FACULTY OF SCIENCE

DIVISION OF COMPUTER AND INFORMATION SCIENCE

M.Sc. Data Science
(2-Year)

Programme Code: SCIS22

Handbook
2019-2020
These Regulations are common to all the students admitted to the Two-Year Master’s Programmes in the Faculties of Arts, Science, Indian Languages, Education, Marine Sciences, and Fine Arts from the academic year 2019-2020 onwards.

1. Definitions and Nomenclature

1.1 University refers to Annamalai University.

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

1.3 Discipline refers to the specialization or branch of knowledge taught and researched in higher education. For example, Botany is a discipline in the Natural 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.A., M.Sc.

1.5 Course is an individual subject in a programme. Each course may consist of Lectures/Tutorials/Laboratory work/Seminar/Project work/Experiential learning/ Report writing/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. Each academic year is divided into two semesters.

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 also known as Course Objectives** are statements that define the expected goal of a course in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

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. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters.

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**
   2.1 The Department of Computer and Informations Science offers a Two Year M.Sc. 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 are eligible for admission.

   2.2 Reservation of seats for candidates belonging to ST/SCA/SC/MBC/DNC/BC/BC (Muslim) communities and Differently-abled will be made as per the rules and regulations of the Government of Tamil Nadu.

   2.3 In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for all the above Programmes.

3. **Programme Duration**
   3.1 The Two Year Master’s Programmes consist of two academic years.

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

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

4. **Programme Structure**
   4.1 The Two Year Master’s Programme consists of Core Courses, Elective Courses (Departmental & Interdepartmental), and Project.

   4.2 **Core courses**
      4.2.1 These are a set of compulsory courses essential for each programme.
      4.2.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

   4.3 **Elective courses**
      4.3.1 **Departmental Electives (DEs)** are the Electives that students can choose from a range of Electives offered within the Department.

      4.3.2 **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.

      4.3.3 Students shall take a combination of both DEs and IDEs.
4.4 Experiential Learning
4.4.1 Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

4.4.2 In-plant training/field trips/internships/industrial visits (as applicable) fall under this category.

4.4.3 Experiential learning is categorised as Core.

4.5 Project
4.5.1 Each student shall undertake a Project in the final semester.

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

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

4.5.4 Students who wish to undertake project work in recognised institutions/industry shall obtain prior permission from the University. The Research Supervisor will be from the host institute, while the Co-Supervisor shall be a faculty in the parent department.

4.6 Value added Courses (VACs)
4.6.1 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.

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

4.6.3 Each VAC carries 2 credits with 30 hours of instruction, of which 60% (18 hours) shall be Theory and 40% (12 hours) Practical.

4.6.4 Classes for a VAC are conducted beyond the regular class hours and preferably in the II and III Semesters.

4.7 Online Courses
4.7.1 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.

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

4.8 Credit Distribution
The credit distribution is organised as follows:

<table>
<thead>
<tr>
<th></th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>65-75</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>6-8</td>
</tr>
<tr>
<td>Total (Minimum requirement for award of Degree)</td>
<td>90-95*</td>
</tr>
</tbody>
</table>

*Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 90-95 credits.
4.9 Credit Hours
Each course is assigned credits and credit hours on the following basis:
1 Credit is defined as
1 Lecture period of one hour per week over a semester
1 Tutorial period of one hour per week over a semester
1 Practical/Project period of two or three hours (depending on the discipline) per week over a semester.

5 Attendance
5.1 Each faculty handling a course shall be responsible for the maintenance of Attendance and Assessment Record for candidates who have registered for the course.
5.2 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 organisation of lesson plan of the Course Instructor.
5.3 The record shall be submitted to the Head of the Department once a month for monitoring the attendance and syllabus coverage.
5.4 At the end of the semester, the record shall be duly signed by the Course Instructor and the Head of the Department and placed in safe custody for any future verification.
5.5 The Course Instructor 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.
5.6 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.
5.7 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.

6 Mentor-Mentee System
6.1 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.
6.2 The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.
6.3 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.

7 Examinations
7.1 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).
7.2 There will be two CIA Tests and one ESE in each semester.
7.3 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.
7.4 Continuous Internal Assessment Tests
7.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments, seminars, and viva-voce that would be suitable to the course. This requires an element of openness.

