Your View-The Pages Template - Improving View and Adding Navigation: Modify Page URLs - Rewriting the View - Testing the View - Modify the Templates - Improving the Templates - Page Not Found! Adding a 404

Unit – IV **(12 Hours)**

Creating a Contact Form: Contact Form - Add URL to Pages App - Add Navigation to Site Template - Create the Contact Form Template - Create the Contact Form View - Emailing the Form Data. User Management - Users in the Admin -Users in the Front End - Add the Registration View - Create the Templates - The Login Template - The Register Template - The Success Template - Modify the Base Template - Create URL configuration - Testing the Authentication System - Restricting Users in the Front End

Unit – V **(12 Hours)**

Deploying a Django Website: Choosing a Host - Preparing the Site for Deployment - Deploy to Python Anywhere - Add a Database - Upload the Site Files - Install Django -

Install the Web App - Configure the Web App - Run Django Management Commands - Link to the Static Files - Add a Home Page - Set Site to Production Mode

Books for Study

1. Nigel George, "Build a Website with Django 3: A Complete Introduction to Django 3", GNW Independent Publishing, 2020.
   Unit 1 – *Chapter 3, 4*
   Unit 2 – *Chapter 6, 7*
   Unit 3 – *Chapter 8, 9*
   Unit 4 – *Chapter 10, 13*
   Unit 5 – *Chapter 14*

Books for Reference

1. Melé, Antonio, "Django 3 By Example: Build Powerful and Reliable Python Web Applications from Scratch", 3rd Edition. United Kingdom, Packt Publishing, 2020.
2. George, Nigel. "Build Your First Website with Python and Django", GNW Independent Publishing, 2017.
3. Vincent, William S, "Django for Beginners: Build Websites with Python and Django", Amazon Digital Services LLC - KDP Print US, 2020.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
II	21PDS2CC05	CORE-5: ADVANCED WEB TECHNOLOGY							4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	3	2	3	2	3	3	3	2	3	2.6
CO-2	3	3	2	1	2	3	2	3	2	3	2.4
CO-3	3	2	3	3	1	3	3	2	3	3	2.6
CO-4	2	2	3	2	2	3	3	2	3	2	2.4
CO-5	3	2	3	3	2	2	2	3	3	3	2.6
Mean Overall Score											2.5 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2CP03**	**Software Lab-3: ADVANCED WEB TECHNOLOGY**	**4**	**2**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	show the usage of Django frameworks	**K1**
CO-2	outline the new ways to design using Django templates and forms	**K2**
CO-3	apply the advanced and customized form designs	**K3**
CO-4	analyse the tools and techniques for web scrapping in Django framework using Scrapy	**K4**
CO-5	decide and develop a clear picture of advanced web technology and deploy it in the design and development of web applications	**K5&K6**

Lab Exercises

1. Setting Up Django Environment
2. Creating Django Projects
3. Building URL Handlers
4. Working with Django Views
5. Building Django Templates
6. Working with Django Models and Import Data
7. Django Forms
8. Advanced Django Forms
9. Work with styling and customizing of Form Appearance
10. Building a REST API
11. Unit Testing and Securing Django APIs
12. Web Scrapping using ScraPy

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course								Hours	Credits
II	**21PDS2CP03**	**Software Lab-3: ADVANCED WEB TECHNOLOGY**								**4**	**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	3	1	3	3	1	3	3	3	2	3	2.5
CO-2	3	2	3	1	3	3	2	2	3	3	2.5
CO-3	2	1	2	2	2	3	2	3	3	3	2.3
CO-4	3	2	3	1	2	3	3	3	3	3	2.6
CO-5	1	2	3	3	2	3	2	3	2	3	2.4
Mean Overall Score											**2.5 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2CP04**	**Software Lab-4: MACHINE LEARNING**	**4**	**2**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall dataset characteristics	**K1**
CO-2	classify various extraction techniques	**K2**
CO-3	make use of a wide range of machine learning techniques	**K3**
CO-4	examine the classification and regression in machine learning on various systems	**K4**
CO-5	evaluate and build various machine learning techniques to solve real world problems	**K5&K6**

Lab Exercises

1. Cleaning and Pre-processing Data
2. Feature Extraction
3. Feature Engineering
4. Simple Linear Regression Models
5. Complex Regression Models for Non-Linear Problems
6. Classification
7. Ensemble Models for Regression
8. Ensemble Models for Classification
9. Building Recommender Systems
10. Artificial Neural Networks for Classification
11. Artificial Neural Networks for Regression
12. Deep Learning models for Classification and Regression

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
II	**21PDS2CP04**	**Software Lab-4: MACHINE LEARNING**							**4**	**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	3	2	2	1	2	3	3	2	3	3	2.4
CO-2	2	3	3	2	2	3	2	2	3	1	2.3
CO-3	2	2	2	3	3	2	2	2	1	3	2.2
CO-4	3	3	3	2	2	3	3	1	3	1	2.4
CO-5	3	3	2	2	3	2	1	3	1	2	2.2
Mean Overall Score											**2.3 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2SP01**	**Self- Paced Learning: PYTHON FOR DATA SCIENCE**	**-**	**2**

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the advanced features of Python.	**K1**
CO-2	explain the most widely used Python packages.	**K2**
CO-3	make use of the NumPy, Pandas and Matplotlib to perform data analysis and data Visualization.	**K3**
CO-4	analyse data and perform data aggregation with Python.	**K4**
CO-5	determine and build various Customization techniques in Matplotlib.	**K5&K6**

Unit – I

Introduction to NumPy: Understanding Data Types in Python, The Basics of NumPy Arrays, Computation of NumPy Arrays, Aggregations, Comparisons, Masks, Boolean Logic, Fancy Indexing, Sorting Arrays, Structured Data.

Unit – II

Data Manipulation with Pandas: Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchal Indexing, Combing Datasets.

Unit – III

Data Manipulation with Pandas: Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchal Indexing, Combing Datasets.

Unit – IV

Visualization with Matplotlib: Simple Line Plots, Simple Scatter Plot, Visualizing Errors, Density and Contour Plots, Histograms, Binnings and Density.

Unit – V

Customization with Matplotlib: Customizing Plot Legends, Customizing Colorbars, Multiple Subplots, Text and Annotations, Customizing Ticks, Configuration and Stylesheets, Three Dimensional Plotting, Geographic Data with Basemap and Visualisation with Seaborn.

Books for Study

1. Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Data", O'Reilly Media, 1st edition, 2016.
   Unit - I - *Chapter 1 & 2*
   Unit – II - *Chapter 3*

Unit - III - *Chapter 3*
Unit - IV - *Chapter 4*
Unit - V - *Chapter 4*

Books for Reference

1. Wes McKinney, “Python for Data Analysis”, O'Reilly Media, 2nd edition, 2017.
2. Bharti Motwani , “Data Analytics using Python”, Wiley, 1st Edition, 2020.
3. Alberto Boschetti and Luca Massaron, “Python Data Science Essentials”, Packt publishing, 3rd Edition, 2018.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
II	21PDS2SP01	Self- paced Learning: PYTHON FOR DATA SCIENCE							-	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	1	2	2	2	1	1	3	1	1	1.6
CO-2	3	2	3	1	3	3	2	2	3	3	2.5
CO-3	2	3	3	3	3	2	2	3	2	2	2.5
CO-4	3	2	2	2	2	3	3	3	3	3	2.6
CO-5	2	2	1	3	2	3	2	3	2	3	2.3
Mean Overall Score											2.3 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2ES02A**	**DSE-2: MACHINE LEARNING**	**5**	**4**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	list out the fundamental issues and perspectives of machine learning	**K1**
CO-2	compare various linear models to find a best-fit line through a set of data points	**K2**
CO-3	make use of genetic algorithms as a tool for feature selection in machine learning	**K3**
CO-4	examine various dimensionality reduction techniques to reduce the number of input variables in the datasets	**K4**
CO-5	explain and construct the graphical models to exhibit the conditional dependence structure between random variables	**K5&K6**

Unit – I **(15 Hours)**

Introduction to Machine Learning: History and Evolution - Artificial Intelligence Evolution - Different Forms - Machine Learning Categories: Frameworks for Building Machine Learning Systems- Machine Learning Python Packages - Data Analysis Packages - Machine Learning Core Libraries

