Annamalai University

(Accredited with 'A' Grade byNAAC)

Faculty of Science

Department of Computer and Information Science

M.Sc. DATA SCIENCE
(2-Year)

Programme Code: SCIS22

Regulations, Curricula and Syllabi

(2019-20)

Annamalai University

Faculty of Science

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE

M.Sc. DATA SCIENCE

Programme Code: SCIS22

These rules and regulations shall govern the Two year post graduate studies leading to the award of degree of **Master of Science in Data Science** in the Faculty of Science. These academic Regulations shall be called "**Annamalai University, Faculty of Science, Two year M.Sc. Data Science Regulations 2019**". They shall come into force with effect from the academic year 2019 – 2020.

1. **Definitions and Nomenclature**

1.1 **University** refers to Annamalai University.

1.2 **Department** means any of the academic departments and academic centers at the University.

1.3 **Discipline** refers to the specialization or branch of knowledge taught and researched in higher education. For example, Computer Science is a discipline in the Mathematical Sciences, while Economics is a discipline in Social Sciences.

1.4 **Programme** encompasses the combination of courses and/or requirements leading to a Degree. For example, M.Sc., M.A.

1.5 **Course** is an individual subject in a programme. Each course may consist of Lectures/ Laboratory /Seminar/Project work/viva-voce etc. Each course has a course title and is identified by a course code.

1.6 **Curriculum** encompasses the totality of student experiences that occur during the educational process.

1.7 **Syllabus** is an academic document that contains the complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

1.8 **Academic Year** refers to the annual period of sessions of the University that comprises two consecutive semesters.

1.9 **Semester** is a half-year term that lasts for a minimum duration of 90 days.

1.10 **Choice Based Credit System**: A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

1.11 **Core Course** is mandatory and an essential requirement to qualify for the Degree.

1.12 **Elective Course** is a course that a student can choose from a range of alternatives.

1.13 **Value-added Courses** are optional courses that complement the students' knowledge and skills and enhance their employability.

1.14 **Credit** refers to the quantum of course work in terms of number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

1.15 **Credit Hour** refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.

1.16 **Programme Outcomes** (POs) are statements that describe crucial and essential knowledge, skills and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.

1.17 **Programme Specific Outcomes** (PSOs) are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

1.18 **Learning Objectives** are statements that define the expected goal of a course in **Course Objectives** in terms of demonstrable skills or knowledge that will be acquired by a student.

1.19 **Course Outcomes** (COs) are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

1.20 **Grade Point Average** (GPA) is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in section 11.3

1.21 **Cumulative Grade Point Average** (CGPA) is a measure of overall cumulative performance of a student over all the semesters. Calculation of CGPA is given in section11.4.

1.22 **Letter Grade** is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, RA, and W.

2. Programme Offered and Eligibility Criteria:

The Department of Computer and Information Science offers a Two Year M.Sc. in Data Science programme. A pass in any Bachelor's degree programme of minimum 3 years duration with Mathematics or Statistics as any of the core/ancillary course at Graduate level or an examination accepted by the syndicate as equivalent thereto are eligible for admission.

2.1 In the case of SC/ST and differently-abled candidates, a pass in minimum qualification for the above programme.

3. **Reservation Policy:** Admission to the various programmes will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. Programme Duration

4.1 The Two Year Master's Programme consists of two academic years.

4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.

4.3 Each semester will have 90 working days (18 weeks).

5. Programme Structure

5.1 The Two Year Master's Programme consists of Core Courses, Elective Courses (Departmental & Interdepartmental), and Project.

5.2 Core courses

5.2.1 These are a set of compulsory courses essential for each programme.

5.2.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

5.3 Elective courses

5.3.1 Departmental Electives (DEs) are the Electives that students can choose from a range of Electives offered within the Department.

5.3.2 Interdepartmental Electives (IDEs) are Electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the

departments of other faculties.

5.4 **Experiential Learning**

5.4.1 Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

5.4.2 In-plant training/field trips/internships/industrial visits fall under this category.

5.5 **Project**

5.5.1 Each student shall undertake a Project and submit a dissertation as per guidelines in the final semester.

5.5.2 The Head of the Department shall assign a Research Supervisor to the student.

5.5.3 The Research Supervisor shall assign a topic for research and monitor the progress of the student periodically.

5.5.4 Students who wish to undertake project work in recognized institutions/industry shall obtain prior permission from the University. The Research Supervisor will be from the host institute.

5.6 **Value added Courses (VACs)**

5.6.1 Students may also opt to take Value added Courses beyond the minimum credits required for award of the Degree. VACs are outside the normal credit paradigm.

5.6.2 These courses impart employable and life skills. VACs are listed in the University website and in the Handbook on Interdepartmental Electives and VACs.

5.6.3 Each VAC carries 2 credits with 30 hours of instruction. Classes for a VAC are conducted beyond the regular class hours and preferably in the III Semester.

5.7 **Online Courses**

5.7.1 The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.7.2 Students who successfully complete a course in the MOOCs platform shall be exempted from one elective course of the programme.

5.8 **Credit Distribution:** The credit distribution is organized as follows:

	Credits
Core Courses	72
Elective Courses	18
Project	06
Constitution of India*	**02**
Total	**96**

5.9 Credit Assignment

Each course is assigned credits and credit hours on the following basis:

1 Credit is defined as,

1 Lecture period of one hour duration per week over a semester

1 Tutorial period of one hour duration per week over a semester

1 Practical/Project period of two hours duration per week over a semester.

6 Attendance

6.1 Each faculty handling a course shall be responsible for the maintenance of Attendance and Assessment Record for candidates who have registered for the course.

6.2 The Record shall contain details of the students' attendance, marks obtained in the

Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition the Record shall also contain the organization of lesson plan of the Course teacher.

6.3 The record shall be submitted to the Head of the Department and Dean once a month for monitoring the attendance and syllabus coverage.

6.4 At the end of the semester, the record shall be placed in safe custody for any future verification.

6.5 The Course teacher shall intimate to the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.

6.6 Each student shall have a minimum of 75% attendance in all the courses of the particular semester failing which he or she will not be permitted to write the End-Semester Examination. The student has to redo the semester in the next year.

6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness, representing the University in extracurricular activities and participation in NCC/NSS/YRC/RRC.

7 Mentor-Mentee System

7.1 To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

7.2 The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.

7.3 The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.

8 Examinations

8.1 The examination system of the University is designed to systematically test the student's progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

8.2 There will be two CIA Tests and one ESE in each semester.

8.3 The Question Papers will be framed to test different levels of learning based on Bloom’s taxonomy viz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/Creativity.

8.4 Continuous Internal Assessment Tests

8.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments and seminars. This requires an element of openness.

8.4.2 The students are to be informed in advance about the assessment procedures.

8.4.3 The setting of question paper will be decided by the respective faculty.

8.4.4 CIA Test-I will cover the syllabus of first two units while CI Test-II will cover the last three units.

8.4.5 CIA Tests will be for one or two hours duration depending on the quantum of syllabus.

8.4.6 A student cannot repeat the CIA Test-I and CIA Test-II. However, if for any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

8.4.7 For the CIA Tests, the assessment will be done by the Course teacher

8.5 End Semester Examinations (ESE)

8.5.1 The ESE for the first and third semester will be conducted in November and for the second and fourth semester in May.

8.6 Candidates who failed in any course will be permitted to reappear in failed course in the subsequent examinations.

8.7 The ESE will be of three hours duration and will cover the entire syllabus of the course.

9 Evaluation

9.1 Marks Distribution

9.1.1 For each course, the Theory and Practical shall be evaluated for a maximum of 100 marks.

9.1.2 For the theory courses, CIA Tests will carry 25% and the ESE 75% of the marks.

9.1.3 For the Practical courses, the CIA Tests will carry 40% and the ESE 60% of the marks.

9.2 Assessment of CIA Tests

9.2.1 For the CIA Tests, the assessment will be done by the course instructor

9.2.2 For the Theory Courses, the break-up of marks shall be as follows

CIA for Theory	Marks
Test-I & Test-II	15
Seminar	05
Assignment	05
Total	25

9.2.3 For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

CIA for Practical	Marks
Test-I	15
Test-II	15
Viva-voce and Record	10
Total	40

9.3 Assessment of End-Semester Examinations

9.3.1 Evaluation for the ESE is done by internal examiner.

9.4 Assessment of Project/Dissertation

9.4.1 The Project Report/Dissertation shall be submitted as per the guidelines.

9.4.2 The Project Work/Dissertation shall carry a maximum of 100 marks.

9.4.3 CIA for Project work/dissertation will carry 25% and ESE 75%.

9.4.4 The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.

9.4.5 The Project Evaluation Committee will comprise the Head of the Department, Project Supervisor, and a senior faculty.

9.4.6 **The marks shall be distributed as follows:**

Continuous Internal Assessment (25 Marks)		End Semester Examination (75 Marks)	
Review-I – 10	Review-II -15	Project / Dissertation Evaluation	Viva-voce
		50	25

9.5 Assessment of Value-added Courses

9.5.1 Assessment of VACs shall be internal. Two CIA Tests shall be conducted during the semester by the Department(s) offering VAC.

9.5.2 The grades obtained in VACs will not be included for calculating the GPA/CGPA.

9.6 Passing Minimum

9.6.1 A student is declared to have passed in each course if he/she secures not less than 50% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.6.2 A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/year.

10. Conferment of the Master's Degree

A candidate who has secured a minimum of 50% marks in all courses prescribed in the programme and earned the minimum required credits shall be considered to have passed the Master's Programme.

11. Marks and Grading

11.1 The performance of students in each course is evaluated in terms Grade Point (GP).

11.2 The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed.

11.3 **The GPA** is calculated by the formula

$$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$$

where, $\boldsymbol{C_i}$ is the Credit earned for the Course $\boldsymbol{i}$ in any semester;

$\boldsymbol{G_i}$ is the Grade Point obtained by the student for the Course $\boldsymbol{i}$ and

$\boldsymbol{n}$ is the number of Courses passed in that semester.

11.4 **CGPA** is the Weighted Average Grade Point of all the Courses passed starting from the first semester to the current semester.

$$\text{CGPA} = \frac{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i}$$

Where, C_i is the Credit earned for the Course i in any semester;

G_i is the Grade Point obtained by the student for the Course i

n is the number of Courses passed in that semester.

m is the number of semesters.

11.5 **Evaluation :**

11.5.1 **Performance of the student for each course will be rated as shown in the Table.**

Range of Marks	Grade Points	Letter Grade
90 and above	10	S
80-89	9	A
70-79	8	B
60-69	7	C
55-59	6	D
50-54	5	E
Less than 50	0	RA
Withdrawn from the examination	0	W

11.5.2 A ten point rating scale is used for evaluation of the performance of the student to provide overall grade for the Master's Programme.

CGPA	Classification of Final Result
8.25 and above	First Class with Distinction
6.5 and above but below 8.25	First Class
5.0 and above but below 6.5	Second Class
0.0 and above but below 5.0	Re-appear

11.6 **Classification of Results**. The successful candidates are classified as follows:

11.6.1 **For First Class with Distinction:** Candidates who have passed all the courses prescribed in the Programme in the first attempt with a CGPA of 8.25and above within the programme duration. Candidates who have withdrawn from the End Semester Examinations are still eligible for First Class with Distinction (See Section 12 for details).

11.6.2 **For First Class:** Candidates who have passed all the courses with a CGPA of 6.5and above.

11.6.3 **For Second Class:** Candidates who have passed all the courses with a CGPA between 5.0 and less than 6.5.

11.6.4 Candidates who obtain overall highest CGPA in all examinations in the first appearance itself are eligible for University Rank.

11.7 **Course-Wise Letter Grades**

11.7.1 The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

11.7.2 A student is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

11.7.3 A course successfully completed cannot be repeated for the purpose of improving the Grade Point.

11.7.4 A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the candidate has appeared for clearance of the arrears.

11.7.5 If a student secures RA grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit if it involves only rewriting/ incorporating the clarifications suggested by the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

12. Provision for Withdrawal from the End Semester Examination

12.1 The letter grade W indicates that a candidate has withdrawn from the examination.

12.2 A candidate is permitted to withdraw from appearing in the ESE for one course or courses in ANY ONE of the semesters ONLY for exigencies deemed valid by the University authorities.

12.3 Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.

12.4 Application for withdrawal shall be considered only if the student has registered for the course(s), and fulfilled the requirements for attendance and CIA tests.

12.5 The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days notice, due consideration will be given under extraordinary circumstances.

12.6 Withdrawal will not be granted for arrear examinations of courses in previous semesters and for the final semester examinations.

12.7 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) when the course(s) are offered next.

12.8 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the candidate to qualify for First Class with Distinction.

13. **Academic misconduct:** Any action that results in an unfair academic advantage/interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students' work, removing/defacing library or computer resources, stealing other students' notes/assignments, and electronically interfering with other students'/University's intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitized on issues of academic integrity and ethics.