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

7.4.3 The pattern of question paper will be decided by the respective faculty.

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

7.4.5 CIA Tests will be for two to three hours duration depending on the quantum of syllabus.

7.4.6 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.

7.5 End Semester Examinations (ESE)
7.5.1 The ESE for the first/third semester will be conducted in November and for the second/fourth semester in May.

7.5.2 A candidate who does not pass the examination in any course(s) of the first, second and third semesters will be permitted to reappear in such course(s) that will be held in April and November in the subsequent semester/year.

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

8 Evaluation
8.1 Marks Distribution
8.1.1 Each course, both Theory and Practical as well as Project/Internship/Field work/In-plant training shall be evaluated for a maximum of 100 marks.

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

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

8.2 Assessment of CIA Tests
8.2.1 For the CIA Tests, the assessment will be done by the Course Instructor

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

<table>
<thead>
<tr>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I &amp; Test-II</td>
</tr>
<tr>
<td>Seminar</td>
</tr>
<tr>
<td>Assignment</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
8.2.3 For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I</td>
<td>15</td>
</tr>
<tr>
<td>Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Viva-voce and Record</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>

8.3 Assessment of End-Semester Examinations

8.3.1 Evaluation for the ESE is done by both External and Internal examiners (Double Evaluation).

8.3.2 In case of a discrepancy of more than 10% between the two examiners in awarding marks, third evaluation will be resorted to.

8.4 Assessment of Project/Dissertation

8.4.1 The Project Report/Dissertation shall be submitted as per the guidelines laid down by the University.

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

8.4.3 CIA for Project will consist of a Review of literature survey, experimentation/field work, attendance etc.

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

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

8.4.6 The marks shall be distributed as follows:

<table>
<thead>
<tr>
<th>Continuous Internal Assessment (25 Marks)</th>
<th>End Semester Examination (75 Marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review-I 10</td>
<td>Project / Dissertation Evaluation</td>
</tr>
<tr>
<td>Review-II: 15</td>
<td>Viva-voce</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

8.5 Assessment of Value-added Courses

8.5.1 Assessment of VACs shall be internal.

8.5.2 Two CIA Tests shall be conducted during the semester by the Department(s) offering VAC.

8.5.3 A committee consisting of the Head of the Department, faculty handling the course and a senior faculty member shall monitor the evaluation process.

8.5.4 The grades obtained in VACs will not be included for calculating the GPA.

8.6 Passing Minimum

8.6.1 A minimum of 50% marks in each course is prescribed for a pass.

8.6.2 While a minimum of 40% marks in each course is essential for the End Semester Examinations, there is no passing minimum for CIA Tests.

8.6.3 A student is declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examination and not less than 50% marks in aggregate taking CIA and End Semester Examination marks together.
A candidate who has not secured a minimum of 50% of marks in a course (CIA + End Semester) shall reappear for the course in the next semester/year.

9. 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.

10. Marks and Grading
10.1 The performance of students in each course is evaluated in terms Grade Point (GP).
10.2 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 from the first semester to the current semester.
10.3 The GPA is calculated by the formula

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

where, \(C_i\) is the Credit earned for the Course \(i\) in any semester;
\(G_i\) is the Grade Point obtained by the student for the Course \(i\) and
\(n\) is the number of Courses passed in that semester.

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

\[
CGPA = \frac{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i}
\]

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 \(i\) and
\(n\) is the number of Courses passed in that semester.
\(m\) is the number of semesters

10.4 Evaluation of the performance of the student will be rated as shown in the Table.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>80-89</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>70-79</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>60-69</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>55-59</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>50-54</td>
</tr>
<tr>
<td>RA</td>
<td>0</td>
<td>Less than 50</td>
</tr>
<tr>
<td>W</td>
<td>0</td>
<td>Withdrawn from the examination</td>
</tr>
</tbody>
</table>

10.5 Classification of Results. The successful candidates are classified as follows:
10.5.1 For First Class with Distinction: Candidates who have passed all the courses prescribed in the Programme in the first attempt with a CGPA of 8.25 or 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).
10.5.2 For First Class: Candidates who have passed all the courses with a CGPA of 6.5 or above.
10.5.3 For Second Class: Candidates who have passed all the courses with a CGPA between 5.0 and less than 6.5.
10.5.4 Candidates who obtain highest marks in all examinations at the first appearance alone will be considered for University Rank.

10.6 **Course-Wise Letter Grades**

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

10.6.2 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.