Unit – II **(15 Hours)**

Fundamentals of Machine Learning: Scales of Measurement - Feature Engineering - Exploratory Data Analysis - Supervised Learning:-Regression - Supervised Learning:-Classification - Unsupervised Learning Process Flow

Unit – III **(15 Hours)**

Model Diagnosis and Tuning: Optimal Probability Cutoff Point - Rare Event or Imbalanced Dataset - Bias and Variance - K-Fold Cross-Validation - Stratified K-Fold Cross-Validation - Ensemble Methods - Bagging - Boosting - Ensemble Voting - Stacking - Hyper parameter Tuning

Unit – IV **(15 Hours)**

Machine Learning Analysis: How to load Machine Learning Data - Understand Your Data with Descriptive Statistics - Understand Your Data with Visualisation - Prepare Your Data for Machine Learning - Feature Selection for Machine Learning

Unit – V **(15 Hours)**

Machine Learning Projects: Your first Machine Learning Projects in Python Step-By-Step - Regression Machine Learning Case Study Project - Binary Classification Machine Learning Case Study Projects

Books for Study

1. Swamynathan, Manohar. Mastering Machine Learning with Python in Six Steps: A Practical Implementation Guide to Predictive Data Analytics Using Python. United States, Apress, 2019.
   Unit – I - *Chapter 2*
   Unit – II - *Chapter 3*
   Unit - III - *Chapter 4*
2. Machine Learning Mastery With Python: Understand Your Data, Create Accurate Models, and Work Projects End-to-End. N.p., Machine Learning Mastery, 2016.
   Unit - IV - *Chapter 4,5,6,7,8*
   Unit - V - *Chapter 19,20,21*

Books for Reference

1. Oliver Theobald, "Machine Learning for Absolute Beginners: A Plain English Introduction", Third Edition, Independently Published, 2021.
2. Henderson, Matt. Machine Learning for Beginners 2019: The Ultimate Guide to Artificial Intelligence, Neural Networks, and Predictive Modelling (Data Mining Algorithms & Applications for Finance, Business & Marketing), Charlotte Publishing. 2019.
3. Fmello, Rodrigo, and AntonelliPonti, Moacir. "Machine Learning: A Practical Approach on the Statistical Learning Theory", Springer International Publishing, 2018.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
II	21PDS2ES02A	DSE-2: MACHINE LEARNING							5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	2	2	2	3	3	2	2	3	2	2.4
CO-2	3	3	3	2	2	3	3	3	2	2	2.6
CO-3	2	1	2	2	2	3	2	3	3	3	2.3
CO-4	2	3	2	2	2	2	2	3	2	3	2.3
CO-5	2	3	3	2	2	3	3	2	1	3	2.4
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2ES02B**	**DSE-2: WAP and XML**	**5**	**4**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the concepts and procedures of WAP and XML	**K1**
CO-2	classify the functionalities of WAP gateways	**K2**
CO-3	make use of XML concepts to develop Web applications	**K3**
CO-4	examine WML script to perform processing and computation	**K4**
CO-5	design and develop XSL to create a style definition for one XML document or reused for many other XML documents	**K5&K6**

Unit – I **(15 Hours)**

Overview of WAP: WAP and the wireless world – WAP application architecture – WAP internal structure-WAP versus the Web – WAP 1.2 – WTA and push features - Setting up WAP: Available software products – WAP resources – The Development Toolkits.

Unit – II **(15 Hours)**

WAP gateways: Definition – Functionality of a WAP gateway – The Web model versus the WAP model Positioning of a WAP gateway in the network – Selecting a WAP gateway - Basic WML: Extensible Markup language – WML structure – A basic WML card – Text formatting – navigation – Advanced display features.

Unit – III **(15 Hours)**

Interacting with the user: Making a selection – Events – Variables – Input and parameter passing. WML Script: Need for WML script – Lexical Structure – Variables and literals – Operators – Automatic data type conversion – Control Constructs Functions – Using the standard libraries – programs – Dealing with Errors.

Unit – IV **(15 Hours)**

Introduction to XML: An Eagle's Eye View of XML- Design of Domain-Specific Markup Languages- Self-Describing Data- Structured and Integrated Data- The Life of an XML Document- Parsers and Processors- The Process Summarized- Related Technologies- Hypertext Markup Language- Cascading Style Sheets- Extensible Style Language- URLs and URIs- X Links and X Pointers- An Introduction to XML Applications- Chemical Markup Language- Mathematical Markup Language- Channel Definition Format- Extensible Forms Description Language- Human Resources Markup Language-XML for XML

Unit – V **(15 Hours)**

Attributes, Empty Tags and XSL: Attributes – Attributes Versus Elements – Empty Tags – XSL – Well-formed XML documents – Foreign Languages and Non-Roman Text – Non

Roman Scripts on the Web Scripts, Character sets, Fonts and Glyphs – Legacy character sets– The Unicode Character set – Procedure to Write XML Unicode. Document Type Definitions- Document Type Definitions and Validity -Entities and External DTD Subsets - Attribute Declarations in DTDs - Embedding Non-XML Data.

Books for Study

1.Charles Arehart and Others. "Professional WAP with WML, WML script, ASP, JSP, XML, XSLT, WTA Push and Voice XML", Shroff Publishers and Distributers Pvt. Ltd, 2014.

Unit I *Chapter 1,2*
Unit II *Chapter 3*
Unit III *Chapter 4-7*

2. Elliotte Rusty Harold, "XML 1.1. bible", Wiley Publishing, Inc. 2004

Unit-IV *Chapter 1,2*
Unit –V *Chapter 5*

Books for Reference

1. Heather Williamson, "XML: The Complete Reference", Tata McGraw-Hill Education India, 2012.
2. Chris Tull, "Wap 2.0 development",Dorling Kindersley India Pvt Ltd,2009.
3. Cliff Binstock, "The XML Schema Complete Reference", Addison-Wesley,2003.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours	Credits			
II	21PDS2ES02B	DSE-2: WAP and XML					5	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	2	2	2	3	3	2	2	2	2.4
CO-2	3	3	2	2	2	3	3	2	2	2	2.4
CO-3	3	3	2	2	2	3	3	2	2	2	2.4
CO-4	3	3	2	2	2	2	2	2	2	2	2
CO-5	3	3	2	2	2	3	2	2	2	2	2.2
Mean Overall Score											2.3 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PSS2SE01**	**SEC: SOFT SKILLS**	**4**	**3**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the nuances of grooming such as, good manners and etiquettes and demonstrate the public speaking skills via extempore speeches and prepared speeches	**K1**
CO-2	model their own resumes and present them before the interview panel for their mock interview	**K2**
CO-3	select and learn the ten parameters of group discussion, perform on the stage with their associates, which is videotaped, reviewed and evaluated	**K3**
CO-4	apply analytical skills to solve real world problems	**K4**
CO-5	analyse and self-discover themselves to develop their own personalities facilitated with scientific psychological personality tests	**K5&K6**

Unit – I **(12 Hours)**

Basics of Communication: Definition of communication - Process of Communication - Barriers of Communication - Non-verbal Communication - Effective Communication: The Art of Listening - Exercises in Kinesthetics - Production of Speech - Organization of Speech - Modes of delivery - Conversation Techniques - Dialogue - Good manners and Etiquettes - Politeness markers & Listening links

Unit – II **(12 Hours)**

Resume Writing: Resume - Types of Resume - Chronological, Functional and Mixed Resume - Steps in preparation of Resume - structure and framework for writing resume - Intensive training / personalized training on resume writing - Interview Skills: Common interview questions - Attitude - Body Language - The mock interviews - Phone interviews - Behavioral interviews.