14. **Transitory Regulations:** Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects,

as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. Notwithstanding anything contained in the above pages as Rules and Regulations governing the Two Year Master's Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council.

M.Sc. Data Science (Two Year) Programme
Programme Code: SCIS22

Curricula and Scheme of Examination
(For students admitted from the academic year 2019-2020)

Course Code	Course Title	Hours/ Week			C	Marks		
		L	T	P		CIA	ESE	Total
Semester – I								
19PDSC101	Core 1: Introduction to Data Science	5	0		5	25	75	100
19PDSC102	Core 2: Advanced Data Base Management Systems	5	0		5	25	75	100
19PDSC103	Core 3: Advanced Java Programming	5	0		5	25	75	100
19PDSC104	Core 4: Advanced Web Technology	5	0		5	25	75	100
19PDSP105	Core 5: RDBMS – Lab	0	0	2	2	40	60	100
19PDSP106	Core 6: Advanced Web Technology – Lab	0	0	2	2	40	60	100
19XXXXXXX	Elective-I: Interdepartmental Elective	3	0	0	3	25	75	100
					27			
Semester – II								
19PDSC201	Core 7: Distributed Operating System	5	0		5	25	75	100
19PDSC202	Core 8: Dot Net Programming	5	0		5	25	75	100
19PDSC203	Core 9: Data Science with R Programming	5	0		5	25	75	100
19PDSP204	Core 10: Dot Net Programming Lab	0	0	2	2	40	60	100
19PDSP205	Core 11: R Programming for Data Analytics – Lab	0	0	2	2	40	60	100
19PDSE20X	Elective -II Department Elective	3	0		3	25	75	100
19XXXXXXX	Elective-III: Interdepartmental Elective	3	0	0	3	25	75	100
					25			
Semester – III								
19PDSC301	Core 12: Cryptography and Network Security	5	0		5	25	75	100
19PDSC302	Core 13: Data Analytics using Python	5	0		5	25	75	100
19PDSC303	Core 14: Machine Learning	5	0		5	25	75	100
19PDSP304	Core 15: Data Analytics using Python Programming – Lab	0	0	2	2	40	60	100
19PDSP305	Core 16: Machine Learning – Lab	0	0	2	2	40	60	100
19PDSE30X	Elective-IV: Department Elective	3	0		3	25	75	100
19PDSE30X	Elective-V: Department Elective	3	0		3	25	75	100
19PSCI300	Constitution of India*	2	0		2	25	75	100
					25			
Semester – IV								
19PDSC401	Core 17: Big Data Analytics	5	0		5	25	75	100
19PDSC402	Core 18: Software Project Management	5	0		5	25	75	100
19PDSE40X	Elective-VI: Department Elective	3	0		3	25	75	100
19PDSD405	Dissertation and Viva Voce/In plant training	0	0	12	6	25	75	100
					19			
	Total Credits				**96**			
Value Added Courses								
Online Courses (SWAYAM or MOOC)								

L- Lectures; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination

***19PSCI300 = NON CREDIT COMPULSORY COURSE**

Note:

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available. The details of interdepartmental electives are given in the "**Handbook of Interdepartmental Electives-Two Year Programme**" and listed in the University website.

2. Students may opt for any Value-added Courses listed in the University website. The details of Value Added Courses are given in the "**Handbook of Value Added Courses**" and listed in the University website.

ELECTIVE COURSES

DEPARTMENT ELECTIVE COURSES (DE)

S. No.	Course Code	Course Title	Hours/ week			C	Marks		
			L	T	P		CIA	ESE	Total
1.	19PDSE206	Introduction to Data mining	3	0	0	3	25	75	100
2.	19PDSE207	Web Database and Information System	3	0	0	3	25	75	100
3.	19PDSE208	Green Computing	3	0	0	3	25	75	100
4.	19PDSE306	Image and Video Analytics	3	0	0	3	25	75	100
5.	19PDSE307	Data Science Ethics	3	0	0	3	25	75	100
6.	19PDSE308	Time Series Analysis and Forecasting	3	0	0	3	25	75	100
7.	19PDSE309	Cloud Computing	3	0	0	3	25	75	100
8.	19PDSE310	Distributed and Parallel Computing	3	0	0	3	25	75	100
9.	19PDSE311	Multivariate Data Analytics	3	0	0	3	25	75	100
10.	19PDSE403	Healthcare Data Analytics	3	0	0	3	25	75	100
11.	19PDSE404	Business Intelligence	3	0	0	3	25	75	100

VALUE ADDED COURSES (VAC) (For students of other departments)

To be offered in THIRD Semester

S. No.	Course Code	Course Title	Hours/ week			C	Marks		
			L	T	P		CIA	ESE	Total
1.	SCISVAC01	Web Development	3	0	0	3	25	75	100
2.	SCISVAC02	Fundamentals of Computing	3	0	0	3	25	75	100
3.	SCISVAC03	Advanced Web Development	3	0	0	3	25	75	100
4.	SCISVAC04	Internet and its Applications	3	0	0	3	25	75	100

ANNAMALAI UNIVERSITY

Department of Computer and Information Science

Pattern of question paper for END semester examinations

(Based on Revised Bloom's Taxonomy)

Year : I

Programme: M.Sc. Two Year PG Programme **Semester: I / II**

Course Code: **Course Name:**

Time: 3 Hrs **Max.Marks:100**

Part-A (Level-K1/ Level-K2) Marks: (10x2=20)

(Answer ALL of the questions)

1. Define……
2. Multiple Choices a. b. c. d.
3. Multiple Choices a. b. c. d.
4. Match the following i - a ii- b iii- c iv –d v - …..
5. Match the following i - a ii- b iii- c iv –d v - …..
6. Explain…….
7. Select…..
8. Describe……
9. Classify….
10. Elucidate….

Part-B (Level-K3/ Level-K4) Marks: (8x5=40)

(Answer any EIGHT of the questions)

11. Prepare…..
12. Solve…..
13. Apply……
14. Show…..
15. Categorize…
16. Analyze…
17. Distinguish….
18. Infer….
19. Compare….
20. Compute

Part-C (Level-K5) Marks: (3x10=30)

(Answer any THREE of the questions)

21. Discuss…
22. Summarize….
23. Evaluate…..
24. Disprove….

Part-D (Level-K6)*Marks: (1x10=10)

(Answer any ONE of the questions)

25. Design….
26. Develop…

ANNAMALAI UNIVERSITY

Department of Computer and Information Science

Year : II

Programme: M.Sc. Two Year PG Programme **Semester: III / IV**

Course Code: **Course Name:**

Time: 3 Hrs **Max.Marks:100**

Part-A (Level-K1/ Level-K2) Marks: (10x2=20)

(Answer ALL of the questions)

1. Define……
2. Multiple Choices a. b. c. d.
3. Multiple Choices a. b. c. d.
4. Match the following i - a ii- b iii- c iv –d v - …..
5. Match the following i - a ii- b iii- c iv –d v - …..
6. Explain…….
7. Select…..
8. Describe…..
9. Classify….
10. Elucidate….

Part-B (Level-K3/ Level-K4) Marks: (6x5=30)

(Answer any SIX of the questions)

11. Apply……
12. Show…..
13. Prepare
14. Make use of….
15. Categorize…
16. Analyze…
17. Distinguish….
18. Simplify…..

Part-C (Level-K5) Marks: (3x10=30)

(Answer any THREE of the questions)

19. Discuss…
20. Recommend with
21. Evaluate…..
22. Justify….
23. Optimize…

Part-D (Level-K6)*Marks: (2x10=20)

(Answer any TWO of the questions)

24. Design….
25. Formulate …
26. Modify …..

M.Sc. Data Science (TWO YEAR) Programme

[End Semester Examinations]

Bloom's Taxonomy - Questions Conforming to Levels K1 to K6

	I Year (Two year PG)					II Year (Two Year PG)			
	Level	Part	Questions & Marks	Total Marks		Level	Part	Questions & Marks	Total Marks
	K1	A	5 x 2	10		K1	A	5 x 2	10
	K2		5 x 2	10		K2		5 x 2	10
	K3	B	4 x5	20		K3	B	2 x 5	10
	K4		4 x5	20		K4		4 x 5	20
	K5	C	3 x 10	30		K5	C	3 x10	30
	K6	D	1 x 10	10		K6	D	2x 10	20
				100					100

ANNAMALAI UNIVERSITY

Department of Computer and Information Science

[Question Paper Pattern - INTERNAL TESTS I & II (CIA)]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc. Two Year PG Programme **Semester: All**

Time: 2 Hrs **Max.Marks:50**

Part-A (Level-K1) **Marks: (6x2=12)**

(Answer ALL of the questions)

1. Define /Choose/ Relate……
2. What / Why / How?
3. Multiple Choices a. b. c. d.
4. Multiple Choices a. b. c. d.
5. Match the following i - a ii - b iii - c iv - d v - …..
6. Match the following i - a ii - b iii - c iv - d v - …..

Part-B (Level-K2) **Marks: (3x5=15)**

(Answer any THREE of the questions)

7. Explain…..
8. Describe…..
9. Select……
10. Compare

Part-C (Level-K3/ Level-K4) **Marks: (2x7=14)**

(Answer any TWO of the questions)

11. Apply….
12. Calculate….
13. Categorize…

Part-D (Level-K5/ Level-K6) **Marks: (1x9=9)**

(Answer any ONE of the questions)

14. Discuss….
15. Summarize….

PROGRAMME OUTCOMES (POs)

After the successful completion of the M.Sc. Data Science (2 year) Degree Programme, the graduates will be able to:

PO1:	Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.
PO2:	Resource Utilisation. Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments.
PO3:	Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.
PO4:	Critical thinking and Problem solving: Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.
PO5:	Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources.
PO6:	Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.
PO7:	Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.
PO8:	Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.
PO9:	Ethics: Commitment to professional ethics and responsibilities.
PO10:	Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

At the end of the programme, the student will be able to

PSO1	Adapt the acquired knowledge for solving current and emerging issues in Data Science and involved in life long learning.
PSO2	Gain and apply the knowledge of data science concepts in appropriate domain of interest.
PSO3	Ability to analyze the problem, identify the required computing facility and implement it to obtain solutions.
PSO4	Identify and formulate algorithmic principles, mathematical knowledge and theory of Data Science in modeling and design of computer-based systems.
PSO5	Understand and choose the appropriate modern techniques and tools for the complex systems of various domains and understands the advantages and limitations.
PSO6	Ability to communicate effectively in the basis of presenting their research work and gain knowledge on documentation and reports writing in a professional way.
PSO7	Students can independently enable to acquire the innovative ideas as per the modern era and they can create a value and wealth for the futuristic world.
PSO8	Develop and deploy software and/or hardware systems with assured quality and efficiency.

Semester	19PDSC101: Introduction To Data Science	L	T	P	C
I		5	0	0	5

Learning Objective (LO):

LO1	To develop practical data analysis skills, which can be applied to practical problems?
LO2	To develop fundamental knowledge of concepts underlying data science projects.
LO3	To develop practical skills needed in modern analytics.
LO4	To explain how math and information sciences can contribute to building better algorithms and software.
LO5	To give a hands-on experience with real-world data analysis.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Know basic notions and definitions in data analysis, machine learning.
CO2	Know standard methods of data analysis and information retrieval.
CO3	Be able to formulate the problem of knowledge extraction as combinations of data filtration, analysis and exploration methods.
CO4	To enable students to have skills that will help them to solve complex real-world problems in for decision support.
CO5	Be able to formulate the problem of knowledge extraction as combinations of data filtration, analysis and exploration methods

Unit 1 - Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed, Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Introduction to R.

Unit 2 - Data Analysis and Basic Tools: Exploratory Data Analysis (EDA) and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: Real Direct (online real estate firm), Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means - Feature Generation and Feature Selection (Extracting Meaning From Data).

Unit 3 - Feature Extraction: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

Unit 4 - Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine.

Unit 5 - Dimensionality Reduction: Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system

Current Streams of thought: Recent Trends in Data Science: Sequence to Sequence Models in PyTorch, Deep Learning for Real-Time Streaming Data with Kafka and Tensor Flow, Programming with Data: Python and Pandas.

Text Book

1. Cathy O'Neil and Rachel Schutt. *Doing Data Science*, Straight Talk from the Frontline. O'Reilly Edition, 2014.
2. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016.