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

10.6.4 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.

10.6.5 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.

11. **Provision for Withdrawal from the End Semester Examination**

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

11.2 A candidate is permitted to withdraw from appearing for the ESE for valid reasons. However, such permission is granted only once during the entire duration of the programme.

11.3 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.

11.4 Withdrawal is not granted for arrear examinations of courses in previous semesters and for the final semester examinations.

11.5 Candidates who have been granted permission to withdraw from the examination shall reappear for the courses in the subsequent semester/year.

11.6 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.

12. **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 sensitised on issues of academic integrity and ethics.

13. **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.

14. **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.**
# Programme Structure
(For students admitted from the academic year 2019-2020)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours/ Week</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L  P  C</td>
<td>CIA  ESE  Total</td>
</tr>
</tbody>
</table>

### FIRST SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours/ Week</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>19PDSC11</td>
<td>Core 1: Statistical Methods</td>
<td>5 5 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC12</td>
<td>Core 2: Introduction to Data Science</td>
<td>5 5 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC13</td>
<td>Core 3: Advanced Data Base Management Systems</td>
<td>4 4 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC14</td>
<td>Core 4: Advanced Java Programming</td>
<td>4 4 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC15</td>
<td>Core 5: Advanced Web Technology</td>
<td>4 4 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSP16</td>
<td>Core 6: RDBMS – Lab</td>
<td>4 2 40</td>
<td>60 100</td>
</tr>
<tr>
<td>19PDSP17</td>
<td>Core 7: Advanced Web Technology – Lab</td>
<td>4 2 40</td>
<td>60 100</td>
</tr>
<tr>
<td></td>
<td>Total credits</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

### SECOND SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours/ Week</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>19PDSC21</td>
<td>Core 8: Distributed Operating System</td>
<td>4 4 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC22</td>
<td>Core 9: Dot Net Programming</td>
<td>5 5 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC23</td>
<td>Core 10: Data Science with R Programming</td>
<td>5 5 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSE24</td>
<td>Elective I (IDE)</td>
<td>3 3 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSE25</td>
<td>Elective II (DE)</td>
<td>3 3 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSP26</td>
<td>Core 11: Dot Net Programming Lab</td>
<td>4 2 40</td>
<td>60 100</td>
</tr>
<tr>
<td>19PDSP27</td>
<td>Core 12: R Programming for Data Analytics – Lab</td>
<td>4 2 40</td>
<td>60 100</td>
</tr>
<tr>
<td></td>
<td>Total credits</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

### THIRD SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours/ Week</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>19PDSC31</td>
<td>Core 13: Cryptography and Network Security</td>
<td>5 5 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC32</td>
<td>Core 14: Data Analytics using Python</td>
<td>5 5 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC33</td>
<td>Core 15: Machine Learning</td>
<td>4 4 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSE34</td>
<td>Elective III (IDE)</td>
<td>3 3 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSE35</td>
<td>Elective IV (DE)</td>
<td>3 3 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSP36</td>
<td>Core 16: Data Analytics using Python Programming – Lab</td>
<td>4 2 40</td>
<td>60 100</td>
</tr>
<tr>
<td>19PDSP37</td>
<td>Core 17: Machine Learning – Lab</td>
<td>4 2 40</td>
<td>60 100</td>
</tr>
<tr>
<td></td>
<td>Total credits</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

### FOURTH SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours/ Week</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>19PDSC41</td>
<td>Core 18: Big Data Analytics</td>
<td>4 4 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSC42</td>
<td>Core 19: Software Project Management</td>
<td>4 4 25</td>
<td>75 100</td>
</tr>
<tr>
<td>19PDSE43</td>
<td>Elective V (DE)</td>
<td>3 3 25</td>
<td>75 100</td>
</tr>
</tbody>
</table>
L- Lectures; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination

Note:
1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available.
2. Students may opt for any Value-added Courses listed in the University website.

DEPARTMENT ELECTIVE COURSES

<table>
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INTER-DEPARTMENT ELECTIVE COURSES

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Programme Outcomes (Po)

On completion of Two Year M.Sc. Data Science, students 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 (Pso)

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

PSO1: Take leading roles in industry, academia, entrepreneurship and applications.

PSO2: Analyze the data and apply statistical with machine learning concepts, and interpret the results obtained in their operational context.