Unit – III **(12 Hours)**

Group Discussion: Group Discussion Basics - GD Topics for Practice - Points for GD Topics - Case-Based and Article based Group Discussions - Points for Case Studies - and Notes on Current Issues for GDS & Practicum with video coverage - Team Building: Team Vs Group – Synergy - Stages of Team Formation - Broken Square-Exercise - Win as much as you win-Exercise - Leadership – Styles, Work ethics-Personal Effectiveness: Self Discovery - Self Esteem - Goal setting - Problem-solving - Conflict and Stress Management

Unit – IV **(12 Hours)**

Numerical Ability: Average - Percentage - Profit and Loss - Problems on ages - Simple Interest - Compound Interest - Area - Volume and Surface Area - Time and Work - Pipes

and Cisterns - Time and Distance - Problems on Trains - Boats and Streams - Calendar - Clocks - Permutations and Combinations - Probability.

Unit – V **(12 Hours)**

Test of Reasoning: Series Completion - Analogy - Data Sufficiency - Blood Relations - Assertion and Reasoning - Logical Deduction – Direction-Non-Verbal Reasoning: Series - Classification

Books for Study

1. Melchias, G., Balaiah John., John Love Joy, " Winners in the making",St.Joseph's College, Trichy-2,2015
   Unit-I-*Chapter 1 (Sec 1.1,1.2)*
   Unit-II - *Chapter 2 (Sec 2.1,2.2)*
   Unit-III - *Chapter 3,4 (Sec 3.1,3.2, 4.1-4.4)*
   Unit-V - *Chapter 6*
2. Aggarwal, R. S., " Quantitative Aptitude", S.Chand& Sons, 2017
   Unit-IV - *Chapter1 (Sec 1.6,1.8,1.10,1.11, 1.15, 1.16, 1.17, 1.18, 1.19, 1.21, 1.22, 1.25,1.27,1.28, 1.30, 1.31)*

Books for Reference

1. Aggarwal, R.S., "A Modern Approach to Verbal and Non Verbal Reasoning", S. Chand & Co, 2018
2. Schuller, Robert , "Positive Attitudes", Jaico Books, 2010
3. R.S Aggarwal, Vikas Aggarwal, "Objective General English",S.Chand Limited,2018

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	**Course Code**		**Title of the Course**						**Hours**	**Credits**
II	**21PSS2SE01**		**SEC: SOFT SKILLS**						**4**	**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	3	3	3	2	2	3	3	3	2	2	2.6
CO-2	3	3	3	2	2	3	3	3	2	2	2.6
CO-3	3	2	2	2	2	2	2	2	2	2	2
CO-4	3	2	2	2	2	2	3	2	2	2	2.2
CO-5	3	2	2	2	2	2	2	2	2	2	2
Mean Overall Score											**2.3 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PDS2EG01**	**GE-1(WS): Internet of Things**	**4**	**3**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the basics of Internet of things and protocols	**K1**
CO-2	explain the protocol Standardization for IoT	**K2**
CO-3	identify the role of Internet of Things and its application areas	**K3**
CO-4	distinguish between the Web of Things versus Internet of Things	**K4**
CO-5	perceive and discuss the gist of Industrial Internet of Things	**K5&K6**

Unit – I **(12 Hours)**

Definitions and Functional Requirements: Motivation - Architecture - Web 3.0 View of IoT - Ubiquitous IoT Applications - Four Pillars of IoT - DNA of IoT -The Toolkit Approach for End-user Participation in the Internet of Things - Middleware for IoT: Overview - Communication middleware for IoT - IoT Information Security

Unit – II **(12 Hours)**

Protocol Standardization for IoT: Efforts - M2M and WSN Protocols - SCADA and RFID Protocols- Issues with IoT Standardization - Unified Data Standards -Protocols -IEEE 802.15.4 - BACNet Protocol Modbus - KNX – Zigbee-Network layer - APS layer –Security.

Unit – III **(12 Hours)**

Web of Things versus Internet of Things: Two Pillars of the Web - Architecture standardization for WoT Platform Middleware for WoT - Unified Multitier WoT Architecture - WoT Portals and Business Intelligence - Cloud of Things: Grid/SOA and Cloud Computing - Cloud Middleware - Cloud Standards - Cloud Providers and Systems - Mobile cloud Computing - The Cloud of Things Architecture

Unit – IV **(12 Hours)**

Industrial Internet of Things: Introduction to Industrial Internet of Things - Industrie 4.0 - Industrial Internet of Things (IIoT) - IIoT Architecture - Basic Technologies - Applications and Challenges - Security and Safety - Introduction to Security and Safety - Systems Security - Network Security - Generic Application Security - Application Process Security and Safety - Reliable-and-Secure-by-Design IoT Applications - Run-Time Monitoring - The ARMET Approach - Privacy and Dependability

Unit – V **(12 Hours)**

Key Applications Of The Internet Of Things: The Smart Grid - The Marginal Cost of Electricity: Base and Peak Production - Managing Demand: The Next Challenge of Electricity Operators-Demand Response for Transmission System Operators (TSO) - Case Study: RTE in France - The Opportunity of Smart Distributed Energy Management-

Demand Response: The Big Picture - Electric Vehicle Charging- Charging Standards Overview - Use Cases

Books for Study

1. Honbo Zhou, "The Internet of Things in the Cloud A Middleware Perspective", CRC Press, 2013
   Unit I *Chapter 1,2,3,4,5 Sec(1.3,2.1, 2.2,3.1-3.5,4.1-4.3,5.1,5.2)*
   Unit II *Chapter 6 Sec(6.2,6.3)*
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
   Unit III *Chapter 7,8,9 (Sec 7.1-7.4,8.1-8.5,9.2-9.4)*
3. Dimitrios Serpanos Marilyn Wolf, " Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, 2018
   Unit –IV *Chapter 5,6 (Sec 5.1- 5.6, 6.1 -6.9)*
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
   Unit – II *Chapter 1,3,5 (Sec 1.1- 1.3, 3.1-3.4,5.1- 5.4,6.1-6.3,7.1-7.6)*
   Unit –V *Chapter 15,16 (Sec 15.1- 15.7, 16.1 -16.2)*

Books for Reference

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands- on approach", Universities Press, 2015.
2. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012.
3. David Boswarthick, Olivier Hersent, Omar Elloumi, "M2M Communications A Systems Approach", Wiley, 2012

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	**Course Code**		**Title of the Course**						**Hours**	**Credits**
II	**21PDS2EG01**		**GE-1(WS): Internet of Things**						**4**	**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	3	3	2	2	2	3	3	2	2	2	2.4
CO-2	3	3	3	2	2	3	3	3	2	2	2.6
CO-3	3	3	2	2	2	3	3	2	2	2	2.4
CO-4	2	2	3	2	2	3	3	3	2	2	2.6
CO-5	3	3	2	2	2	2	2	2	2	2	2
									Mean Overall Score		**2.4 (High)**

Semester	Course Code	Title of the Course	Hours	Credit
III	**21PDS3CC06**	**CORE-6: TIME SERIES AND SAMPLING THEORY**	**5**	**5**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K-Levels)
CO-1	recall the basic concepts of time series sampling theories	**K1**
CO-2	interpret seasonal variations using time series techniques	**K2**
CO-3	apply simple random sampling techniques to select samples and analyse them wisely	**K3**
CO-4	compare various stratified sampling techniques	**K4**
CO-5	evaluate and predict the trends in seasonal variations using the systematic sampling techniques	**K5&K6**

Unit – I **(15 Hours)**

Introduction to Forecasting: The Nature and Uses of Forecasts - Some Examples of Time Series - The Forecasting Process - Data for Forecasting- The Data Warehouse - Data Cleaning - Imputation - Resources for Forecasting- Statistics Background for Forecasting - Graphical Displays - Time Series Plots - Plotting Smoothed Data

Unit – II **(15 Hours)**

Numerical Description of Time Series Data: Stationary Time Series - Auto covariance and Autocorrelation Functions - The Variogram - Use of Data Transformations and Adjustments -Transformations - Trend and Seasonal Adjustments - General Approach to Time Series Modelling and Forecasting - Evaluating and Monitoring Forecasting Model Performance - Forecasting Model Evaluation - Choosing Between Competing Models - Monitoring a Forecasting Model

Unit – III **(15 Hours)**

Simple random sampling: Simple Random Sampling-Selection of a Simple Random Sample- Definitions and Notation - Properties of the Estimates - Variances of the Estimates - The Finite Population Correction - Confidence Limits- Random Sampling with Replacement- Estimation of a Ratio- Estimates of Totals Over Subpopulations- Comparisons Between Domain Means - Validity of the Normal Approximation - Linear Estimators of the Population Mean.