References

1. Jure Leskovek, Anand Rajaraman and Jerey Ullman. *Mining of Massive Datasets*. v2.1, Cambridge University Press. 2014. (free online)
2. Kevin P. Murphy. *Machine Learning*: *A Probabilistic Perspective.* ISBN 0262018020. 2013.
3. Foster Provost and Tom Fawcett. *Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking*. ISBN 1449361323. 2013.
4. *The Data Science Handbook*, Field Cady John Wiley & Sons, Incorporated, 2017

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1. VERSION 3: *An Introduction to Data Science*, Jeffrey Stanton, Syracuse University https://docs.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit?pli=1

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	1	3	2			2	3		2	1	1			2	2
CO2			1	1			2	3	3	2	1		1	2	3	3	3	
CO3	2	3	3	1		2	2	2		3	3	3			2	3	3	2
CO4			3	3		2	3	2	3		3	3	3			3	3	
CO5	3	1	1	2	3	3		2	3	3	3			1	2	1	2	3

Semester	19PDSC102: Advanced Data Base Management Systems	L	T	P	C
I		5	0	0	5

Learning Objective (LO):

LO1	To understand the basic concepts and terminology related to DBMS and Relational Database Design
LO2	To the design and implement Distributed Databases.
LO3	To Acquire Knowledge of Database Models.
LO4	To understand distributed database architecture.
LO5	To learn the concepts of spatial database

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Know about the Various data models. Understand the E R model and relational model. Apply normalization techniques
CO2	Works on Database Architecture
CO3	Know about the Distributed and Object based Databases Analyze data patterns
CO4	Understand and apply the key concepts and techniques applicable to
CO5	Know about the Spatial Database, Temporal Database, Multimedia Database and XML Databases

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

Unit 2 - Distributed and Object based Databases: Architecture, Distributed data storage, Distributed transactions, Commit protocols, Concurrency control, Query Processing. Complex Data Types, Structured Types and Inheritance, Table Inheritance, array and Multiset, Object Identity and Reference Types, Object Oriented versus Object Relational.

Unit 3 - Spatial Database: Spatial Database Characteristics, Spatial Data Model, Spatial Database Queries, Techniques of Spatial Database Query, Logic based Databases: Introduction, Overview, Propositional Calculus, Predicate Calculus, Deductive Database Systems, Recursive Query Processing.

Unit 4 - XML Databases: XML Hierarchical data model, XML Documents, DTD, XML Schema, XML Querying, XHTML, Illustrative Experiments

Unit 5 - Temporal Databases: Introduction, Intervals, Packing and Unpacking Relations, Generalizing the relational Operators, Database Design, Integrity Constraints, Multimedia Databases: Multimedia Sources, Multimedia Database Queries, Multimedia Database Applications.

Current Streams of thought: Case Studies: Postgre SQL - Introduction - User Interfaces - SQL Variations and Extensions - Transaction Management in Postgre SQL - Storage and Indexing - Query Processing and Optimization - System Architecture.

Text Book

1. Abraham Silberschatz, Henry F Korth , S Sudarshan, "*Database System Comcepts*", 6th edition , McGraw-Hill International Edition , 2011
2. C.J.Date, A.Kannan, S.Swamynathan, "*An Introduction to Database Systems*", 8th Edition, Pearson Education Reprint 2016.

References

1. Ramez Elmasri, Shamkant B Navathe, "*Fundamental of Database Systems*", Pearson, 7th edition 2016.
2. Thomas Connolly, Carolyn Begg., "Database *Systems a practical approach to Design, Implementation and Managemen*t ", Pearson Education, 2014.
3. *Advanced Database Management System* by Rini Chakrabarti and Subhash K., Dreamtech Press India Pvt. Ltd, 2017

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http://www.lincoste.com/ebooks/english/pdf/computers/database_management_systems.pdf

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	3	3			3	2		3	1	2			3	3
CO2				2			3	3	3	1	3		1	2	3			
CO3	3	2	3	3		1	3	2		1		3			3	3		3
CO4			3				3	2			2	3	1			2	3	
CO5		3			2		1			2				3			1	

Semester	19PDSC103: Advanced Java Programming	L	T	P	C
I		5	0	0	5

Learning Objective (LO):

LO1	To deepen student's programming skills by analyzing the real world problem in a programmer's point of view and implement the concepts in real time projects.
LO2	Students will use such streams for file processing as well as client/server communications tasks.
LO3	Students will develop sophisticated, interactive user interfaces using the Java Swing class and appropriate layout managers. Students will also be exposed to advanced topics including multithreading, internet networking, and JDBC database connectivity
LO4	Design and Develop various application by Integrating any of Servlets, JSPs, Swing and Applet using Database, RMI, Spring, Hibernate by analyzing requirements and evaluating existing system.
LO5	Learn the Internet Programming, using Java Applets. Create a full set of UI widgets and other components, including windows, menus, buttons, checkboxes, and text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings. Apply event handling on AWT and Swing components.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Learn the Internet Programming, using Java Applets and create a full set of UI widgets using Abstract Windowing Toolkit (AWT) & Swings
CO2	Learn to access database through Java programs, using Java Data Base Connectivity (JDBC)
CO3	Create dynamic web pages using Servlets and JSP
CO4	Invoke the remote methods and multitier application using Remote Method Invocation (RMI) and EJB
CO5	Learn to access database through Java programs, using Java Data Base Connectivity (JDBC). Create dynamic web pages, using Servlets

UNIT 1 - Design Patterns: Introduction to Design patterns - Catalogue for Design Pattern - Factory Method Pattern, Prototype Pattern, Singleton Pattern- Adapter Pattern- Proxy Pattern- Decorator Pattern- Command Pattern- Template Pattern- Mediator Pattern-Collection

Framework – Array List class – Linked List class – Array List vs. Linked List - List Iterator interface - Hash Set class- Linked Hash Set class-Tree Set class Priority Queue class - Map interface-Hash Map class- Linked Hash Map class –Tree Map class - Comparable interface - Comparator interface-Comparable vs. Comparator

UNIT 2 - Applet Fundamentals: Applet Class - Applet lifecycle- Steps for Developing Applet Programs- Passing Values through Parameters- Graphics in Applets- GUI Application **-** Dialog Boxes - Creating Windows - Layout Managers – AWT Component classes – Swing component classes- Borders – Event handling with AWT components - AWT Graphics classes - File Choosers - Color Choosers – Tree – Table –Tabbed panels–Progressive bar - Sliders.

UNIT 3 – JDBC: Introduction - JDBC Architecture - JDBC Classes and Interfaces – Database Access with MySQL -Steps in Developing JDBC application - Creating a New Database and Table with JDBC - Working with Database Metadata; Java Networking Basics of Networking - Networking in Java- Socket Program using TCP/IP - Socket Program using UDP- URL and Inet address classes.

UNIT 4 - Servlet: Advantages over Applets - Servlet Alternatives - Servlet Strengths - Servlet Architecture - Servlet Life Cycle – Generic Servlet, Http Servlet - First Servlet - Invoking Servlet - Passing Parameters to Servlets - Retrieving Parameters - Server-Side Include – Cookies- JSP Engines - Working with JSP - JSP and Servlet - Anatomy of a JSP Page- Database Connectivity using Servlets and JSP.

UNIT 5 - Lambda Expressions- Method Reference- Functional Interface- Streams API, Filters- Optional Class- Nashorn- Base 64 Encode Decode- JShell(RPEL)- Collection Factory Methods- Private Interface Methods- Inner Class Diamond Operator- Multi resolution Image API

Current Streams of thought: Current Trends in Java Technology towards IoT, Cloud and Mobile App Development.

Text Book

1. Bert Bates, Karthy Sierra , Eric Freeman, Elisabeth Robson, "*Head First Design Patterns*", O'REILLY Media Publishers.(1st-Unit).
2. Herbert Schildt, "*Java: A Beginner Guide*", Oracle Pres-Seventh Edition. (2nd and 3rd Unit).
3. Murach's, "*Java Servlets and JSP*", 2nd Edition, Mike Murach & Associates Publishers; 3rd Edition. (4th Unit).
4. Warburton Richard, "*Java 8 Lambdas*", Shroff Publishers & Distributors Pvt Ltd. (5th Unit).

References

1. Paul Deitel and Harvey Deitel, "*Java: How to Program*", Prentice Hall Publishers; 9th Edition.
2. Jan Graba, "*An Introduction to Network Programming with Java-Java 7 Compatible*", 3rd Edition, Springer.

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1. http://greenteapress.com/thinkapjava/thinkapjava.pdf

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		3	2	3	2		1	3	3		2	3	2			3	1
CO2				3			1			3	2		3			2		
CO3	2	3	3	3		3	3	1		3		1			3	1		3
CO4			3		3	3	1	3			3	3	2				1	3
CO5	3	3	3	2		3	1	3			3	1	2		3	3		

Semester	19PDSC104: Advanced Web Technology	L	T	P	C
I		5	0	0	5

Learning Objective (LO):

LO1	Define the fundamental ideas and standards underlying Web Service Technology
LO2	Explore the backbone of web page creation by developing .NET skill.
LO3	Enrich knowledge about HTML control and web control classes
LO4	Understand the need of usability, evaluation methods for web services.
LO5	The basics of the asp.net programming with the introduction of .NET framework and NET class framework with some programming variables, data types, object-oriented terminology, creating objects and classes, overloading methods, constructors, shared methods and more.

Course Outcomes (CO)

CO1	Design a web page with Web form fundamentals and web control classes
CO2	Recognize the importance of validation control, cookies and session
CO3	Apply the knowledge of ASP.NET object, ADO.NET data access & SQL to develop a C/S model.
CO4	Recognize the difference between Data list and Data grid controls in accessing data.
CO5	Differentiate the major frameworks allowing to develop web services and cloud applications and assess their suitability for specific usage scenarios

Unit 1 - OVERVIEW OF ASP.NET - The .NET framework – Learning the .NET languages : Data types – Declaring variables- Scope and Accessibility- Variable operations- Object Based manipulation- Conditional Structures- Loop Structures- Functions and Subroutines. Types, Objects and Namespaces : The Basics about Classes- Value types and Reference types- Advanced class programming- Understanding name spaces and assemblies. Setting Up ASP.NET and IIS .

Unit 2 - Developing ASP.NET Applications - ASP.NET Applications: ASP.NET applications– Code behind- The Global.asax application file- Understanding ASP.NET Classes- ASP.NET Configuration. Web Form fundamentals: A simple page applet- Improving the currency converter- HTML control classes- The page class- Accessing HTML server controls. Web controls: Web Control Classes – Auto Post Back and Web Control events- Accessing web controls. Using Visual Studio.NET: Starting a Visual Studio.NET Project- Web form Designer- Writing code- Visual studio.NET debugging. Validation and Rich Controls: Validation- A simple Validation example- Understanding regular expressions- A validated customer form. State management - Tracing, Logging, and Error Handling.

Unit 3 - Working with Data - Overview of ADO.NET - ADO.NET and data management- Characteristics of ADO.NET-ADO.NET object model. ADO.NET data access : SQL basics– Select , Update, Insert, Delete statements- Accessing data- Creating a connection- Using a command with a Data Reader - Accessing Disconnected data - Selecting multiple tables – Updating Disconnected data. Data binding: Single value Data Binding- Repeated value data binding- Data binding with data bases. Data list – Data grid – Repeater – Files, Streams and Email – Using XML

Unit 4 - Web Services - Web services Architecture : Internet programming then and now- WSDL–SOAP- Communicating with a web service-Web service discovery and UDDI. Creating Web services : Web service basics- The Stock Quote web service – Documenting the web service- Testing the web service- Web service Data types- ASP.NET intrinsic objects. Using web services: Consuming a web service- Using the proxy class- An example with Terra Service.

Unit 5 - Advanced ASP.NET - Component Based Programming: Creating a simple component – Properties and state- Database components- Using COM components. Custom controls: User Controls- Deriving Custom controls. Caching and Performance Tuning: Designing and scalability– Profiling- Catching- Output catching- Data catching. Implementing security: Determining security requirements- The ASP.NET security model- Forms authentication- Windows authentication.

Current Streams of thought: Recent Trends: AMP Is A New Norm, The Arrival Of Progressive Web Apps (PWA), RAIL Concept On The Rise.

Textbooks

1. Mathew Mac Donald, "*ASP.NET Complete Reference*", TMH 2005.

References

1. Crouch Matt J, "*ASP.NET and VB.NET Web Programming*", Addison Wesley 2002.
2. J.Liberty, D.Hurwitz, "*Programming ASP.NET*", Third Edition, O'REILLY, 2006.

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1. https://ptgmedia.pearsoncmg.com/images/9780735643383/samplepages/9780735643383.pdf

OUTCOME MAPPING

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	1	3	2	1			3	2		3	2	3			3	3
CO2			3	1			3	3		1	3		2	3	2	3	3	
CO3	1	3		2		3	1	3			3	2			3	3		2
CO4			2	3		1		3	2			3	2			3	2	
CO5	2				3				1	3				1				

Semester	19PDSP105: RDBMS Lab	L	T	P	C
I		0	0	2	2

Learning Objective (LO):

LO1	Keep abreast of current developments to continue their own professional development.
LO2	To engage themselves in lifelong learning of Database management systems theories and technologies this enables them to purse higher studies.
LO3	To interact professionally with colleagues or clients located abroad and the ability to overcome challenges that arises from geographic distance, cultural differences, and multiple languages in the context of computing.
LO4	Develop team spirit, effective work habits, and professional attitude in written and oral forms, towards the development of database applications.
LO5	The major objective of this lab is to provide a strong formal foundation in database concepts, technology and practice to the participants to groom them into well-informed database application developers.