PSO3: Scientific, ethical and socially responsible approach for conducting and contributing to research in their specific area of study and to international trends in and related to their field of study.

PSO4: Implement the concepts of Statistics, optimization techniques, Data Repository, Data Analytics on real world problems, and to take a decision on the problem.

PSO5: Identify the appropriate mathematical and statistical techniques to solve the problems and give right solution to the industry and scientific communities, and the society.

PSO6: Develop programming skills in recent data analysis software to implement the above concepts.

PSO7: Handle the projects related to electronic commerce, software development related to on-line applications and can achieve organizational goals and objectives.

PSO8: Control, and maintain the communication system networks, and they should be cope up with the data analyzing techniques.
SYLLABUS

SEMESTER-I

19PDSC11: Core Course 01 – Statistical Methods

Credits: 5
Hours: 5

Learning Objectives (LO):

Obtain knowledge on sampling, tests of hypothesis, and statistical tests like t-test, F-test, Goodness of Fit, and Confidence interval.
Train the students to use time series models like autoregressive model and autocorrelation, and Markov models; and gain knowledge on model fitting.

Unit-1:
Descriptive statistics: Classical and axiomatic definitions of Probability and consequences. Law of total probability, Conditional probability, Bayes’ theorem and applications. Discrete and continuous random variables.

Unit-2:

Unit -3:
Testing: Hypothesis testing, Estimation and sampling techniques, Sampling distributions of sample mean, sample variance, t, chi-square and F tests of significance.

Unit-4:
Non-parametric tests: Goodness of fit, Test of independence, sign, run, Wilcoxon, Mann-Whitney, Wald-Wolfowitz.

Unit-5:
Multivariate Distance: Mean vector, co-variance matrix, Generalized variance, Hotling’s $T^2$ Mahalanobis test, Battacharya Distance, Test for equality of Mean vector and Co-variance matrices of two populations, Elements of Decision Theory and Bayesian approach.

Text Books:

Supplementary Books:

Course Outcomes (COs):

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

| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
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19PDSC12: Core Course 02 – Introduction To Data Science  Credits:5

Learning Objectives (LO):
To develop fundamental knowledge of concepts underlying data science and give a hands-on experience with real-world data analysis.

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:

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

Text Book:

Supplementary Books:
Course Outcomes (COs):

| 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. |

Outcome Mapping

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19PDSC13: Core Course 03 – Advanced Database Management Systems

Learning Objectives (LO):
To Acquire Knowledge of Database Models.
To understand distributed database architecture.
To learn the concepts of spatial database.
To familiar with temporal database.

Unit-1:

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:

Unit-4:

Unit-5:

Text Book:

**Supplementary Books:**

**Course Outcomes (COs):**
On successful completion of the course, the students will be able to

| CO1: Know about the Various data models. |
| CO2: Works on Database Architecture |
| CO3: Analyze data patterns |
| CO4: Handle object oriented databases. |

**Outcome Mapping:**

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19PDSC14: Core Course 04 – Advanced Java Programming  
Credits:4  
Hours:4

**Learning Objectives (LO):**
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
To enable the students to learn the ethical, historical, environmental and technological aspects of Advanced Java Programming and how it impacts the social and economic development of society.

**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-Templat 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-

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:

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- Multiresolution Image API.

Textbooks
Bert Bates, Karthy Sierra, Eric Freeman, Elisabeth Robson, “Head First Design Patterns”, O’REILLY Media Publishers.(1st-Unit).

Supplementary Books:

Course Outcomes:
On successful completion of the course, the students 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 |

Course Outcomes (COs):

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Learning Objectives (LO):

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

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:


Unit-3:


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 StockQuote 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 TerraService.

Unit-5:


Text Book:


Supplementary Books:

Course Outcomes (COs):

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

| 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 and SQL to develop a client server model. |
| CO4: | Recognize the difference between Data list and Data grid controls in accessing data. |

Outcome Mapping:

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19PDSP16: Core Course 06 – Rdbms Lab Credits:2 Hours:4

Learning Objectives (LO):

Keep abreast of current developments to continue their own professional development.
To engage themselves in lifelong learning of Database management systems theories and technologies this enables them to pursue higher studies.
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.
Develop team spirit, effective work habits, and professional attitude in written and oral forms, towards the development of database applications.