Unit – IV **(15 Hours)**

Stratified Random Sampling: Properties - Unbiased Estimate of the Mean and Variance of the Estimated Mean- Optimum Allocation - Relative Precision of Stratified Random and Simple Random Sampling

Unit – V **(15 Hours)**

Systematic Sampling: Estimation of the Mean and Variance - Comparison of Simple, Stratified and Systematic Sampling - Population with Linear Trend-Methods for Populations with Linear Trends - Circular Systematic Sampling - Populations with Periodic Variation – Auto correlated Populations - Natural Populations

Books for Study

1. Douglas C. Montgomery , Cheryl L. Jennings , Murat Kulahci ,"Introduction to Time Series Analysis And Forecasting",Wiley,2015
   Unit-I *Chapter 1,2 (Sec 1.1-1.5, 2.1,2.2)*
   Unit-II *Chapter 2 (Sec 2.3-2.6)*
2. William G. Cochran, "Sampling Techniques", John Wiley Sons,2007.
   Unit-III *Chapter 2 (Sec 2.1-2.8,2.10-2.16)*
   Unit-IV *Chapter 5 (Sec 5.3-5.6)*
   Unit-V *Chapter 8 (Sec 8.3-8.10)*

Books for Reference

1. Box, George EP, Gwilym M. Jenkins, Gregory C. Reinsel, and Greta M. Ljung, "Time series analysis: forecasting and control" , John Wiley & Sons, 2015
2. Wilfredo Palma ,"Time Series Analysis",Wiley,2016
3. Pillai RSN and Bagavathi V, "Statistics", S. Chand & Co., Ed, 2003.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours	Credits			
III	21PDS3CC06	CORE-6: TIME SERIES AND SAMPLING THEORY					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	3	2	2	3	3	3	2	2	2.6
CO-2	3	3	3	2	2	3	3	3	2	2	2.6
CO-3	3	2	2	2	2	3	2	2	2	2	2.2
CO-4	2	2	2	2	2	3	3	2	2	2	2.4
CO-5	2	2	2	2	2	3	3	2	2	2	2.4
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
III	21PDS3CC07	CORE-7: SOFTWARE PROJECT MANAGEMENT	4	4

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	define the software development activities and their organization	K1
CO-2	demonstrate the ways to manage goals, time, cost, changes and risks.	K2
CO-3	make use of the people to manage the organization.	K3
CO-4	analyze the software project pricing.	K4
CO-5	explain and design the project life cycle	K5&K6

Unit – I **(12 Hours)**

Project: Project – Software Project – Managing Projects – Software Project Management. - Software Development Activities and Their Organization: Software Requirements Definition – Business Modelling – Design and Implementation - Verification and Validation – Deployment – Operations and Maintenance.

Unit – II **(12 Hours)**

Managing Goals, Time and Costs: Assessing value and Risks – Formalizing the project Goals – Deciding the work – Estimating – Schedule the Plan – Optimizing a Plan – Budgeting and Accounting – Project Execution – Project Monitoring and Control – Project Closing-Managing Changes, Risks and Quality: Managing Changes – Risk Management – Quality Management.

Unit – III **(12 Hours)**

Managing People and Organizing Communication: Managing People – Project Organization Structure – Managing Communication

Unit – IV **(12 Hours)**

Software Project Pricing: From Cost to Pricing – Software Pricing – Project Pricing Strategies – Procurement and Outsourcing

Unit – V **(12 Hours)**

Managing Software Development Projects: Project Life Cycle – From Traditional to Agile – Agile Methodologies – Open Source Development Practices.

Books for Study

1. Adolfo Villafiorita, "Introduction to Software Project Management", CRC Press, Taylor & Francis Group, 2016.
   Unit – I - *Chapter1 & 2*
   Unit – II - *Chapter 3 & 4*

Unit – III - *Chapter 5*
Unit – IV - *Chapter 6*
Unit – V - *Chapter 7*

Books for Reference

1. BOB Huges, Mike Cotterell, Rajib Mall, "Software Project Management", McGraw Hill, 6th Edition, 2017.
2. C. Ravindranath Pandian, "Applied Software Risk Management-A Guide for Software Project Managers", Auerbach Publications, 2015.
3. Benjamin A. Lieberman, "The Art of Software Modeling", Auerbach Publications, 2010.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
III	21PDS3CC07	CORE-7: SOFTWARE PROJECT MANAGEMENT							4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	2	2	2	2	2	2	3	2	2	2.1
CO-2	3	2	3	2	2	2	3	3	2	2	2.4
CO-3	2	2	3	2	3	3	3	3	3	2	2.6
CO-4	3	2	2	2	2	3	3	3	3	3	2.6
CO-5	3	2	2	3	2	3	3	2	2	3	2.5
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credit
III	**21PDS3CC08**	**CORE-8: CLOUD COMPUTING**	**4**	**4**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	show a comprehensive understanding of cloud technologies and architectures.	**K1**
CO-2	summarize multitenancy, Auto-Scaling and Load Balancing.	**K2**
CO-3	identify the Intercloud and High performance Computing.	**K3**
CO-4	categorize the Security, Privacy and Trust Management Issues for Cloud Computing.	**K4**
CO-5	compare and test the cloud monitoring and Bursting tools.	**K5&K6**

Unit – I **(12 Hours)**

Cloud Computing: An overview – Cloud Computing Past, Present and Future – Methodologies – Architecture and Deployment Techniques – Cloud Services – Cloud Applications – Issues with Cloud Computing - Cloud Computing and Startups: Time to Market – Implications – Changes to the Startup ecosystem – Evolution of the Cloud-Based Company - A Taxonomy of Interoperability for IaaS: Interoperability of Cloud Platforms – Taxonomy of Interoperability for IaaS - Taxonomy Study on Cloud Computing Systems and Technologies: Deployment Models – Delivery Models – Cloud Resource Management.

Unit – II **(12 Hours)**

Intercloud: From the political world to the IT – Intercloud resource sharing models – Advantages and New Business Opportunities – High Cooperation Federation Establishment – Technologies for Achieving the Intercloud - High Performance Computing Clouds: High Performance Computing vs. Cloud Computing – Taxonomy of HPC Clouds – HPC Cloud Challenges – HPC Cloud Solution – Cloud Benchmark of HPC Applications.

Unit – III **(12 Hours)**

Multitenancy: Concepts and Future – Background – Features, Advantages and Problems – Modeling Multitenancy - Auto-Scaling, Load Balancing and Monitoring in Commercial and Open-Source Clouds: Cloud Auto-Scaling – Cloud Client Load Balancing – Cloud Client Resource Monitoring.

Unit – IV **(12 Hours)**

Monitoring: Monitoring in the Cloud – Available Monitoring Tools/solution – Monitoring Infrastructure - Cloud Bursting: Aneka – Hybrid Cloud Deployment Using Aneka – Resource Provisioning Policies – Performance Analysis

Unit – V **(12 Hours)**

Energy Efficient Models for Resource Provisioning and Application Migration in Clouds: Energy Efficient in LCDSs – Energy Efficient and Applications – Energy Efficient VM

Consolidation - Security, Privacy and Trust Management Issues for Cloud Computing: Cloud Computing Securities – Scenarios – Cloud Security Challenges – Handle Cloud Security Challenges – Cloud Computing Privacy – Trust Management.