Course Outcomes (CO)

CO1	Understand, appreciate and effectively explain the underlying concepts of database technologies. Design and implement a database schema for a given problem-domain. Normalize a database.
CO2	In drawing the ER, EER, and UML Diagrams. In analyzing the business requirements and producing a viable model for the implementation
CO3	In converting the entity-relationship diagrams into relational tables.
CO4	To develop appropriate Databases to a given problem that integrates ethical, social, legal, and economic concerns.
CO5	Populate and query a database using SQL DML/DDL commands. Programming PL/SQL including stored procedures, stored functions, cursors, packages.

List of Exercises

Cycle-I:

(Simple SQL)

1. Employee Management System Using SQL Commands.
2. Students Management System Using SQL Commands.
3. Bank Management System Using SQL Commands.
4. Index Creation.
5. Implementation of SQL queries for route database.
6. Implementation of SQL queries for route database - part I.
7. Implementation of SQL queries for route database - Part II.
8. Creating view using SQL commands.
9. Creation of Table Partition.
10. Default trigger procedure and drop command
11. Report creation.

Cycle-II:

(PL/SQL)

12. Factorial of number
13. Checking whether a number is prime or not
14. Fibonacci series
15. Reversing the string
16. Swapping of two numbers
17. Odd or even number
18. Duplication of records

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		2		3				2	3		1	2	3			3	3
CO2			3	2	3	2	3	1		3				3		2	3	
CO3	1	3		3		2	3	1			3	1			3			2
CO4			2	3		1		3	2	3		1	3			1	3	
CO5		3		2	3		3		2	1	3			3		1		1

Semester	19PDSP106: Advanced Web Technology Lab	L	T	P	C
I		0	0	2	2

Learning Objective (LO):

LO1	To understand the concept of web technologies
LO2	To understand the importance of cascade style sheets in creating a web application
LO3	To understand the importance of Java Script in creating a web Application
LO4	To understand the use of XML in Document type Definition
LO5	To know about PHP scripts and create adaptive web pages

Course Outcomes (CO)

CO1	Develop to build a complete website using HTML.
CO2	Create web pages using DHTML and Cascading Style Sheets.
CO3	Able to include JavaScript for form validations and email validations.
CO4	Develop a simple web application using server side PHP programming and Database Connectivity using MySQL.
CO5	Able to create a complete Web Application with all the required modules.

List of Exercises

- Write a HTML Program for using Image, Link and Formatting tags.
- Write a HTML Program to using table tag of your class Time table.
- Write a Forms in Html
- Write a HTML program to illustrate Frame tag..
- Write a HTML program to describe the cascade style sheet.
- Write a program to Document Type Definition in XML.
- Write a program For Validation using JavaScript.
- Write a Calculator program in Java script.
- Write a program for Multiplication table using Java script.
- Connection in My sql with php
- Insert record in mysql with php
- Create, Insert, Delete, Edit in mysql with php

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		2		3				3	2		3	3	1			3	1
CO2			3	2	3	1	3	1		3				2		3	1	
CO3	1	3		2		3	1	3			3	1			3			2
CO4			3	3		3		1	3	2		3	2			3	2	
CO5			1	3		3		3	2	3		2	3			3	1	

Semester	19PDSC201: Distributed Operating System	L	T	P	C
II		5	0	0	5

Learning Objective (LO):

LO1	To study distributed operating system concepts
LO2	To understand hardware, software and communication in distributed OS
LO3	To learn the distributed resource management components.
LO4	Practices to learn concepts of OS and Program the principles of Operating Systems
LO5	To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems. To know about Shared Memory Techniques.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Understand the different Distributed Systems and the challenges involved in Design of the Distributed Systems.
CO2	Knowledge on mutual exclusion and Deadlock detection of Distributed operating system.
CO3	Able to design and implement algorithms of distributed shared memory and commit protocols Understand how computing power is created and synchronized in Distributed systems
CO4	Able to design and implement fault tolerant distributed systems. Have Sufficient knowledge about file access, Synchronization and Deadlock.
CO5	Learn how to store data in Distributed File System. Understand How Distributed Shared Memory is managed.

UNIT 1 - Introduction – Operating System Definition – Functions of Operating System – Types of Advanced Operating System – Design Approaches – Synchronization Mechanisms – concepts of a Process – Critical Section Problem – Process Deadlock – Models of Deadlock – Conditions for Deadlock – System with single-unit requests, Consumable Resources , Reusable Resources.

UNIT 2 - Distributed Operating Systems: Introduction- Issues – Communication Primitives – Inherent Limitations –Lamport's Logical Clock , Vector Clock, Global State , Cuts – Termination Detection – Distributed Mutual Exclusion – Non Token Based Algorithms – Lamport's Algorithm - Token Based Algorithms –Distributed Deadlock Detection – Distributed Deadlock Detection Algorithms – Agreement Protocols

UNIT 3 - Distributed Resource Management – Distributed File Systems – Architecture – Mechanisms – Design Issues – Distributed shared Memory – Architecture – Algorithm – Protocols – Design Issues – Distributed Scheduling – Issues – Components – Algorithms.

UNIT 4 - Failure Recovery and Fault Tolerance – Concepts – Failure Classifications – Approaches to Recovery – Recovery in Concurrent Systems – Synchronous and Asynchronous Check pointing and Recovery –Check pointing in Distributed Database Systems – Fault Tolerance Issues – Two-Phase and Non blocking Commit Protocols – Voting Protocols – Dynamic Voting Protocols.

UNIT 5 - Multiprocessor and Database Operating Systems –Structures – Design Issues – Threads – Process Synchronization – Processor Scheduling – Memory management – Reliability/Fault Tolerance – Database Operating Systems – concepts – Features of Android OS, Ubuntu, Google Chrome OS and Linux operating systems.

Current Streams of thought: Case study - Windows 7- History - Design Principles - System Components - Terminal Services and Fast User Switching - File System - Networking - Programmer Interface - Android - Overview of Android Operating System - The Android ecosystem - Android Architecture - Android Versioning.

Text Book

1. Mukesh Singhal N.G.Shivaratri, "*Advanced Concepts in Operating Systems*", McGraw Hill 2000.
2. *Distributed Operating Syste*m – Andrew S. Tanenbaum, PHI.

References

1. Abraham Silberschatz, Peter B.Galvin, G.Gagne, "*Operating Concepts*", 6th Edition Addison Wesley publications 2003.
2. Andrew S.Tanenbaum, "*Modern Operating Systems*", 2nd Edition Addison Wesley 2001
3. *Distributed Systems*, 3rd Edition , Maarten van Steen, Andrew S. Tanenbaum ,CreateSpace Independent Publishing Platform; 3.01 edition (February 1, 2017)

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1. https://www.cs.swarthmore.edu/~newhall/readings/p419-tanenbaum.pdf
2. https://davarpanahjazi.iut.ac.ir/sites/davarpanahjazi.iut.ac.ir/files//u125/distribute_os-tanenbaum.pdf
3. https://www.distributed-systems.net/index.php/books/distributed-systems/

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	1	3	2			2	3		2	1	1			2	2
CO2			3	3		2	3	2	3		3	3	3			3	3	
CO3	2	3	3	1		2	2	2		3	3	3			2	3	3	2
CO4		1	1			2	3	3	2	1		1	2	3	3	3	1	1
CO5	3	1	1	2	3	3		2	3	3	3			1	2	1	2	3

Semester	19PDSC202: Dot Net Programming	L	T	P	C
II		5	0	0	5

Learning Objective (LO):

LO1	To explore the backbone of web page creation by developing .NET skill.
LO2	To Familiar with Application, session and view state management
LO3	To Provide depth knowledge about ADO.NET
LO4	To Understand the need of usability, evaluation methods for web services
LO5	To acquire knowledge on the usage of recent platforms in developing web applications

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Learn major programming paradigms and techniques involved in design and implementation of modern programming languages.
CO2	Learn about Microsoft .NET framework
CO3	By the end students can develop, implement and creating Applications with C#. VB.NET and ASP.NET
CO4	Creating ASP.Net applications using standard .net controls.
CO5	An ability to use current techniques, skills, and tools necessary for computing practice.

Unit 1 - The .NET Framework - Learning the .NET languages - Introduction - Net revolution - .Net framework and its architecture – CLR – What is Assembly – Components of Assembly – DLL hell and Assembly Versioning- O Objects and Namespaces - Setting Up ASP.NET and IIS

Unit 2 - Developing VB.NET Applications - Introduction to VB.Net, The .Net Frame work and Common language runtime, Building VB. Net Application, VB IDE, forms, properties, events, VB language-console application and 46 windows application, data type, declaring variable, scope of variable, operators and statements - Windows Applications-forms, adding controls to forms, handling events, MsgBox, Input Box, multiple forms, handling mouse and Keyboard events, object oriented programming creating and using classes and objects, Handling Exceptions- on Error Goto

Unit 3 - Developing - ASP.NET Applications - ASP.NET Applications – Understanding ASP.NET Controls - Overview of ASP.NET framework, Web Form fundamentals - Web control classes – Using Visual Stdio.NET - Validation and Rich Controls -State management – Tracing, Logging, and Error Handling.

Unit 4 - Developing C#.NET Applications - Introducing C# - overview of C# - Literals, Variables- Data Types, -Operators, -checked and unchecked operators – Expressions – Branching -Looping-*Object Oriented Aspects Of C#:* Class – Objects - Constructors and its types- inheritance, properties, indexers, index overloading – polymorphism - sealed class and methods - interface, - abstract class, operator overloading, - delegates, events, errors and exception - Threading.

Unit 5 - ADO.NET - Overview of ADO.NET - ADO.NET data access – Connected and Disconnected Database, Create Connection using ADO.NET Object Model, Connection Class, Command Class Data binding – Data list – Data grid – Repeater – Files, Streams and Email – Using XML.

Current Streams of thought: DATA SET Creating Tables in Dataset- Updating, Inserting and Modification in Data Table - Saving Changes into Data Base using Command Builder -Working With Command and Connection - CONNECTIONS AND COMMAND OBJECT Connection Object - Command Object - Execute Non Query - Execute Scalar - DATA READER Reading Data in Connected Environment - Moving and Accessing Value of Record - Execute Reader - DATAGRIDVIEW & DATA BINDING Row State Filter and Sort Property - Update records via a Data grid view - Insert records via a Data grid view - Delete records via a Data grid view - TRANSACTION Introduction of Transaction (ACID) - Transaction Class - Method and Property - Commit and Rollback.

Text Book

1. Struts: *The Complete Reference*, James Holmes 2nd Edition 2007 McGraw Hill Professional
2. Mathew Mac Donald, "*ASP.NET Complete Reference*", TMH 2005

3. Herbert Schildt, "*The Complete Reference: C# 4.0*", Tata McGraw Hill, 2012. Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012
4. *ASP.NET Unleashed, C# programming* – Wrox publication
5. *Visual Basic. NET Black Book*, by Steven Holzner

References

1. Jesse Liberty , '*Programming C#,* " , 4th Edition, O'Reilly Media.
2. Mario Szpuszta, Matthew MacDonald , "*Pro ASP.NET 4 in C#* "2010: Includes Silverlight ,"Apress, Third Edition
3. J.Liberty, D.Hurwitz, "*Programming ASP.NET*", Third Edition, O'REILLY, 2006.
4. *Visual Basic. Net programming in easy steps* by Tim Anderson,
5. *Dot Net Programming*, Second Edition, Prajakta Mane,2016

Website- E-Learning Resources

1. https://www.introprogramming.info/wp-content/uploads/2013/07/Books/CSharpEn/Fundamentals-of-Computer-Programming-with-CSharp-Nakov-eBook-v2013.pdf

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	1	3	3	3	3			2	3		3	1	2			3	3
CO2				2			3	3	3	1	3		1	2	3			
CO3	3	1	3	1		3	3	1		1		3			3	3		3
CO4			3				3	2			2	3	1			2	3	
CO5		3			2		1			2				3			1	

Semester	19PDSC203: Data Science With R Programming	L	T	P	C
II		5	0	0	5

Learning Objective (LO):

LO1	To provide an overview of a new language R used for data science and to introduce students to the R programming environment and related eco-system and thus provide them with an in demand skill-set, in both the research and business environments.
LO2	To demonstrate usage of as standard Programming Language.
LO3	To familiarize students with how various statistics like mean median etc. can be collected for data exploration in R and enable students to use R
LO4	Understand the basics in R programming in terms of constructs, control statements, string functions
LO5	Able to appreciate and apply the R programming from a statistical perspective and create and edit visualizations with R

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Install and use R for simple programming tasks.
CO2	Extend the functionality of R by using add-on packages and extract data from files and other sources and perform various data manipulation tasks on them.
CO3	Code statistical functions in R and use R Graphics and Tables to visualize results of various statistical operations on data.
CO4	Apply the knowledge of R gained to data Analytics for real life applications. to conduct analytics on large real life datasets.
CO5	Analyse the use of basic functions of R Package. Demonstrate exploratory data analysis (EDA) for a given data set. Implement and assess relevance and effectiveness of machine learning algorithms for a given dataset.