List of Exercises

Cycle-I:

(Simple SQL)

1. Employee Management System Using SQL Commands.
2. Students 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

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

Course Outcomes (COs):

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<th>CO</th>
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<td>CO1</td>
<td>In drawing the ER, EER, and UML Diagrams.</td>
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<td>CO2</td>
<td>In analyzing the business requirements and producing a viable model for the implementation of the database.</td>
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<td>In converting the entity-relationship diagrams into relational tables.</td>
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<td>CO4</td>
<td>To develop appropriate Databases to a given problem that integrates ethical, social, legal, and economic concerns.</td>
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Outcome Mapping:

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19PDSP17: Core Course 07 - Advanced Web Technology – Lab  Credits:2  Hours:4

Learning Objectives (LO):
To understand the concept of web technologies.
To creating web pages by using HTML Tags.
To understand the importance of cascade style sheets in creating a web application.
To understand the importance of Java Script in creating a web Application
To understand the use of XML in Document type Definition.
To know about PHP scripts and create adaptive web pages.

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
Course Outcomes (COs):
On successful completion of the course, the students will be able to

| 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. |

Outcome Mapping:

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SEMESTER II

19PDSC21: Core Course 08 – Distributed Operating System

Learning Objectives (LO):
To study distributed operating system concepts
To understand hardware, software and communication in distributed OS
To learn the distributed resource management components.
Practices to learn concepts of OS and Program the principles of Operating Systems

UNIT-1:

UNIT- 2:

UNIT- 3:

UNIT- 4:

UNIT-5:

Text Books:
2. Distributed Operating System – Andrew S. Tanenbaum, PHI.

Supplementary Books:

Course Outcomes (COs):

| CO1: | Clear understanding on several resource management techniques like distributed shared memory and other resources |
| 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 |
| CO4: | Able to design and implement fault tolerant distributed systems. |

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19PDSC22: Core Course 09 – Dot Net Programming

Learning Objectives (LO):
To explore the backbone of web page creation by developing .NET skill.
To Familiar with Application, session and view state management
To Provide depth knowledge about ADO.NET
To Understand the need of usability, evaluation methods for web services
To acquire knowledge on the usage of recent platforms in developing web applications

Unit-1:

Unit –2:
Developing VB.NET Applications - Introduction to VB.Net, The .Net Framework 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 programmingcreating and using classes and objects, Handling Exceptions- on Error Goto

Unit-3:

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.

Text Books:
2. Mathew Mac Donald, “ASP.NET Complete Reference”, TMH 2005
5. ASP.NET Unleashed, C# programming – Wrox publication
6. Visual Basic. NET Black Book, by Steven Holzner

Supplementary Books:
2. Mario Szpuszta, Matthew MacDonald, “Pro ASP.NET 4 in C# 2010: Includes Silverlight
2,”Apress, Third Edition
4. Visual Basic. Net programming in easy steps by Tim Anderson,

Course Outcomes (COs):

| 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.

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19PDSC23: Core Course 10 – Data Science With R Programming

Learning Objectives (LO):

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.

To demonstrate usage of as standard Programming Language.

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

Unit-1:
Overview and Preliminaries


Unit-2:
Input, Output, Reading and Subsetting


Unit-3:
Control Structures and Loop Functions


Unit-4:
Statistics functions - Debugging, Profiling

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.

Text Book:

Supplementary Books:

Course Outcomes (COs):

| 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. |

Outcome Mapping

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19PDSP26: Core Course 11 - Dot Net Programming Lab

Learning Objectives (LO):
To impart basic knowledge of different control statements and array associated with C# programming.
To learn various C# elements and OOPS concepts.
To learn interface, delegates, event and error handling concepts in C#.
To impart knowledge on networking including socket programming and reflection.
To acquire a working knowledge of windows and web based applications.

LIST OF EXERCISE

24
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

Course Outcomes (COs):
On successful completion of the course, the students will be able to:

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<td>Develop correct, well-documented C# programs using control statements.</td>
<td>Develop object oriented programming using C# classes and objects.</td>
<td>Handle the exception and event-driven programs.</td>
<td>Perform network based programming including chat applications.</td>
<td>Develop windows and web based applications.</td>
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Outcome Mapping:

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Learning Objectives (LO):
To understand and be able to use the basic programming principles such as data types, variable, conditionals, loops, array, recursion and function calls.
To learn how to use basic mathematical problems are evaluated and be able to manipulate text files and file operations.
To understand the process and will acquire skills necessary to effectively attempt a programming problem and implement it with a specific programming language - 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

Course Outcomes (COs):

<table>
<thead>
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<th>CO1</th>
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<tbody>
<tr>
<td>Understand and summarize different File handling operations in R.</td>
<td>Design and develop Client Server network applications using R.</td>
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Outcome Mapping:

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SEMESTER – III

19PDSC31: Core Course 13 – Cryptography And Network Security Credits:5 Hours:5

Learning Objectives (LO):
To understand Cryptography Theories, Algorithms and Systems.
To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.
To know about the malicious software & firewalls.