Books for Study

1. Lizhe Wang, Rajiv Ranjan, Jinjun Chen and Boualem Benatallah, "Cloud Computing Methodology, Systems and Applications", CRC Press, Taylor & Francis Group, 2017.
   Unit – I - *Chapter 1,2,3 & 4*
   Unit – II - *Chapter 9, 11 & 12*
   Unit – III - *Chapter 14 & 15*
   Unit – IV - *Chapter 16 & 17*
   Unit – V - *Chapter 18*

Books for Reference

1. Joseph Ingeno, "Software Architect's Handbook", Packt Publishing,2018.
2. Scott Goessling, Kevin L. Jackson, "Architecting Cloud Computing Solutions", Packt Publishing, 2018.
3. Dan C. Marinescu, "Cloud Computing Theory and Practice", Elsevier, 2nd Edition, 2017.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
III	21PDS3CC08	CORE-8: CLOUD COMPUTING							4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	3	2	3	3	3	3	3	2	3	2.7
CO-2	2	3	2	2	3	2	3	2	2	2	2.3
CO-3	3	3	2	2	2	2	2	2	2	2	2.2
CO-4	2	2	2	3	2	3	2	2	2	3	2.3
CO-5	3	3	2	2	1	1	2	3	2	3	2.2
Mean Overall Score											2.3 (High)

Semester	Course Code	Title of the Course	Hours	Credit
III	**21PDS3CC09**	**CORE-9: DIGITAL IMAGE PROCESSING**	**4**	**4**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the Digital Image Fundamentals	**K1**
CO-2	summarize the filtering in the frequency domain.	**K2**
CO-3	interpret Image restoration and reconstruction.	**K3**
CO-4	examine the various image transformation techniques.	**K4**
CO-5	assess and design the color image processing.	**K5&K6**

Unit – I **(12 Hours)**

Digital Image Processing: Introduction - The Origins of Digital Image Processing - Examples of Fields that Use Digital Image Processing - Fundamental Steps in Digital Image Processing - Components of an Image Processing System - Digital Image Fundamentals: Elements of Visual Perception - Light and the Electromagnetic Spectrum. Image Sensing and Acquisition - Image Sampling and Quantization - Some Basic Relationships Between Pixels - An Introduction to the Mathematical Tools Used in Digital Image Processing.

Unit – II **(12 Hours)**

Filtering in the Frequency Domain: Background - Preliminary Concepts - Sampling and the Fourier Transform of Sampled Functions - The Discrete Fourier Transform of One Variable - Extensions to Functions of Two Variables - Some Properties of the 2-D DFT and IDFT - The Basics of Filtering in the Frequency Domain - Image Smoothing Using Lowpass Frequency Domain Filters - Image Sharpening Using Highpass Filters - Selective Filtering - The Fast Fourier Transform.

Unit – III **(12 Hours)**

Image Restoration and Reconstruction: Noise Models - Restoration in the Presence of Noise Only Spatial Filtering - Periodic Noise Reduction Using Frequency Domain Filtering - Linear, Position-Invariant Degradations - Estimating the Degradation Function - Inverse Filtering - Minimum Mean Square Error (Wiener) Filtering - Constrained Least Squares Filtering - Geometric Mean Filter.

Unit – IV **(12 Hours)**

Wavelet and Other Image Transforms: Matrix-based Transforms – Correlation - Basis Functions in the Time-Frequency Plane - Basis Images - Fourier-Related Transforms - Walsh-Hadamard Transforms - Slant Transform - Haar Transform - Wavelet Transforms.

Unit – V **(12 Hours)**

Color Image Processing: Color Fundamentals - Color Models - Pseudocolor Image Processing - Basics of Full-Color Image Processing - Color Transformations - Color Image Smoothing and Sharpening - Using Color in Image Segmentation - Noise in Color Images - Color Image Compression.

Books for Study

1. Rafael Gonzalez, Richard E. Woods, "Digital Image Processing", Fourth Edition, PHI/Pearson Education, 2018.
   Unit – I - *Chapter1 & 2*
   Unit – II - *Chapter 4*
   Unit – III - *Chapter 5*
   Unit – IV - *Chapter 6*
   Unit – V - *Chapter 7*

Books for Reference

1. Todd R.Reed, "Digital Image Sequence Processing, Compression, and Analysis", CRC Press, 2015.
2. L.Prasad, S.S.Iyengar, "Wavelet Analysis with Applications to Image Processing", CRC Press, 2015.
3. A. K. Jain, "Fundamentals of Image Processing", Second Ed., PHI, New Delhi, 2015.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course								Hours	Credits
III	21PDS3CC09	CORE-9: DIGITAL IMAGE PROCESSING								4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	2	3	2	3	3	3	2	2	2	2.4
CO-2	3	3	3	3	2	3	2	2	3	2	2.6
CO-3	3	2	2	3	2	2	3	3	3	3	2.6
CO-4	3	3	2	2	3	2	2	2	3	2	2.4
CO-5	2	2	3	2	3	3	2	2	2	2	2.3
Mean Overall Score											2.46 (High)

Semester	Course Code	Title of the Course	Hours	Credit
III	**21PDS3CP05**	**Software Lab-5: Image Processing**	**4**	**2**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K-Levels)
CO-1	define various detection techniques in images.	**K1**
CO-2	demonstrate the techniques to create better image solutions.	**K2**
CO-3	develop efficient programs to disentangle problems that occur while processing the images.	**K3**
CO-4	analyze image processing techniques to detect accurate results.	**K4**
CO-5	elaborate and discuss how to process videos using various motion detection techniques.	**K5&K6**

Lab Exercises:

1. Program for Installing and configuring Open CV
2. Program for Basic Image Operations – Colors, Pixel manipulation, filtering, blur, dilation and erosion
3. Program for Scale, rotate and transform images
4. Program for Skew Detection and Correction
5. Program for Object Detection and Thresholding
6. Program for Contour Object Detection and Edge Detection
7. Program for Digit Detection
8. Program for Handling Video Input
9. Program for Motion Detection using Open CV
10. Program for Build a CAR Number Plate Detection System.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours				Credit
III	**21PDS3CP05**	**Software Lab-5: IMAGE PROCESSING**					**4**				**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	2	2	3	2	2	3	3	2	2	2	2.3
CO-2	3	2	3	3	2	3	2	2	3	2	2.5
CO-3	3	3	2	2	3	2	2	2	2	2	2.3
CO-4	2	2	2	2	3	3	2	2	2	2	2.2
CO-5	3	2	2	3	3	3	2	3	2	2	2.5
Mean Overall Score											**2.4 (High)**

Semester	Course Code	Title of the Course	Hours	Credit
III	**21PDS3IS01**	**Internship**	**-**	**2**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	find their specific areas of interest, refine their skills and abilities	**K1**
CO-2	show a greater sense of self-awareness and *appreciation* for others	**K2**
CO-3	develop work habits and attitudes that are essential to succeed in the workplace	**K3**
CO-4	discover the importance of communication, interpersonal and other critical skills in the job interview process.	**K4**
CO-5	choose and prioritize employment contacts leading directly to a full-time job following graduation from college.	**K5&K6**

Internship:

The Student has to undergo 40 Hours of Internship Programme in the Industry

Sl. No	Area of Work	Maximum Marks
1.	a) Work Related performance – Work Attitude / Academic Preparation / Problem Solving Ability / Adaptability / Overall Attendance / Progress towards learning goals.	25
	b) Organizational skills – Time Management Skills / Planning Skills/ Communication skills	25
	c) Relationships with others - Willingness to cooperate with co-workers / Ability to work with supervisor / Acceptance of constructive comments / Ability to take direction	25
2.	VIVA VOCE EXAMINATION	25
	TOTAL	100

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours				Credits
III	**21PDS3IS01**	**INTERNSHIP**					**-**				**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	2	2	3	3	3	3	2	3	2	3	2.6
CO-2	3	2	3	3	3	3	3	2	3	3	2.8
CO-3	3	3	3	3	3	2	3	2	3	2	2.7
CO-4	2	3	2	2	2	2	2	3	2	3	2.3
CO-5	3	2	1	1	2	3	2	3	2	3	2.2
Mean Overall Score											**2.5 (High)**

Semester	Course Code	Title of the Course	Hours	Credit
III	**21PDS3ES03A**	**DSE-3: CRYPTOGRAPHY AND NETWORK SECURITY**	**5**	**4**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K-Levels)
CO-1	recall the fundamentals of networks security, security architecture, threats and vulnerabilities	**K1**
CO-2	explain Symmetric Encryption principles and Message Confidentiality	**K2**
CO-3	make use of various Public-key Cryptography techniques for secure data transmission	**K3**
CO-4	analyse essential approaches and techniques to ensure IP security and network management security	**K4**
CO-5	assess and build the various Message Authentication and Hash Functions to provide message authentication	**K5&K6**

Unit – I **(15 Hours)**

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

Unit – II **(15 Hours)**

Symmetric Encryption and Message Confidentiality: Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Stream Ciphers and RC4, Cipher Block Modes of Operation, Location of Encryption Devices, Key Distribution - Confidentiality Using Symmetric Encryption - Placement of Encryption Function - Traffic Confidentiality - Key Distribution - Random Number Generation**.**

Unit – III **(15 Hours)**

Public-key Cryptography: Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures, Key Management.