Unit 1 - Overview and Preliminaries: Basic Features of R - Design of R System-Limitations of R – Installation – R studio - Getting started with R interface - Entering Input - R Objects – Attributes - Creating Vectors - Mixing Objects – Matrices – Lists – Factors - Data Frames.

Unit 2 - Input, Output, Reading and Subsetting: Reading Data Files - Reading in Larger Datasets - Calculating Memory Requirements - File Connections - Reading Lines of a Text File - Reading From a URL Connection - Subsetting a Vector - Subsetting a Matrix - Subsetting Lists - Subsetting Nested Elements of a List - Extracting Multiple Elements of a List - Partial Matching. Date, Time and Managing Data Frames Operations on Dates and Times - Data Frames - dplyr Package - Installing the dplyr package – select – filter – arrange – rename – mutate - group_by - pipeline operator.

Unit 3 - Control Structures and Loop Functions: if-else - for Loops - Nested for loops - while Loops - repeat Loops - next, break - Looping on the Command Line - lapply() - sapply() - split() - Splitting a Data Frame – tapply - apply() - Col/Row Sums and Means - mapply() - Vectorizing a Function.

Unit 4 - Statistics functions: Debugging, Profiling, Mean - Median - variance of the population - Estimated standard deviation - Standard scores – Sort – Rank – summary function - Debugging Tools in R - traceback() - debug() - recover() - Using system.time() - Timing Longer Expressions - The R Profiler - Using summaryRprof().

Unit 5 - Simulation and Graphs: Generating Random Numbers - Setting random number seed - Simulating Linear Model - Loading and Processing Raw Data – Creating a Graph - density plots - dot plots, bar charts - line charts - pie charts - box plots - Scatter plots.

Current Streams of thought: Application – Exploratory Data Analysis Introduction to EDA - Questions - Variation- Missing values - Covariation- Patterns- & Models Ggplot2 calls

Text Book

1. Roger D. Peng, "*R Programming for Data Science*", Lean Publishing, (2015), ISBN: 9781365056826, 1365056821.

References

1. Winston Chang, "*R Graphics Cookbook*", O'Reilly Media, Inc., (2012), ISBN: 9781449363086.
2. *Using R for Introductory Statistics* by John Verzani, CRC Press, 2004.
3. *Hands-on programming with R*, Garrett Grolemund, O'Reilley, 1st Edition, 2014
4. *R for everyone,* Jared Lander, Pearson, 1st Edition, 2014
5. *Statistics : An Introduction Using R*, Michael J. Crawley, WILEY, Second Edition, 2015.

Website- E-Learning Resources

1. *https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdfing.pdf*

2. Wickham, H. & Grolemund, G. (2018). for Data Science. O'Reilly: New York. Available for free at http://r4ds.had.co.nz

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2		3	1	3			3	1	2		3	3		
CO2				3			1			3	2		3			2		
CO3	2	3	3	3		3	3	1		3		1			3	1		3
CO4			3		3	3	1	3			3	3	2				1	3
CO5	3		3	2	3	2		1	3	3		2	3	2			3	1

Semester	19PDSP204: Dot Net Programming Lab	L	T	P	C
II		0	0	2	2

Learning Objective (LO):

LO1	To impart basic knowledge of different control statements and array associated with C # programming.
LO2	To learn various C# elements and OOPS concepts.
LO3	To learn interface, delegates, event and error handling concepts in C#.
LO4	To impart knowledge on networking including socket programming and reflection.
LO5	To acquire a working knowledge of windows and web based applications.

Course Outcomes (CO)

CO1	Develop correct, well-documented C# programs using control statements.
CO2	Develop object oriented programming using C# classes and objects.
CO3	Handle the exception and event-driven programs.
CO4	Perform network based programming including chat applications.
CO5	Develop windows and web based applications.

List of Exercises

1. Finding Prime number using Classes and Objects
2. Separating Odd/Even Number into Different Arrays
3. String Manipulations
4. Jagged Array manipulation
5. Implementing ‘ref’ and ‘out’ keywords
6. Implementing ‘Params ’ keyword
7. Boxing and Unboxing
8. Constructor Overloading
9. Implementing property

10. Implementing indexer
11. Implementing Multiple inheritance using Interface
12. Implementing Abstract Class
13. Exception Handling Using Try, Catch, and Finally
14. Demonstrating multicast Delegates
15. Implementing the Concept of Reflection
16. Socket Programming
17. Simple Calculator-A Window Application
18. Student Profile-A Window Application
19. Palindrome-A Web Application
20. Formatting Text-A Web Application

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		2		3				2	3		1	2	3			3	3
CO2			3	2	3	2	3	1		3				3		2	3	
CO3	1	3		3		2	3	1			3	1			3			2
CO4			2	3		1		3	2	3		1	3			1	3	
CO5		3		2	3		3		2	1	3			3		1		1

Semester	19PDSP205: R Programming for Data Analytics - Lab	L	T	P	C
II		0	0	2	2

Learning Objective (LO):

LO1	To understand and be able to use the basic programming principles
LO2	To understand data types, variable, conditionals, loops, array, recursion and function calls.
LO3	To learn how to use basic mathematical problems are evaluated and be able to manipulate text files.
LO4	To learn how to use file operations.
LO5	To understand the process and will acquire skills necessary to effectively attempt a programming problem and implement it with a specific programming language - R.

Course Outcomes (CO)

CO1	Understand and summarize different operations in R.
CO2	Understand and summarize different File handling operations in R.
CO3	Design and develop Client Server network applications using R.
CO4	Develop a simple recursion and function calls using R
CO5	Able to create a complete required modules using R

List of Exercises

Cycle – I

1. R Program to check if a Number is Positive, Negative or Zero.
2. R program to check prime numbers.
3. R Program to check Armstrong Number.
4. R Program to Find Hash of File.
5. R Program to Root search.

Cycle – II

6. Factorial of number
7. Fibonacci series
8. Reversing the string
9. Swapping of two numbers
10. Odd or even number
11. Duplication of records
12. Convert Decimal into Binary using Recursion.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		1		3				3	2		3	3	1			3	1
CO2			2	2	3	2	3	1		3				2		3	1	
CO3	3	1		2		3	1	3			3	1			3			2
CO4			3	3		2		1	2	2		3	2			3	2	
CO5			1	3		3		3	2	3		1	3			3	2	

Semester	19PDSC301: Cryptography and Network Security	L	T	P	C
III		5	0	0	5

Learning Objective (LO):

LO1	To know about the malicious software & firewalls.
LO2	To understand Cryptography Theories, Algorithms, Techniques and Systems.
LO3	To know the various cryptographic operations.
LO4	To understand necessary Approaches to build protection mechanisms in order to secure computer networks.
LO5	To Understand the various Authentication Applications.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Understand the fundamentals of networks security, security Architecture, threats and vulnerabilities
CO2	Apply the different cryptographic operations of symmetric cryptographic algorithms
CO3	Apply the different cryptographic operations of public key cryptography
CO4	Apply the various Authentication schemes to simulate different applications.
CO5	Understand various Security practices and System security standards

Unit 1 - Introduction - Security trends – Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies – Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption

techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

Unit 2 - Symmetric Encryption and Message Confidentiality - Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Stream Ciphers and RC4 , Cipher Block Modes of Operation, Location of Encryption Devices, Key Distribution. Public-key Cryptography and Message Authentication: Approaches to Message Authentication, Secure Hash Functions and HMAC, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures, Key Management.

Unit 3 - Authentication Applications - Kerberos, x.509 Authentication Service, Public-Key Infrastructure. Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME.

Unit 4:

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

Unit- 5:

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

Current Streams of thought: Applications Security, Data Loss Prevention, E-mail Security, Mobile Device Security, Web Security.

Text Book

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

References

1. Tatiana Hodorogea, "*Cryptography & Network Security", (2020), 2nd Edition, Excelic Press*
2. Stallings, "*Cryptography and Network Security*", (2019), 7th Edition, Pearson India.
3. Sai Huda, " *Next Level Cyber Security": Detect the signals, Stop the Hack,* (2017) Create Space Independent Publishing Platform.
4. e-book link: Http://Nptel.Ac.In/.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3				3		2		3			1		3			3	
CO2			3		2		3			2			3	1		3	3	
CO3	3			2		3		3		1	3		2		3			
CO4		3		2				3	2		3	1	3			3		
CO5	1		3	2		3		1	3		1	3	1		3	2		

Semester	19PDSC302: Data Analytics Using Python	L	T	P	C
III		5	0	0	5

Learning Objective (LO):

LO1	To introduce the programming concepts and techniques.
LO2	To introduce the Python language syntax.
LO3	To learn control statements, loops, functions, and lists.
LO4	To write programs for problems in mathematics, science, Finance, games.
LO5	To analyze and design programs.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Analyze and design strategies for solving basic programming problems.
CO2	Primitive data types, selection statements, loops, functions to write programs.
CO3	Develop programs to solve a variety of problems in math, science, business, and games.
CO4	Use the step-wise refinement approach.
CO5	Use lists to store, process, and sort data.

Unit 1 - Algorithmic Problem Solving: Algorithms, Building Blocks Of Algorithms (Statements, State, Control Flow, Functions), Notation (Pseudo Code, Flow Chart, Programming Language), Algorithmic Problem Solving. Simple Strategies For Developing Algorithms (Iteration, Recursion). Illustrative Problems: Find Minimum In A List, Insert A Card In A List Of Sorted Cards, Guess An Integer Number In A Range, Towers Of Hanoi.

Unit 2 - Python Introduction: Python Interpreter And Interactive Mode; Values And Types: Int, Float, Boolean, String, And List; Variables, Expressions, Statements, Tuple Assignment, Precedence Of Operators, Comments; Modules And Functions, Function Definition And Use, Flow Of Execution, Parameters And Arguments; Illustrative Programs: Exchange The Values Of Two Variables, Circulate The Values Of N Variables, Distance Between Two Points.

Unit 3 - Conditionals: Boolean Values And Operators, Conditional (If), Alternative (If-Else), Chained Conditional (If-Elif-Else); Iteration: State, While, For, Break, Continue, Pass; Fruitful Functions: Return Values, Parameters, Local And Global Scope, Function Composition, Recursion; Strings: String Slices Immutability, String Functions And Methods, String Module; Lists As Arrays. Illustrative Programs: Square Root, GCD, Exponentiation, Sum An Array Of Numbers, Linear Search, Binary Search.

Unit 4 - Lists: List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple As Return Value; Dictionaries: Operations And Methods; Advanced List Processing – List Comprehension; Illustrative Programs: Selection Sort, Insertion Sort, Merge sort, Histogram.

Unit 5 - Files And Exception: Text Files, Reading And Writing Files, Format Operator; Command Line Arguments, Errors And Exceptions, Handling Exceptions, Modules, Packages; Illustrative Programs: Word Count, Copy File.

Current Streams of thought: Lambda Functions, comprehensions, Generators, Decorators, Hashability.

Text Book

1. Y. Daniel Liang "*Introduction to Programming Using Python"*, (2013) First Edition, Prentice Hall.

References

1. Zed A Shaw, "*Learn More Python 3 the Hard way*", (2020), First Edition, Pearson India.
2. Paul J. Deitel , *"Python for Programmers*", (2020), First Edition, Pearson India.
3. Harsh Basin, *"Python for Beginners" ,New Age International Private Ltd, (2019), First Edition.*
4. e-book Link: http://read.pudn.com/downloads666/ebook/2698270/Introduction%20to%20Programming%20Using%20Python.pdf

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	1	2	2	3	3	3			2		1	3	1	2	1		1
CO2	3	3										2	3	2	3	3	3	
CO3	2	3	3	1	3			2				3		3				2
CO4	3	2									3	3		3	3	3		3
CO5	2	3		3	2													

Semester	19PDSC303: Machine Learning	L	T	P	C
III		5	0	0	5

Learning Objective (LO):

LO1	To Understand the various Learning Methods.
LO2	To Learn about Machine Intelligence and Machine Learning applications
LO3	To implement and apply machine learning algorithms to real-world applications.
LO4	To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
LO5	To understand how to perform evaluation of learning algorithms and model selection.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO2	Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
CO3	Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised
CO4	Be able to design and implement various machine learning algorithms in a range of real-world applications.
CO5	Have a Good understanding of the Inverted Deduction and Resolution.