Unit- 1:


Unit- 2:


Unit- 3:

Unit- 4:

Unit- 5:

Text books:

Supplementary Books:

Course Outcomes (COs):

At the end of the course, the student should be able to:

<table>
<thead>
<tr>
<th>CO1: Understand the fundamentals of networks security, security architecture, threats and vulnerabilities</th>
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<tr>
<td>CO2: Apply the different cryptographic operations of symmetric cryptographic algorithms</td>
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<td>CO3: Apply the different cryptographic operations of public key cryptography</td>
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<td>CO4: Apply the various Authentication schemes to simulate different applications.</td>
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<tr>
<td>CO5: Understand various Security practices and System security standards</td>
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27
19PDSC32: Core Course 14 – Data Analytics Using Python  Credits:5
Hours:5

Learning Objectives (LO):
To introduce the programming concepts and techniques.
To introduce the Python language syntax.
To learn control statements, loops, functions, and lists.
To write programs for a wide variety problems in maths, science, finance, and games.
To analyze and design programs.

Unit-1:

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:

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.

Text Book:

Supplementary Books:

Course Outcomes (COs):

| CO1: | Analyze and design strategies for solving basic programming problems. |
| CO2: | primitive data types, selection statements, loops, functions to write programs. |
| CO3: | Use 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. |

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19PDSC33: Core Course 15– Machine Learning Credits: 4 Hours: 4

Learning Objectives (LO):
To Learn about Machine Intelligence and Machine Learning applications
To implement and apply machine learning algorithms to real-world applications.
To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
To understand how to perform evaluation of learning algorithms and model selection.

UNIT-1:

UNIT-2:

UNIT-3:

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

UNIT-5:


Text Book:

Supplementary Books:

Course Outcomes (COs):

On completion of the course students will be expected 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 unsupervised learning. |
| CO4  | Be able to design and implement various machine learning algorithms in a range of real-world applications. |

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19PDSP36: Core Course 16 – Data Analytics Using Python Programming Lab Credits:2 Hours:4

Learning Objectives (LO):

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

LIST OF EXERCISES

• Write a Python program to sum all the items in a list.
- Write a Python program to get the largest number from a list.
- Write a Python program to remove duplicates from a list.
- 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).
- Write a Python program to split a list into different variables.
- Write a Python program to print a nested lists (each list on a new line) using the print() function.
- Write a Python program to create a list with infinite elements.
- Write a Python program to access dictionary keys element by index.
- Write a Python program to remove duplicates from a list of lists.

Course Outcomes (COs):

<table>
<thead>
<tr>
<th>CO1:</th>
<th>Understand and summarize different File handling operations in Python.</th>
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<tbody>
<tr>
<td>CO2:</td>
<td>Design and develop Client Server network applications using Python.</td>
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Outcome Mapping:

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19PDSP37: Core Course 17 - Machine Learning Lab

Learning Objectives (LO):

- To expose the students in emerging technologies in the areas of machine learning.
- To make use of Data sets in implementing the machine learning algorithms.
- To implement the machine learning concepts and algorithms.
- To develop a basic understanding of the principles of machine learning.
- To derive practical solutions using predictive analytics.
- To understand which techniques are more appropriate for which problems.

LIST OF EXERCISES

- Reading and writing into .csv files
- Implement the Find –S algorithm.
- Implement the Candidate-Elimination algorithm.
- Classify a sample using ID3 algorithm.
- Build an artificial neural network by implementing backpropagation algorithm.
- Construct the naïve Bayesian classifier for classification.
- Construct a naïve Bayesian classifier and evaluate the classifier with accuracy, precision, and recall metrics.
- Implement the k-Nearest Neighbour algorithm to classify the data set.
- Implement the non-parametric Locally Weighted Regression algorithm.