Unit – IV **(15 Hours)**

Message Authentication and Hash Functions: Authentication Requirements - Authentication Functions - Message Authentication Codes - Hash Functions - Security of Hash Functions and Macs - Authentication Applications - Kerberos, x.509 Authentication Service, Public-Key Infrastructure. Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME.

Unit – V **(15 Hours)**

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

Books for Study

1. Stallings William, "Cryptography and Network Security - Principles and Practice", Pearson Education India, 2017.
   Unit-I - *Chapter 1,2 (Sec 1.1-1.6,2.1-2.3,2.5)*
   Unit-II - *Chapter 6,7 (Sec 6.1-6.3, 7.1- 7.4)*
   Unit-III - *Chapter 8,9,10*
   Unit-IV - *Chapter 11,14,15 (Sec 11.1-11.5,14.1-14.3,15.1,15.2*)
   Unit-V - *Chapter 16,17 (Sec 16.1-16.5,17.1-17.3)*

Books for Reference

1. Ajay Kumar, Dr S.Bose, "Cryptography and Network Security", Pearson Education India,2017
2. Manoj Kumar, "Cryptography and Network Security", Krishna Prakashan Media,2012
3. Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security (SIE)",Tata McGraw Hill Education Private Limited,2011.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours	Credit			
III	21PDS3ES03A	DSE-3: CRYPTOGRAPHY AND NETWORK SECURITY					5	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	2	2	2	2	3	2	2	2	2	2.2
CO-2	3	2	2	2	2	3	2	2	2	2	2.2
CO-3	3	2	2	2	2	3	2	2	2	2	2.2
CO-4	2	2	2	2	2	2	2	2	2	2	2
CO-5	3	2	2	2	2	3	2	2	2	2	2.2
Mean Overall Score											2.2 (High)

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PDS3ES03B**	**DSE-3: NATURAL LANGUAGE PROCESSING**	**5**	**4**

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	define the Linear Text Classification of NLP	**K1**
CO-2	demonstrate the Nonlinear classification	**K2**
CO-3	identify the various Language Models of NLP	**K3**
CO-4	analyse and Apply the Formal Language Theory	**K4**
CO-5	explain and formulate the Logical Semantics & Predicate-argument Semantics	**K5&K6**

Unit – I **(15 Hours)**

NLP Introduction: Natural Language Processing and Its Neighbours – Three Themes in NLP - Linear Text Classification: The bag of words – Naïve Bayes – Discriminative Learning – Loss Functions and Large-margin Classification – Logistic Regression – Optimization.

Unit – II **(15 Hours)**

Nonlinear Classification: Feedforward Neural Network – Designing Neural Network – Learning Neural Network – Conventional Neural Network - Linguistic Applications of Classification: Sentiment and Opinion Analysis – Word Sense Disambiguation – Design Decisions for Text Classification – Evaluating Classifier – Building Datasets.

Unit – III **(15 Hours)**

Language Models: N-Gram Language Models – Smoothing and Discounting – Recurrent Neural Network Models – Evaluating Language Models – Out of Vocabulary Words - Sequence Labeling: Sequence Labeling as Classification – Structure Prediction – The Viterbi Algorithm – Hidden Markov Model.

Unit – IV **(15 Hours)**

Formal Language Theory: Regular Languages – Context Free Languages - Context Free Parsing: Deterministic Bottom up Parsing – Ambiguity – Weighted Context Free Grammars – Learning Weighted Context Free Grammars – Grammar Refinement

Unit – V **(15 Hours)**

Logical Semantics: Meaning and Denotation – Logical Representation of Meaning – Semantic Parsing and the Lambda Calculus – Learning Semantic Parsers - Predicate-Argument Semantics: Semantic Roles – Semantic Role Labeling – Abstract Meaning Representation.

Books for Study

1. Jacob Eisenstein, “Introduction to Natural Language Processing”, MIT Press, 2019.
   Unit – I - *Chapter* 1 (1.1, 1.2), *Chapter 2*
   Unit – II - *Chapter 3 & 4*
   Unit – III - *Chapter 6 & 7*
   Unit – IV - *Chapter 9 & 10*
   Unit – V - *Chapter 12 & 13*

Books for Reference

1. Majumder, Bodhisattwa, et al. “Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems”, O'Reilly Media, 2020.
2. Hobson Lane, Cole Howard, Hannes Hapke, “Natural Language Processing in Action Understanding, analyzing, and generating text with Python”, Manning Publications, 2019.
3. Eisenstein, Jacob, “Introduction to Natural Language Processing”, MIT Press, 2019.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
III	21PDS3ES03B	DSE-3: NATURAL LANGUAGE PROCESSING							5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	2	3	1	3	3	2	3	2	2.5
CO-2	3	2	3	2	2	3	3	2	3	3	2.6
CO-3	1	2	1	2	3	2	3	2	3	3	2.2
CO-4	2	3	2	2	2	2	2	3	2	3	2.3
CO-5	2	2	2	2	2	3	3	2	2	3	2.3
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PDS3EG02**	**GE-2 (BS): DEEP LEARNING**	**4**	**3**

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the Deep Learning techniques	**K1**
CO-2	explain Boltzmann machines and computer vision of Deep learning	**K2**
CO-3	apply the neural network technology and its functions	**K3**
CO-4	analyse the deep learning concepts and acquaint themselves with the usage of ANN, CNN, RNN techniques	**K4**
CO-5	evaluate and solve the challenging computer vision problems through deep learning	**K5&K6**

Unit – I **(12 Hours)**

Foundation of Neural Networks and Deep Learning: Neural Networks–Training Neural Networks - Activation Function –Loss Function- Hyperparameters

Unit – II **(12 Hours)**

Fundamentals of Deep Networks: Defining Deep Learning – Common Architecture Principles of Deep Networks – Building Blocks of Deep Network

Unit – III **(12 Hours)**

Convolutional Neural Networks (CNNs): Biological Inspiration – Intuition - CNN Architecture Overview - Input Layers - Convolutional Layers - Pooling Layers - Fully Connected Layers - Other Applications of CNNs

Unit – IV **(12 Hours)**

Recurrent Neural Networks: Modeling the Time Dimension - 3D Volumetric Input - General Recurrent Neural Network Architecture - LSTM Networks - Domain-Specific Applications and Blended Networks. - Recursive Neural Networks: Network Architecture - Varieties of Recursive Neural Networks - Applications of Recursive Neural Networks

Unit – V **(12 Hours)**

Tensor Flow: Introduction - Go with the Flow: Up and Running with TensorFlow - Understanding TensorFlow Basics - Convolutional Neural Networks

Books for Study

1. Josh Patterson and Adam Gibson, “Deep Learning A practitioners Approach”,Shroff publishers & Distributors, First edition 2017.
   Unit – I - *Chapter 1*
   Unit – II - *Chapter 2*

Unit - III - *Chapter 3*

Unit - IV - *Chapter 4*

2. Resheff, Yehezkel S., et al., "Learning TensorFlow: A Guide to Building Deep Learning Systems", O'Reilly Media, 2017.

Unit - V - *Chapter 1,2,3,4*

Books for Reference

1. BeyLevelsd, Grant, et al., "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", Pearson Education, 2019.
2. Afzal, Saduf, et al., "Advances in Deep Learning",Springer Singapore, 2019.
3. Chollet, François, "Deep Learning with Python", Manning Publications, 2018.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course					Hours				Credits
III	21PDS3EG02	GE-2 (BS): DEEP LEARNING					4				3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	2	2	3	1	3	2	1	3	2	2.5
CO-2	3	3	3	2	3	3	2	2	2	2	2.6
CO-3	3	3	2	1	2	3	2	1	3	2	2.2
CO-4	2	2	2	3	2	2	3	2	2	2	2.3
CO-5	3	1	3	2	3	3	1	3	2	2	2.3
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
IV	**21PDS4PW01**	**PROJECT WORK**	**21**	**19**