UNIT 1 - INTRODUCTION: - Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT 2 - NEURAL NETWORKS AND GENETIC ALGORITHMS : Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT 3 - BAYESIAN AND COMPUTATIONAL LEARNING: Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT 4 - INSTANT BASED LEARNING: K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

UNIT 5 - ADVANCED LEARNING: Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.

Current Streams of thought: Deep Generative Models, Monte Carlo Methods, Probabilistic Programming, Variation Auto Encoders

Text Book

1. Tom M. Mitchell, "*Machine Learning*", (2013), McGraw-Hill Education (India) Private Limited.

References

1. Christoph Molnar, " *Interpretable Machine Learning*", (2020), First Edition, Lulu.com
2. Emmanuel Ameisen, "*Building Machine Learning Powered Applications*", (2020), First Edition, Oreilly
3. Ciuseppe Bonaccorso, "*Mastering machine Learning Algorithms*", (2020), Second Edition, Packt.
4. e-book Link: https://1library.net/document/nzwn7glz-machine-learning-tom-mitchell-pdf.html

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2		3	1	3			3	1	2		3	3		
CO2				3			1			3	2		3			2		
CO3	2	3	3	3		3	3	1		3		1			3	1		3
CO4			3		3	3	1	3			3	3	2				1	3
CO5	3		3	2	3	2		1	3	3		2	3	2			3	1

Semester	19PDSP304: Data Analytics using Python Programming Lab	L	T	P	C
III		0	0	2	2

Learning Objective (LO):

LO1	To Identify the problem in File Handling and implement it with a specific programming language using Python.
LO2	To understand the basic programming principles such as data types, variable, conditionals, loops, array, recursion and function calls.
LO3	To learn how to use basic mathematical problems are evaluated and be able to manipulate text files and file operations.
LO4	To impart knowledge on networking including socket programming and reflection.
LO5	To understand the process of Dictionary keys and will acquire skills necessary to effectively attempt in Python programming

Course Outcomes (CO)

CO1	Understand and summarize different File handling operations in Python.
CO2	Design and develop Client Server network applications using Python.
CO3	Understand Mathematical Problems, Nested Lists concepts in Python
CO4	Perform network based programming including chat applications.
CO5	Design and Develop the Dictionary Key elements in Python

List of Exercises

1. Write a Python program to sum all the items in a list.
2. Write a Python program to get the largest number from a list.
3. Write a Python program to remove duplicates from a list.
4. Write a Python program to generate and print a list of first and last 5 elements where the values are square of numbers between 1 and 30 (both included)
5. Write a Python program to split a list into different variables.
6. Write a Python program to print a nested lists (each list on a new line) using the print() function.
7. Write a Python program to create a list with infinite elements.
8. Write a Python program to access dictionary keys element by index.
9. Write a Python program to remove duplicates from a list of lists.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		2	1	1		3	3		2	1	3		2			1	2
CO2	3	3	2	2		3				2		3		3		2	3	
CO3	3		2	1	1		3	3		2	1	3		2			1	2
CO4	3	3	2	2		3				2		3		3		2	3	
CO5		3		2	3		3		2	1	3			3		1		1

Semester	19PDSP305: Machine Learning Lab	L	T	P	C
III		0	0	2	2

Learning Objective (LO):

LO1	To understand and be able to use the basic programming principles
LO2	To implement the machine learning concepts and algorithms.
LO3	To expose the students in emerging technologies in the areas of machine learning.
LO4	To make use of Data sets in implementing the machine learning algorithms
LO5	To understand the basic patterns of machine learning

Course Outcomes (CO)

CO1	Understand and summarize different operations.
CO2	To identify the machine learning Techniques and algorithms.
CO3	Apply machine learning tools to build and evaluate predictors
CO4	To identify how machine learning use in computer algorithms to search for patterns in data.
CO5	Familiarize in using data patterns to make decisions and predictions with real-world examples.

List of Exercises

1. Reading and writing into .csv files
2. Implement the Find –S algorithm.
3. Implement the Candidate-Elimination algorithm.
4. Classify a sample using ID3 algorithm.
5. Build an artificial neural network by implementing backpropagation algorithm.
6. Construct the naïve Bayesian classifier for classification.
7. Construct a naïve Bayesian classifier and evaluate the classifier with accuracy, precision, and recall metrics
8. Applying EM algorithm for clustering using K-means algorithm.
9. Implement the k-Nearest Neighbour algorithm to classify the data set.
10. Implement the non-parametric Locally Weighted Regression algorithm.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	1		3	2		3		3	3	3	2	1		
CO2	1					3	3					1				3		
CO3	2	3	3		3						3	2				2		
CO4	2				3		2	1			3	2	3			3		
CO5			1	3		3		3	2	3		1	3			3	2	

Semester	19PDSC401: Big Data Analytics	L	T	P	C
IV		5	0	0	5

Learning Objective (LO):

LO1	To learn the concepts and datasets of big data analytics
LO2	To understand the methodologies of big data analysis.
LO3	To study mathematical and statistical concepts related to big data analysis.
LO4	To practice with modern computing big data technologies
LO5	To provide better understanding for applications of associated computing techniques like Hadoop and map

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Identify the characteristics of datasets for various applications.
CO2	To Select environment and methodologies for the applications.
CO3	To Solve problems associated with big data characteristics concepts.
CO4	To integrate mathematical and statistical tools with modern technologies like Hadoop and Map reduce
CO5	To Provide better solutions and develop applications to the problem associated with big data Techniques

Unit 1 - Introduction to Big Data: Introduction to Big Data Platform – Traits of Big data - Challenges of Conventional Systems - Web Data – Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

Unit 2 - Data Analysis: Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Neural Networks: Learning And Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees - Stochastic Search Methods.

Unit 3 - Mining Data Streams: Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

Unit 4 - Frequent Itemsets and Clustering: Mining Frequent Item sets - Market Based Model – Apriori Algorithm – Handling Large Data Sets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering High Dimensional Data – CLIQUE And PROCLUS – Frequent Pattern based Clustering Methods – Clustering in Non-Euclidean Space – Clustering for Streams and Parallelism.

Unit 5 - Hadoop and R for Visualization: Back ground and fundamentals-moving data in and out of Hadoop-data serialization-applying Map Reduce patterns to big data- streaming big data-integrating R and Hadoop for statistics and more-predictive analytics with Mahout- Hacking with Hive-Programming pipelines with pig – HBase- MySQL -NoSQL- RHadoop.

Current Streams of thought: Accessible Artificial Intelligence, Dark Data, Natural Language Processing, Hybrid Clouds, Edge Computing, Quantum Computing.

Text Book

1. Michael Berthold, David J. Hand, "*Intelligent Data Analysis*", (2007), Springer.

2. Anand Rajaraman and Jeffrey David Ullman, "*Mining of Massive Datasets*", (2012), Cambridge University Press.

References

1. David Stephenson, "*Big Data Demystified*", (2018), First Edition, FT Publishing International.
2. Bill Chambers, Matei Zaharia "*Big Data Processing Made Simple*", (2018), First Edition, Oreilly Media, USA.
3. Nilanjan Dey, Aboul Ella Hassanian, Suresh Chandra Sathapathy, *"Internet of Things and Big Data Analytics Toward Next Generation Intelligence",* (2017), First Edition, Springer.
4. e-book Link: https://www.researchgate.net/publication/235945820_Intelligent_Data_Analysis_An_Introduction

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	3		3	3		3		3	2	3		3	3	2
CO2	3	3	3	3		1		3	2	3		3	2	3		3	3	3
CO3		3		1				2		1		3				2	2	2
CO4		2		2		3		3			2	2				2	1	3
CO5	1	3	2	2	1		2	2	3	3		1	1			1	3	3

Semester	19PDSC402: Software Project Management	L	T	P	C
IV		5	0	0	5

Learning Objective (LO):

LO1	To Understand the framework of project management
LO2	To Learn to monitor, Plan and control the project
LO3	To Know the sound knowledge in Performance and Agile method
LO4	To Know the team, cost, quality, Knowledge and resource management
LO5	To identify and control the risk in the projects.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Analyze the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
CO2	Align the project to the organization's strategic plans and business justification throughout its lifecycle.
CO3	Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
CO4	Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project
CO5	Adapt projects in response to issues that arise internally and externally.+

Unit 1 - Project Management Framework: Introduction: 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. **The Standard for Project Management of a Project**: Project management processes for a project: Common project management process interactions - Projects management process groups - Initiating process group - planning process group - Executing process group - Monitoring and controlling process group - Closing process group.

Unit 2 - Choosing Methodologies and Technologies – Software Processes and Process Models – Choice of Process Models – The Waterfall Model– Prototyping – other ways of categorizing

prototype - **Agile Methods** – Extreme Programming Selecting the Most Appropriate Process Model- Need of Agile - Iterative vs Incremental-Agile Manifesto and Mindset – Lean, Scrum and Kanban methods-uncertainty, Risk, and lifecycle selection-Scrum Elements overview-5 levels of planning-Scrum Process overview-Agile Team-roles and responsibilities- Epic-feature-User Stories-PBI-The Sprint.

Unit 3 - The Project Management Knowledge Areas: Project integration management: Develop project charter - Develop project management plan - Direct and manage project execution - Monitor and control project work - Perform integrated change control - Close project or phase. Project scope management: Collect requirements - Define Scope - Create WBS - Verify Scope - Control Scope. Project team management: Define activities - Sequence activities - Estimate activity resources - Estimate Activity Durations - Develop Schedule - Control Schedule.

Unit 4 - Project cost management: Estimate costs - Determine budget - Control costs. Project Quality Management: Plan quality - perform quality assurance - Perform quality control. Project Human Resource Management: Develop human resource plan - Acquire project team - Develop project team - Manage project team. Project Communications Management: Identify stakeholders - Plan communications - Distribute information - Manage stakeholder expectations - report performance.

Unit 5 - Project Risk Management: Plan risk management - Identify risks - Perform qualitative risk analysis - Perform quantitative risk analysis - plan risk responses - Monitor and control risks. Project Procurement Management: Plan - Conduct - Administer - Close procurements.

Current Streams of thought: Digital Technology in Project, Importance of management in Project Success, Risk Management, Increased Organizational Collaborations, Globalized Gig Economy.

Text Book

1. Project Management Institute "*A guide to the Project management Body of Knowledge (PMBOK Guide*", , (2008), Fouth Edition, , Pennsylvania,
2. BOB Huges, Mike Cotterell, Rajib Mall "*Software Project Management*" ,(2011), Fifth Edition, McGraw Hill.

References

1. Sam Ryan, "*Agile Project Management*", (2019), First Edition, Enrica Francalanci.
2. Cyntha snyder Dionisio, "*Microsoft Project 2019 Dummies*",(2019), First Edition, John Wiley and Sons.
3. Scott Berkun, "*Mastering Project Management*",.(2020), First Edition, Tantor Audio Publisher.
4. Alek Smolinski, "*Project management Body of Knowledge*",(2019), Alek Smolinski Publisher.
5. e-book Link: https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwjjpOeei_3sAhUTt5YKHbfuAnsYABAEGgJ0bA&ae=2&ohost=www.google.com&cid=CAASE-

RoFkdv62lZgmfBTQBGgTtAPzI&sig=AOD64_2ONLEGfXgH6jJrB_HC66qGfovLKQ&dct=1&adurl=&q=

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3		3	2			2			1	2	3			3	2
CO2	2		3					1		1		3		3		2	3	
CO3	3			2	3	3		2				3	2	3	3		3	2
CO4	2		2			2		2		3	2		3			2		1
CO5	3	1		1		1		3		3	3		3			1		3

ELECTIVES

DEPARTMENT ELECTIVE COURSES

Semester	19PDSE206 - Introduction to Data Mining	L	T	P	C
II		3	0	0	3

Learning Objective (LO):

LO1	To identify the scope and necessity of Data Mining.
LO2	To identify the scope and necessity of Warehousing.
LO3	To understand various tools of Data Mining
LO4	To develop ability to design various algorithms based on data mining tools.
LO5	To learn towards advances in data mining.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Understand the concepts of data mining.
CO2	Understand the concepts of warehousing.
CO3	Analyze the feasibility of data mining solution.
CO4	Apply basic statistical analysis to evaluate the results of data mining models.
CO5	Develop data mining application to solve problems.

Unit-1:

Introduction: Data Mining Concept, Origin, Process, Applications, Techniques, Challenges Data Preprocessing: Data types, Quality, Descriptive data summarization – central tendency and dispersion measure, Data cleaning, Data integration and transform.

Unit-2:

Data reduction Association Rule Mining: Market-basket analysis basics, Naïve algorithm, Apriori algorithm, Direct Hashing and Pruning (DHP), Software for Association Rule Mining Classification and Prediction: Decision Tree, Classification by decision tree induction, Bayesian

classification, Rule-based classification, Prediction – Linear and Nonlinear Regression, Classification software.