Course Outcomes (COs):

On successful completion of the course, the students will be able to
Learning Objectives (LO):

This course will enable students to:
- To learn the concepts of big data analytics
- To understand the methodologies of big data analysis.
- To study mathematical and statistical concepts related to big data analysis.
- To practice with modern computing big data technologies
- To provide better understanding for applications of associated computing techniques and technologies like Hadoop and map reduce

Unit-1:


Unit-2:


Unit-3:


Unit-4
**Frequent Itemsets and Clustering:** Mining Frequent Itemsets - Market Based Model – Apriori Algorithm – Handling Large Data Sets in Main Memory – Limited Pass Algorithm – Counting Frequent Itemsets 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:** Background and fundamentals-moving data in and out of Hadoop-data serialization-applying MapReduce 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.

**Text Books:**

**Supplementary Books:**

**Course Outcomes (COs):**
On successful completion of the course, the students will be able to

| CO1: | Identify the characteristics of datasets for various applications. |
| CO2: | Select environment for the applications. |
| CO3: | Solve problems associated with big data characteristics. |
| CO4: | Integrate mathematical and statistical tools with modern technologies like Hadoop and Mapreduce |
| CO5: | Provide better solutions and develop applications to the problem associated with big data |

**Outcome Mapping:**

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19PDSC42: Core Course 19– Software Project Management

Credits: 5
Hours: 5

Learning Objectives (LO):
This course will enable students to:
- Understand the framework of project management
- Learn to monitor and control the project
- Know the sound knowledge in Agile method
- Know the team, cost, quality and resource management
- Identify and control the risk in the projects

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:

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:

Unit-5:

Text Books:

Supplementary Books:

1. Futrell, "Quality Software Project Management", Pearson Education India.

Course Outcomes (COs):

| 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 success. |
| CO5: | Adapt projects in response to issues that arise internally and externally. |

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ELECTIVES

19PDSE24: 11 – Fundamentals of Business Statistics

Credits: 3
Hours: 3

Learning Objectives (LO):

Students will understand the importance of data-driven business decisions and the basic role of probability in business decision making.

To understand the importance of business sampling methods, and be able to describe different business sampling methods.

Unit-1:
Introduction: Demographic data collection, View Videos of Data Analytics Business Applications, Types of Data and Data Sources. Sample vs. Population. Sampling Ideas. Introduction to Sample Project.

Unit-2:


Unit-3:


Unit-4:


Unit-5:


**Text Book:**


**Supplementary Books:**


**Course Outcomes (COs):**

| CO1: | Apply knowledge to solve simple tasks using computer tools. |
| CO2: | Independently calculate basic statistical parameters (mean, measures of dispersion, correlation coefficient, indexes). |
| CO3: | Choose a statistical method for solving practical problems. |

**Outcome Mapping:**
Learning Objectives (LO):

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

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.

Text Books:

Supplementary Books:

Course Outcomes (COs):

| CO1 | Understand the fundamental advantage and necessity of forecasting in various situations. |

19PDSE24: 12 – Time Series Analysis and Forecasting
Credits: 3
Hours: 3
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.

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19PDSE24 13 – Multivariate Data Analytics

Credits: 3
Hours: 3

Learning Objectives (LO):

Obtain knowledge on sampling, tests of hypothesis, and statistical tests like Multiple Regression and Canonical correlation.

Train the students to use time series models like vector and matrices, Distance Measures and Factor Analysis.

Unit-1:

**Basic concepts**: Variate, Measurement Scale, Statistical significance and power, missing data, outlier detection and handling, transformations to achieve normality, linearity, homoscedasticity, 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.


Text book:

Supplementary Books:

Course Outcomes (COs):

| 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. |

Outcome Mapping:

| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
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19PDSE25 21 – Introduction to Data Mining

Learning Objectives (LO):

To identify the scope and necessity of Data Mining and Warehousing.
To understand various tools of Data Mining
To develop ability to design various algorithms based on data mining tools.

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:

Unit-4:

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.

Text Books:

Supplementary Books:

Course Outcomes (COs):

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

Outcome Mapping:

| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
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19PDSE25: 22 - Web Database and Information System
Credits: 3
Hours: 3

Learning Objectives (LO):
Understand how n-tiered architectures can be used to implement secure, scalable systems
Design and develop database-driven websites and applications
Understanding XML as a messaging and data exchange mechanism
Understand Web “semantic systems,” such as auctions, recommendation systems, and search ranking.
Understand critical components of the modern Web infrastructure: DNS, Content Delivery Networks, etc.