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	show leadership skills and learn time management	**K1**
CO-2	identify various tools to be applied to a specific problem	**K2**
CO-3	evaluate the reports	**K3**
CO-4	take part in a team as well as manage it to deliver stunning outcomes	**K4**
CO-5	assess and develop the individual skills to present and organize projects	**K5&K6**

Project Work

SL	Area of Work	Maximum Marks
1.	**PROJECTWORK:** (i) Plan of the Project	40
	(ii) Execution of the plan / Collection of data / Organization of Materials / Fabrication Experimental study / Hypothesis, Testing etc., and Presentation of the report.	90
	(iii) Individual Initiative	20
2.	Viva Voce Examination	50
	TOTAL	**200**

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
IV	**21PDS4PW01**	**PROJECT WORK**							**21**	**19**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	
CO-1	3	2	3	2	3	2	3	2	3	2	2.5
CO-2	2	1	3	3	1	2	3	3	2	2	2.2
CO-3	1	3	1	3	3	3	3	2	3	3	2.5
CO-4	3	2	3	3	3	3	3	2	3	2	2.7
CO-5	2	2	3	3	2	1	1	3	2	3	2.2
									Mean Overall Score		**2.4 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4CE01	COMPREHENSIVE EXAMINATION	-	2

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the basics of statistics and correlation techniques	K1
CO-2	illustrate the basic and advanced methods of big data technology	K2
CO-3	develop a comprehensive understanding of cloud technologies and architectures	K3
CO-4	examine Project life cycle and Organization	K4
CO-5	evaluate and construct BI tools critically to support the strategic decision-making of an organization	K5&K6

Unit - I

Correlation: Definition of Correlation- Scatter Diagram- Karl Pearson's Coefficient of Linear Correlation- Spearman's Rank Correlation. Canonical Correlations and Canonical Variables: Canonical Correlations and Variates in the Population- Estimation of Canonical Correlations and Variates - Statistical Inference. Concepts of time series - Components of time series - Additive and multiplicative models for the analysis of time series

Unit – II

Introduction to Big Data Analytics: Big Data Overview – Big Data ECO system - Data Analytics Lifecycle – Data Discovery – Data Preparation – Model Planning – Model Building – Communicate Results – Operationalize - Relational and parallel Database Design: Basics, Entity Types, Relationship Types, ER Model, ER-to- Relational Mapping algorithm. Normalization: Functional Dependency, 1NF, 2NF, 3NF, BCNF, 4NF and 5NF - Distributed and Object based Database: Architecture, distributed data storage, Distributed transactions, Commit protocols, Concurrency control, Query Processing

Unit – III

Cloud Computing: Evolution of Cloud Computing -Essential Characteristics of cloud computing - Operational models - Service models. Google cloud platform - Amazon AWS - Microsoft Azure - Pivotal cloud foundry and Open Stack - Machine Learning: Definition- Main Types of Learning-Supervised Learning- The Brain and the Neuron –Design a Learning System –Perspectives and Issues in Machine Learning –Concept Learning Task

Unit – IV

Definitions and Functional Requirements of IoT: Architecture - Web 3.0 View of IoT - Ubiquitous IoT Applications - Four Pillars of IoT - DNA of IoT -The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview - Communication middleware for IoT - IoT Information Security - Introduction to Business Intelligence: Definition– Business Intelligence into Context – Task and Analysis Format

Unit – V

Introduction to algorithms: Algorithm Definition – Algorithm Specification –Asymptotic Notations. Elementary Data Structures: Stacks and Queues – Trees – Graphs - Project Management Framework: Project - Project management - Relationship among Project, Program and Portfolio management -Project and operations management-Role of project manager Project management body of knowledge - Enterprise Environmental factors - Project life cycle and Organization: Overview of project life cycle-Projects vs Operational Work-Stakeholders-Organizational influences on project management

Books for Reference

1. Cheryl Ann Willard, "Statistical Methods An Introduction to Basic Statistical Concepts and Analysis",Taylor& Francis Publication, 2020.
2. EMC Education Services,"Data Science & Big Data Analytics: Discovering, Analysing, Visualizing and Presenting Data", Wiley & Sons, Inc Publications, 2016
3. Abraham Silberschatz, Henry F Korth , S Sudarshan, "Database System Comcepts", 6th edition , McGraw-Hill International Edition , 2015
4. Buyya, Vecciola and Selvi, "Mastering Cloud Computing: Foundations and Applications Programming", Tata McGraw Hill, 2013
5. Stephen Marsland, "Machine Learning –An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
6. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands- on approach", Universities Press, 2015
7. Grossmann, Wilfried, and Rinderle-Ma, Stefanie., "Fundamentals of Business Intelligence",Belgium, Springer Berlin Heidelberg, 2015.
8. Ellis Horowitz, SatrajSahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Universities Press, Second Edition, Reprint 2009.
9. BOB Huges, Mike Cotterell, Rajib Mall, "Software Project Management", McGraw Hill, Fifth Edition,2011

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course								Hours	Credits
IV	21PDS4CE01	COMPREHENSIVE EXAMINATION								-	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	3	2	3	2	3	1	3	3	2	2.4
CO-2	2	1	3	2	2	1	3	3	3	3	2.3
CO-3	3	2	1	2	1	3	2	3	3	2	2.2
CO-4	3	2	3	3	1	2	3	3	2	3	2.5
CO-5	2	3	2	3	3	3	1	1	2	3	2.3
Mean Overall Score											2.3 (High)

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4CC10	CORE-10: BUSINESS INTELLIGENCE	4	4

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall the concepts and components of Business Intelligence (BI)	K1
CO-2	interpret the data provisioning in BI to fetch the desired data from the source to the target system	K2
CO-3	apply the data visualization in Business Intelligence to translate the *information* into a visual context	K3
CO-4	analyse large sets of data through process analysis in BI	K4
CO-5	evaluate and construct BI tools critically to support the strategic decision-making of an organization	K5&K6

Unit – I **(12 Hours)**

Introduction to Business Intelligence: Definition– Putting Business Intelligence into Context – Task and Analysis Format

Unit – II **(12 Hours)**

Modelling in Business Intelligence: Models and Modelling in Business Intelligence – Logical and Algebraic Structure – Graph Structure – Analytical |Structure – Models and Data

Unit – III **(12 Hours)**

Data Provisioning: Data Collection and Description – Data Extraction – Transactional Data Towards Analytical Data – Scheme and Data Integration

Unit – IV **(12 Hours)**

Data Description and Visualization: Description and visualization for Business process – Description and visualization of data in customer perspective -Basic Visualization Technique -Reporting

Unit – V **(12 Hours)**

Process Analysis: Business process analysis and Simulation – Process performance Management and Warehousing – Process Mining – Business Process Compliance – Evaluation Assessment

Books for Study

1. Grossmann, Wilfried, and Rinderle-Ma, Stefanie. Fundamentals of Business Intelligence. Belgium, Springer Berlin Heidelberg, 2015.
   Unit – I - *Chapter 1*
   Unit – II - *Chapter 2*

Unit - III - *Chapter 3*
Unit - IV - *Chapter 4*
Unit - V - *Chapter 7*

Books for Reference

1. Olszak, Celina M, "Business Intelligence and Big Data: Drivers of Organizational Success". United States, CRC Press, 2020.
2. King, David, et al. Business Intelligence, Analytics, and Data Science: A Managerial Perspective. Germany, Pearson, 2017.
3. Brijs, Bert. "Business Analysis for Business Intelligence", CRC Press, 2016.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
IV	21PDS4CC10	CORE-10: BUSINESS INTELLIGENCE							4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	2	2	3	3	2	2	2	2	2	2.3
CO-2	2	3	3	3	3	3	3	3	3	3	2.9
CO-3	3	2	2	2	2	2	3	3	2	2	2.3
CO-4	3	2	2	3	3	3	2	2	2	3	2.5
CO-5	1	3	3	2	3	1	2	2	3	2	2.2
Mean Overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4ES04A	DSE-4: SENTIMENT ANALYSIS	5	4