Unit-3:

Cluster Analysis: Types of data in cluster analysis, Partitioning methods, Hierarchical methods, Density-based methods, Quality and Validity of clustering methods Cluster analysis software Web.

Unit-4:

Data Mining: Web content mining, Web usage mining, Web structure mining, Hubs and Authorities, HITS algorithm, Web mining software Text Mining, Support Vector Machine.

Unit-5:

Data Mining Application and Information Privacy: Applications and trends in data mining such as Web, finance, telecommunication, biology and medicine, science and engineering retail industry, Social impacts of data mining, information privacy and data security, IT Act overview.

Current Streams of thought: Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops.

Text Books:

1. Jiawei Han, Micheline Kamber, (2000), *Data Mining: Concepts and Techniques* Morgan Kaufmann Publishers.

Supplementary Books:

1. Dr. Matthew A. North, (2012) *Data Mining for the Masses*, A Global Text Project Book.
2. Jaiwei Han and Micheline Kamber, (2011), *Data Mining Concepts and Techniques*, Morgan Kaufmann Publishers, 3rd Edition.
3. https://swayam.gov.in/nd2_cec20_cs12/preview

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	1		2		3	3	3	1	3		3	3	2	3			2	1
CO2	3	2		3		2		2		3				3		3	2	
CO3	3		2	1		3		3		3	3		2		2			2
CO4	3		2		3	2	2	3		2	1		1			3		3
CO5		1		3		3		3	3		2		2					

Semester	19PDSE207 - Web Database and Information System	L	T	P	C
II		3	0	0	3

Learning Objective (LO):

LO1	Understand how n-tiered architectures can be used to implement secure, scalable systems
LO2	Design and develop database-driven websites and applications
LO3	Understanding XML as a messaging and data exchange mechanism
LO4	Understand Web "semantic systems," such as auctions, recommendation systems, and search ranking.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Know the concepts and terminologies related to web analytics.
CO2	Explore various parameters used for web analytics and their impact.
CO3	Explore the use of tools and techniques of web analytics.
CO4	Get experience on websites, web data insights and conversions.

Unit-1:

Introduction: Web Overview, Introduction to Apache, MySQL, Networking : TCP/IP, HTTP, Introduction to PHP, Dynamic Page Generation, Sessions and Personalization.

Unit-2:

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

Unit-3:

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

Unit-4:

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

Unit-5

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

Current Streams of thought: Geo-Social Data, Capstone work, Web Analytics Case Studies.

Textbook:

1. Avinash Kaushik, (2009), *Web Analytics 2.0: The Art of Online Accountability and Science Of Customer Centricity*, 1st edition, Sybex,.

Supplementary Books:

1. Eric Fettman, Shiraz Asif, Feras Alhlou , (2016),*Google Analytics Breakthrough*, John Wiley & sons.
2. Michael Beasley, (2013), *Practical Web Analytics for User Experience: How Analytics can help you Understand your Users*, Morgan Kaufmann.
3. Magy Seif El-Nasr, Anders Drachen, Alessandro Canossa, eds., (2013), *Game Analytics: Maximizing the Value of Player Data*, Springer.
4. Bing Liu, (2011), *Web Data Mining: Exploring Hyperlinks, Content, and Usage Data,* 2nd Edition, Springer.
5. Justin Cutroni, (2010), *Google Analytics*, O'Reilly.
6. http://www.demandmetric.com/

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1					3	3			1	3		1		3			3	
CO2			2	2		3		2		3	2	3		1		3	2	
CO3	3			3	2	3		1				3			2			3
CO4	3	2	3	2		3		2	3	1						3		3

Semester	19PDSE208 - Green Computing	L	T	P	C
II		3	0	0	3

Learning Objective (LO):

LO1	To learn the fundamentals of Green Computing.
LO2	To analyze the Green computing Grid Framework.
LO3	To understand the issues related with Green compliance.
LO4	To study and develop various case studies.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
CO2	Enhance the skill in energy saving practices in their use of hardware.
CO3	Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders.
CO4	Understand the ways to minimize equipment disposal requirements.

Unit-1: Fundamentals

Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

Unit-2: Green Assets and Modeling

Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

Unit-3: Grid Framework

Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.

Unit-4: Green Compliance

Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future.

Unit-5: Case Studies

The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

Current Streams of thought: Organizational Check-ups, Equipment Check-ups, Gather Data, Analyse Data, Benefits, Realities.

Text Books:

1. Bhuvan Unhelkar, (2014), *Green IT Strategies and Applications-Using Environmental Intelligence*, CRC Press.
2. Woody Leonhard, Katherine Murray, (2012), *Green Home computing for dummies*, Wiley Publication.

Supplementary Books:

1. San Murugesan, G.R. Gangadharan, (2012), *Harnessing Green IT Principles and Practices*, Wiley Publication.
2. Alin Gales, Michael Schaefer, Mike Ebbers, (2011),*Green Data Center: steps for the Journey*, Shroff/IBM rebook.
3. John Lamb, (2009),*The Greening of IT*, Pearson Education.
4. Jason Harris, (2008), *Green Computing and Green IT- Best Practices on regulations & industry*, Lulu.com.
5. Carl speshocky, (2010), *Empowering Green Initiatives with IT*, John Wiley & Sons.
6. Wu Chun Feng (editor), *Green computing: Large Scale energy efficiency*, CRC Press.
7. https://thefutureofthings.com/3083-green-computing/
8. https://www.engpaper.com/green-computing-02.html

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		2		3	3				2		3			3			
CO2		3		3		1		3		3		3		1	3		2	1
CO3	3			3		2					2		3	2			2	3
CO4	2		1		2			3				1		2	3			3

Semester	19PDSE306 - Image and Video Analytics	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	To learn the fundamentals of digital image processing
LO2	To learn the concepts of image and video analysis.
LO3	To understand the real time use of image and video analytics.
LO4	To demonstrate real time image and video analytics applications and others.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Describe the fundamental principles of image and video analysis and have an idea of their application.
CO2	Solving problems in image and video analysis
CO3	Apply image and video analysis in real world problems.
CO4	Critically analyse multimedia applications.

Unit-1:

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

Unit-2:

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

Unit-3:

Colour models and Transformations: Image and Video segmentation-Image and video demonising- Image and Video enhancement- Image and Video compression.

Unit-4:

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

Unit-5:

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

Current Streams of thought: Digital Image Processing, Computer Vision.

Textbook:

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

Supplementary Books:

1. Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola, (2015), *Intelligent Transport Systems: Technologies and Applications*, Wiley.
2. Jean-Yves Dufour, (2013), *Intelligent Video Surveillance Systems*, Wiley.
3. Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, (2012), *Video Analytics for Business Intelligence*, Springer.
4. Rick Szelisk, (2011), *Computer Vision: Algorithms and Applications*, Springer.
5. Basudeb Bhatta, (2010), *Analysis of Urban Growth and Sprawl from Remote Sensing Data*, Springer.
6. W. Härdle, M. Müller, S. Sperlich, A. Werwatz, (2004), *Nonparametric and Semi parametric Models*, Springer.
7. https://warwick.ac.uk/fac/sci/dcs/teaching/modules/cs413

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3		1	2		3	3	2	2	2	2		3			3	3
CO2	2	3	1	2		2		3		1	1	3	3	2		1	3	
CO3	3		1	1	3	3	2		1	3			3					**1**
CO4		2			3		1	1	3	3	2		1	3		2		**1**

Semester	19PDSE307 - Data Science Ethics	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	Identify and articulate some basic ethical and policy-based frameworks
LO2	Understand the relationship between data, ethics, and society
LO3	Be able to critically assess their own work and education in the area of data science
LO4	Develop fluency in the key technical, ethical, policy, and legal terms and concepts related to data science.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Know the ethics of data science.
CO2	Apply data representation and techniques to solve real-world problems.
CO3	Explore the different performance issues and tasks in parallel and distributed computing.
CO4	Develop parallel algorithms for solving real–world problems.

Unit-1:

Introduction: Overview of ethical issues in data-driven organizations, Overview of data science as an ethical practice, Introduction to the unique ethical challenges of 'big data', Ethical Theory - Philosophical frameworks for assessing fairness, Moving towards contemporary theories of fairness.

Unit-2:

Research ethics for data science: Ethical side effects of the publish or perish system: p-hacking and small sample size, The misapplication of informed consent in data veillance practices, Techniques of data ethics, Getting from data to individuals: Internet traces and Geo fingerprints.

Unit-3:

Discrimination and algorithms: The ethics of price discrimination, Criminal justice by algorithm, The philosophical challenge of thinking in categories, How humans explain their social worlds through perceptions and statistics, Social processes and the impact of categorical life.

Unit-4:

Data ethics for researchers: Health Research, Educational Research, The ethics of data scraping and storage, Mosaic data, found data, and designed data.

Unit-5:

Privacy and Surveillance: Special topics in surveillance: Adtech, Special topics in surveillance: Employment, Differential privacy, Guidance for acting ethically with data.

Current Streams of thought: Data hack and academic data standards, alter data, web based censorship measurement.

Text Book:

1. DJ Patil, Hilary Mason, Mike Loukides, (2018), *Ethics and Data Science,* O'Reilly Media, Inc.,.

Supplementary Books:

1. Rousseau, Jean-Jacques. (1754), *Discourse on the origin and basis of inequality among men*. [Many print versions of this text have been published. Available in full here: https://www.aub.edu.lb/fas/cvsp/Documents/DiscourseonInequality.pdf879500092.pdf]
2. Voorhoeve, Alex. (2009), *Interview with Frances Kamm in Conversations on Ethics,* Oxford University Press. Accessed online: http://personal.lse.ac.uk/voorhoev/frances%20kamm%20chapter.pdf
3. https://datasociety.net/library/data-ethics-case-studies/

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1					3	3			1	3		1		3			3	
CO2			2	2		3		2		3	2	3		1		3	2	
CO3	3			3	2	3		1				3			2			3
CO4	3	2	3	2		3		2	3	1						3		3

Semester	19PDSE308 - Time Series Analysis and Forecasting	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	Compute and interpret a correlogram and a sample spectrum
LO2	Derive the properties of ARIMA and state-space models
LO3	Choose an appropriate ARIMA model for a given set of data and fit the model using an appropriate package
LO4	Compute forecasts for a variety of linear methods and models.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Understand the fundamental advantage and necessity of forecasting in various situations.
CO2	Know how to choose an appropriate forecasting method in a particular environment.
CO3	Know how to apply various forecasting methods, which includes obtaining the relevant data and carrying out the necessary computation.
CO4	Improve forecast with better statistical models based on statistical analysis.

Unit-1:

Economic Time Series: Different components, illustration, additive and multiplicative models, determination of trend, seasonal and cyclical fluctuations.

Unit-2:

Time Series Analysis: Time-series as discrete parameter stochastic process, auto covariance and autocorrelation functions and their properties. Exploratory time Series analysis, tests for trend and seasonality, exponential and moving average smoothing.

Unit-3:

Stationary Processes: (1) moving average (MA), (2) auto regressive (AR), (3) ARMA and (4) AR integrated MA (ARIMA) models. Box-Jenkins models, choice of AR and MA periods.

Unit-4:

Estimation: Discussion (without proof) of estimation of mean, auto covariance and autocorrelation functions under large sample theory, estimation of ARIMA model parameters.

Unit-5:

Spectral Analysis: of weakly stationary process, periodogram and correlogram analyses, computations based on Fourier transform, non stationary process, introduction to forecasting.

Current Streams of thought: Decomposition method, Model forecast theory.

Text Books:

1. Brockwell & Davis, (2016), *Introduction to Time Series and Forecasting*, 3rd edition, Springer.

Supplementary Books:

1. Avishek Pal and PKS Prakash, (2017), *Practical Time Series Analysis*, Packt Publishing Ltd., Birmingham, Mumbai.
2. Shumway & Stoffer (2011) *Time Series Analysis and its applications, with examples in R* , 3rd edition, Springer.
3. Cryer & Chan (2010) *Time Series Analysis with Applications in R*, Springer Prado & West.
4. Campagnoli, Chapman & Hall Petris, Petrone, (2009), *Time Series: Modeling, Computation, and Inference*, *Dynamic Linear Models with R*, Springer.
5. http://www.personal.psu.edu/asb17/old/sta4853/

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1			2		3	3			3	2			2	3		2		
CO2				2	2	3		3		1		3		3		2	2	
CO3	3			1		2		3		3	3	3	2		3		3	3
CO4	3		3	1	2	2		1		3	3		1			1		3

Semester	19PDSE309 - Cloud Computing	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	To learn how to use Cloud Services.
LO2	To implement Virtualization
LO3	To implement Task Scheduling algorithms.
LO4	Apply Map-Reduce concept to applications.
LO5	To build Private Cloud.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Acquire Knowledge on the features and development of Cloud Computing.
CO2	Define the principles of virtualization.
CO3	Use various performance criteria to evaluate the quality of the cloud architecture.
CO4	Identify the Service-Oriented Architecture for Distributed Computing workflow.
CO5	Create combinatorial auctions for cloud resources and design scheduling algorithms for computing clouds

Unit-1:

Introduction: Basics, applications, intranet and cloud, examples: Amazon, Google, Microsoft, IBM– advantages and disadvantages of cloud computing, Google app engine, Microsoft Azure, Amazon(EC2, S3,SQS),open stack, cloud computing services

Unit-2:

Hardware and architecture: clients-security-network-services. Accessing the cloud: platforms-web applications-web APIs- web browsers. Cloud storage: overview-providers. Standards: application-client-infrastructure-service.

Unit-3:

Software as Service: overview-driving forces-company offerings-industries. Software plus services: Overview-mobile device integration-providers-Microsoft Online.

Unit-4:

Developing Applications: Google-Microsoft-Intuit Quick Base-Cast Iron Cloud-Bungee Connect-Development (App engine, Azure, open stack etc.)- trouble shooting and application management.

Unit-5:

Local clouds and thin clients: Virtualization-server solutions-thin clients. Cloud Migration: cloud services for individuals-enterprise cloud- methods for migration-analyzing cloud services.

Current Streams of thought: Hadoop, Google App Engine, Open Stack, Federation.

Current Streams of thought: Hadoop, Google App Engine, Open Stack, Federation.

Text Book:

1. Anthony T.Velte, Toby Velte , (2010),*Cloud Computing a practical approach* , Mcgraw Hill.

Supplementary Books:

1. Kailash Jayaswal, Jagannath Kallakurchi, Donald Houde, Dr. Deven Shah, (2015), *Cloud Computing Black Book*, Dream Tech Press.
2. Kris Jamsa, (2014), *Cloud Computing*, Jones and Barlett, Student Edition.
3. Janakiram M.S.V, (2010), *Demystifying the Cloud – An introduction to Cloud Computing*, version 1.1.
4. Mark C. Chu-Carroll, (2011), *Code in the Cloud- Programming Google App Engine*, The Pragmatic Bookshelf Raleigh, North Carolina Dallas, Texas.
5. https://swayam.gov.in/nd1_noc20_cs55/
6. https://nptel.ac.in/courses/106/105/106105223/

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	1	3	2		3	3		2	3	3		2			3	3
CO2	1	3	2	3		2		3	3	3		1		3		2	3	
CO3		3		3				3		2		3	3				2	3
CO4		3		3		3		1			3		3		2	3		3
CO5	3	2	3	2	3		3	3	2	3	2	3			2			3

Semester	19PDSE310 - Distributed and Parallel Computing	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	To learn core ideas behind parallel and distributed computing.
LO2	To explore the methodologies adopted for concurrent and distributed
LO3	To understand the networking aspects of parallel and distributed computing.
LO4	To provide an overview of the computational aspects of parallel and distributed computing.
LO5	To learn parallel and distributed computing models.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Explore the methodologies adopted for concurrent and distributed environment.
CO2	Analyse the networking aspects of Distributed and Parallel Computing.
CO3	Appreciate the strengths of parallel computing approaches to problem solving
CO4	Provides presentation and defence of designed solutions.
CO5	Provides professional communication skills and provides opportunities for collaborative project development.

Unit-1:

Parallel and Distributed Computing — Introduction- Benefits and Needs- Parallel and Distributed Systems- Programming Environment- Theoretical Foundations- Parallel Algorithms— Introduction- Parallel Models and Algorithms- Sorting- Matrix Multiplication- Convex Hull- Pointer Based Data Structures.

Unit-2:

Synchronization: Process Parallel Languages- Architecture of Parallel and Distributed Systems- Consistency and Replication- Security- Parallel Operating Systems.

Unit-3:

Management of Resources in Parallel Systems: Tools for Parallel Computing- Parallel Database Systems and Multimedia Object Servers.

Unit-4:

Networking Aspects of Distributed and Parallel Computing - Process- Parallel and Distributed Scientific Computing.

Unit-5:

High-Performance Computing: Molecular Sciences- Communication- Multimedia Applications for Parallel and Distributed Systems- Distributed File Systems.

Current Streams of thought: Map Reduce, Work flow systems, Virtualization, Fault Tolerance.

Textbook

1. Jacek Błażewicz, et al., (2013), *Handbook on parallel and distributed processing*, Springer Science & Business Media.

Supplementary Books:

1. Gregor Kosec and Roman Trobec, (2015), *Parallel Scientific Computing: Theory, Algorithms, and Applications of Mesh Based and Meshless Methods*, Springer.
2. Andrew S. Tanenbaum, and Maarten Van Steen, (2007), *Distributed Systems: Principles and Paradigms*. Prentice-Hall.
3. George F.Coulouris, Jean Dollimore, and Tim Kindberg, (2005), *Distributed systems: concepts and design*", Pearson Education.
4. https://nptel.ac.in/courses/106/106/106106107/
5. https://hpc.llnl.gov/training/tutorials/introduction-parallel-computing-tutorial

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1		1		3		3		3		2		3	3		1		2	1
CO2		2		2	3	3		3		2	1	3	2		2	3	3	3

CO3		2	3	2	3		3	3	2	3	2	3			2			3
CO4		3		3				3		2		3	3				2	3
CO5		3		3		3		1			3		3		2	3		3

Semester	19PDSE311 - Multivariate Data Analytics	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	Obtain knowledge on sampling, tests of hypothesis, and statistical tests like Multiple Regression and Canonical correlation.
LO2	Train the students to use time series models like vector and matrices, Distance Measures and Factor Analysis.
LO3	To identify the most appropriate statistical techniques for a multivariate dataset
LO4	Use statistical software packages for the analysis of multivariate data

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	The students should have knowledge on assimilate the data and fit-in appropriate time series model.
CO2	The students should have develop the software for the models at implementation level.
CO3	The students should have the capability of developing statistical packages, which computes descriptive statistics.
CO4	The students should have compares means and variances of the data; and fits the time series models for the given data.

Unit-1:

Basic concepts: Variate, Measurement Scale, Statistical significance and power, missing data, outlier detection and handling, transformations to achieve normality, linearity, homo scedasticity, non-metric data with dummy variables.

Unit-2:

Multiple Regression and Canonical Correlation: Basics of Multiple Regression, Prediction using independent variables, decision process for multiple regression analysis, estimating the regression model and assessing overall model fit.

Basics of Canonical Correlation: Variate of dependent variable, First and Second order Canonical functions estimation, Relationship of Canonical correlation to other multivariate techniques, Deriving Canonical function, interpreting Canonical variate.

Unit-3:

Basics of vector and matrices (only problems): Random sample, Mean vector, Co-variance matrix. Multivariate normal distribution: normal density function and its properties.

Test for Mean vectors (only problems): Hotelling's T^2 test, Test for two population mean vectors, Test for several population mean vectors. Test for equality of mean vector with equal and unequal covariance.

Unit-4:

Test for Covariance matrices (only problems): Test for equality of two population Co-variance matrices, Equality of several population Covariance matrices.

Distance Measures (only problems): Mahalanobis D^2 measure, Manhattan distance, Bhattacharyya distance, Discriminant analysis – two-class problems and L-class problems.

Unit-5:

Principal component analysis (only problems): Sample variability with one sample principal component, Sample variability with two sample principal component, Principal component with standardized data, Principal component from correlation matrix.

Factor Analysis (only problems): Orthogonal factor analysis, Factor analysis of consumer–preference data, Factor analysis of stock price data, Factor analysis of Olympic decathlon data. Test for two common factors. Factor loading and rotation.

Current Streams of thought: Cluster Analysis, Principal Component Analysis, Factor Analysis.

Text book:

1. Richard A. Johnson, Dean W. Wichern, "Applied Multivariate Statistical Analysis", Sixth edition, Pearson press, 2007.

Supplementary Books:

1. Joseph F. Hair, Jr.,William C. Black Barry J. Babin, Rolph E. Anderson, (2013), *Multivariate Data Analysis*, Seventh Edition, Pearson press.
2. Michael Milton, (2013), *Head First Data Analysis,* Shroff Publishers.
3. Keinosuke Fukunaga, (1990), *Introduction to Statistical Pattern Recognition*, Second Edition, Academic Press.

4. https://www.academia.edu/41117363/Multivariate_Data_Analysis_7th_Edition_by_Joseph_F_Hair_Jr
5. https://www.statgraphics.com/multivariate-methods

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		3		2			3			3	1	3	3		3	2	1
CO2	2		3	3	2						3	3	3	1	3		2	2
CO3	3	2	1		1						2		2	2			3	3
CO4	3										3							

Semester	19PDSE403 - Healthcare Data Analytics	L	T	P	C
IV		3	0	0	3

Learning Objective (LO):

LO1	To explore the various forms of electronic health care information.
LO2	To learn the techniques adopted to analyse health care data.
LO3	To understand the predictive models for clinical data
LO4	To solve challenges involved in healthcare data

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Analyse health care data using appropriate analytical techniques.
CO2	Apply analytics for decision making in healthcare services.
CO3	Apply data mining to integrate health data from multiple sources and develop efficient clinical decision support systems.
CO4	Apply current trends and approaches in healthcare data

Unit -1:

Introduction: Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges- Phenotyping Algorithms.

Unit -2:

Analysis: Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine.

Unit -3:

Analytics: Natural Language Processing and Data Mining for Clinical Text- Mining the Biomedical- Social Media Analytics for Healthcare.

Unit -4:

Advanced Data Analytics: Advanced Data Analytics for Healthcare– Review of Clinical Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.

Unit -5:

Applications: Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.

Current Streams of thought: Health care data analytics tools, Health care data management tools.

Textbook:

1. Chandan K. Reddy and Charu C Aggarwal, (2015), *Healthcare data analytics*, Taylor & Francis.

Supplementary Books:

1. Hui Yang and Eva K. Lee, (2016), *Healthcare Analytics: From Data to Knowledge to Healthcare Improvement*, Wiley.
2. https://www.definitivehc.com/

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3		3	3	2		2	1		2	1	3		3			2	3
CO2	2	1	2	2		3				2		3		2		3	3	
CO3		3		3		3		3		3		3	2		1		2	1
CO4		1		2		3				2		3		2		3		2

Semester	19PDSE404 - Business Intelligence	L	T	P	C
IV		3	0	0	3

Learning Objective (LO):

LO1	Be exposed with the basic rudiments of business intelligence system
LO2	Understand the modelling aspects behind Business Intelligence
LO3	Understand the business intelligence life cycle and the techniques used in it
LO4	Be exposed with different data analysis tools and techniques

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1	Link data mining with business intelligence.
CO2	Apply various modelling techniques.
CO3	Explain the data analysis and knowledge delivery stages.
CO4	Apply business intelligence methods to various situations.

Unit -1:

Business Intelligence: Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence.

Unit -2:

Knowledge Delivery: The business intelligence user types, Standard reports, Interactive Analysis and Adhoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.

Unit -3:

Efficiency: Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Pattern matching – cluster analysis, outlier analysis

Unit – 4:

Business Intelligence Applications: Marketing models – Logistic and Production models – Case studies.

Unit – 5:

Future of Business Intelligence: Future of business intelligence – Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology.

Current Streams of thought: Data Classification, Data Clustering, Linear Regression, Logistic Regression.

Text Books:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, (2013), *Decision Support and Business Intelligence Systems*, 9th Edition, Pearson.

Supplementary Books:

1. Grossmann W, Rinderle-Ma, (2015), *Fundamental of Business Intelligence*, 1st Edition, Springer.
2. David Loshin Morgan, Kaufman, (2012), *Business Intelligence: The Savvy Manager"s Guide*, Second Edition.
3. Efraim Turban, Ramesh Sharda, Dursun Delen, (2011), *Decision support and Business Intelligence Systems*, 9th Edition, Pearson.
4. Carlo Vercellis, (2009), *Business Intelligence: Data Mining and Optimization for Decision Making*, Wiley Publications.
5. Cindi Howson, (2007), *Successful Business Intelligence: Secrets to Making BI a Killer App*, McGraw-Hill.
6. Ralph Kimball , Margy Ross , Warren Thornthwaite, Joy Mundy, Bob Becker, (2007), *The Data Warehouse Lifecycle Toolkit*, Wiley Publication Inc.,.
7. Larissa T. Moss, S. Atre, (2003),*Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making*, Addison Wesley,.
8. https://www.academia.edu/40285447/Business_Intelligence_and_Analytics

Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	1	3	2		3	3		2	3	3		2			3	3
CO2	3	3	3	2		2		3	3	3		1		3		2	2	
CO3		3		3				3		2		3	3				3	3
CO4		2		3		3		1			3		3		2	3		3