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall various tools used for sentiment analysis	K1
CO-2	classify the whole document text as expressing a positive, neutral or negative opinion.	K2
CO-3	make use of Subjectivity and Sentiment Classification to classify a sentence as subjective or objective	K3
CO-4	examine the aspects of sentiment classification in social media platforms	K4
CO-5	explain and choose domain specific Sentiment Lexicon generation	K5&K6

Unit – I **(15 Hours)**

Introduction to Sentiment Analysis: Sentiment Analysis Applications -Sentiment Analysis Research- Different Levels of Analysis - Sentiment Lexicon and Its Issues - Analyzing Debates and Comments - Mining Intentions - Opinion Spam Detection and Quality of Reviews - The Problem of Sentiment Analysis - Definition of Opinion - Definition of Opinion Summary - Affect, Emotion, and Mood - Different Types of Opinions

Unit – II **(15 Hours)**

Document Sentiment Classification: Supervised Sentiment Classification- Classification Using Machine Learning Algorithms - Classification Using a Custom Score Function - Unsupervised Sentiment Classification - Classification Using Syntactic Patterns and Web Search - Classification Using Sentiment Lexicons - Sentiment Rating Prediction - Cross-Domain Sentiment Classification - Cross-Language Sentiment Classification - Emotion Classification of Documents

Unit – III **(15 Hours)**

Sentence Subjectivity and Sentiment Classification: Sentence Subjectivity Classification - Sentence Sentiment Classification - Assumption of Sentence Sentiment Classification - Classification Methods - Dealing with Conditional Sentences - Dealing with Sarcastic Sentences - Cross-Language Subjectivity and Sentiment Classification - Using Discourse Information for Sentiment Classification - Emotion Classification of Sentences

Unit – IV **(15 Hours)**

Aspect Sentiment Classification: Rules of Sentiment Composition - Negation and Sentiment - Modality and Sentiment - Coordinating Conjunction But - Sentiment Words in Non-opinion Contexts - Rule Representation - Word Sense Disambiguation and Coreference Resolution

Unit – V **(15 Hours)**

Sentiment Lexicon Generation: Dictionary-Based Approach - Corpus-Based Approach - Identifying Sentiment Words from a Corpus - Dealing with Context-Dependent Sentiment Words - Lexicon Adaptation - Some Other Related Work - Desirable and Undesirable Facts - Analysis of Comparative Opinions- Problem Definition- Identify Comparative Sentences - Identifying the Preferred Entity Set - Special Types of Comparison- Sentences Involving Compare and Comparison - Entity and Aspect Extraction

Books for Study

1. Bing Liu, "Sentiment Analysis - Mining opinion, Sentiments and Emotions", Cambridge University Press, 2015.
   Unit-I -*Chapter 1,2 (Sec 1.1-1.5, 2.1,2.2)*
   Unit-II- *Chapter 3 (Sec 3.1-3.6)*
   Unit-III - *Chapter 4 (Sec 4.1-4.8)*
   Unit-IV - *Chapter 5 (Sec 5.1-5.8)*
   Unit-V - *Chapter 7,8 (Sec 7.1-7.3, 8.1-8.5)*

Books for Reference

1. Roy De Groot, "Data mining for Tweet sentiment classification - Twitter sentiment analysis", LAP Lambert Academic Publishing, 2012.
2. Bing Liu, "Sentiment Analysis and Opinion Mining", Morgan and Claypool publishers, 2012.
3. Ghowsalya Balu, "Forecast rating based on public comments by sentiment analysis",LAP LAMBERT Academic Publishing,2019.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
IV	21PDS4ES04A	DSE-4: SENTIMENT ANALYSIS							5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	2	2	2	3	2	2	2	2	2.2
CO-2	3	2	2	2	2	3	3	2	2	2	2.4
CO-3	3	2	2	2	2	3	3	2	2	2	2.4
CO-4	3	3	2	2	2	3	2	2	2	2	2.2
CO-5	3	2	2	2	2	3	2	2	2	2	**2.2**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4ES04B	DSE-4: SOFT COMPUTING	5	4

CO No.	CO – Statements On successful completion of this course, students will be able to	Cognitive Levels (K- Levels)
CO-1	recall various tools used for sentiment analysis	K1
CO-2	interpret artificial neural networks and fuzzy theory from an engineering perspective	K2
CO-3	apply Genetic Algorithms to find optimal or near-optimal solutions to difficult problems	K3
CO-4	examine the concepts of Supervised Learning Networks	K4
CO-5	explain and discuss neural network theory and fuzzy logic theory	K5&K6

Unit – I **(15 Hours)**

Introduction to Neural Networks: Application Scope of Neural Networks - Fuzzy Logic - Genetic Algorithm - Hybrid Systems - Soft Computing- Artificial Neural Network: An Introduction -Fundamental Concept - Evolution of Neural Networks - Basic Models of Artificial Neural Network

Unit – II **(15 Hours)**

Supervised Learning Network: Introduction to Supervised Learning Network- Perceptron Networks - Adaptive Linear Neuron (Adaline) - Multiple Adaptive Linear Neurons - Back-Propagation Network - Radial Basis Function Network - Time Delay Neural Network - Functional Link Networks - Tree Neural Networks -Wavelet Neural Networks

Unit – III **(15 Hours)**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets: Classical Sets (Crisp Sets) - Fuzzy Sets - Classical Relations and Fuzzy Relations- Cartesian Product of Relation - Classical Relation - Fuzzy Relations - Tolerance and Equivalence Relations – Non-interactive Fuzzy Sets

Unit – IV **(15 Hours)**

Classical Relations and Fuzzy Relations: Cartesian Product of Relation- Classical Relation-Fuzzy Relations -Tolerance and Equivalence Relations- Non-interactive Fuzzy Sets- Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Arithmetic-Extension Principle-Fuzzy Measures - Measures of Fuzziness -Fuzzy Integrals

Unit – V **(15 Hours)**

Genetic Algorithm: Biological Background - Traditional Optimization and Search Techniques - Genetic Algorithm and Search Space -Genetic Algorithm vs. Traditional Algorithms - Basic Terminologies in Genetic Algorithm - Simple GA- General Genetic Algorithm --Operators in Genetic Algorithm - Stopping Condition for Genetic Algorithm Flow -Constraints in Genetic Algorithm -Problem Solving Using Genetic Algorithm -The

Schema Theorem- Classification of Genetic Algorithm- Holland Classifier Systems - Genetic Programming -Advantages and Limitations of Genetic Algorithm -Applications of Genetic Algorithm

Books for Study

1. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", 3rd Edition, Wiley India Pvt. Limited, 2018.
   Unit-I -*Chapter 1,2 (Sec 1.1-1.6, 2.1-2.3)*
   Unit-II- *Chapter 3 (Sec 3.1-3.10)*
   Unit-III - *Chapter 10 (Sec 10.1-10.3)*
   Unit-IV -*Chapter 11,14 (Sec 11.1-11.6,14.1-14.6)*
   Unit-V-*Chapter 21 (Sec 21.1-21.18)*

Books for Reference

1. Roy, Samir;Chakraborty. Soft Computing. India, Pearson Education India, 2013
2. Saroj Kaushik, Sunita Tiwari, "Soft Computing: Fundamentals, Techniques and Applications",McGraw-Hill Education, 2018
3. N.P. Padhy, S.P. Simon ,"Soft Computing with MATLAB programming",Oxford University Press,2015.

Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course							Hours	Credits
IV	21PDS4ES04B	DSE-4: SOFT COMPUTING							5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	3	2	2	3	3	3	2	2	2.6
CO-2	3	3	3	2	2	2	3	3	2	2	2.4
CO-3	3	3	2	2	2	3	3	2	2	2	2.4
CO-4	2	2	2	2	2	3	2	2	2	2	2.2
CO-5	2	2	2	2	2	2	2	2	2	2	2
Mean Overall Score											2.3 (High)