Unit-1:


Unit-2:


Unit-3:


Unit-4:


Unit-5


Textbook:

Supplementary Books:

Course Outcomes (COs):

Students 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. |

Outcome Mapping:
Learning Objectives (LO):
To learn the fundamentals of Green Computing.
To analyze the Green computing Grid Framework.
To understand the issues related with Green compliance.
To study and develop various case studies.

Unit-1:
Fundamentals

Unit-2:
Green Assets and Modeling

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

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.

Text Books:
2. Woody Leonhard, Katherine Murray, —Green Home computing for dummies, August 2012.
Supplementary Books:

5. Wu Chun Feng (editor), —Green computing: Large Scale energy efficiency, CRC Press

Course Outcomes (COs):

Upon completion of the course, the students 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. |

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19PDSE34: 31 - Management Decision Analysis

Credits : 3
Hours: 3

Learning Objectives (LO):

To understand the statistical concepts and take managerial decisions
To learn the time series models and problem formation terminals for management decision making by applying time series models.

Unit-1:

Introduction: Concepts with methodologies for data analysis, Probability and significance as a measure of uncertainty; Discrete and continuous random variables with practical applications, Introduction to sampling and statistical inference.

Unit-2:

Principles and Analysis: Introduction to various Multivariate Data Analysis like Linear and Multiple regression models with different forecasting techniques, Conjoint Analysis, Canonical Correlation, Cluster Analysis.

Unit-3:
**Time Series Analysis:** Multidimensional Scaling, Structural Equation Modeling, ARCH, GARCH, PC-GARCH, E-GARCH, O-GARCH, AGARCH.

**Unit-4:**

**Problem formulation techniques and concepts:** Multiple Objective Decision Making (MODM), Multiple Criteria Decision Making (MCDM); Decisions under uncertainty, concept of Fuzzy logic and its use in MODM and MCDM. Different methodology of optimization and decision making like Data Envelopment Analysis (DEA), Analytical Hierarchy Process (AHP); Statistical Decision Trees and its Applications.

**Unit-5:**

**Utility analysis:** Utility analysis and its significance to MCDM and MODM, Concepts of heuristic approaches with introduction to Genetic Algorithm (GA), Tabu Search (TS), Artificial Immune System (AIS), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Simulated Annealing (SA).

**Textbook:**

**Supplementary Books:**

**Course Outcomes (COs):**

| CO1: Make decision on the managerial problem |
| CO2: Apply the statistical methods for real time problems |
| CO3: Solve the Complicated problem with the help of decision making optimization strategies |

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19PDSE34: 32 Soft Skills Development

**Learning Objectives (LO):**

To develop the soft skill among the students.
To impart the student knowledge in developing the positive attitude and art of speaking and writing.
To indulge the students to improve the body language group discussion and time management.

Unit-1:

Soft skills and developing positive Attitude
Soft skills: introduction – what are soft skills? - selling your soft skills - attribute regarded as soft skills – soft skills – social- soft skills- thinking – soft skills – Negotiating –exhibiting your soft skills- indentifying your soft skills- improving your soft skills - soft skills training –train yourself-top 60 soft skills.
Developing positive attitude: introduction – meaning - features of attitudes- attitude and behavior formation of attitudes– change of attitudes – what can you do to change attitude?-ways of changing attitude in a person – attitude in a workplace – the power of positive attitude-developing positive attitude-example of positive attitude- example of negative attitude-over coming negative attitude- negative attitude and its result.

Unit-2:

Art of speaking and writing
Art of speaking: Introduction-what make communication important? - Defining communication-special features of communication –communication process- channel of communication-importance of communication - tips for effective communication - tips for powerful presentation-art of public speaking - importance of public speaking.

Unit-3:

Body language
Introduction – body talk – voluntary and involuntary body language-forms of body language-parts of body language - origin of body language - uses of body language - body language in building interpersonal relations – body language in building industrial relations-reason to study body language-improving your body language – types of body language-Gender differences-female interest and body language - shaking hands with women - interpreting body language-developing confidence with correct body language.

Unit-4:

Group discussion
Introduction – meaning of GD – why group discussion? - characters tested in a GD – tips on GD – types of GD - skills required in a GD - consequences of GD - behavior of a GD - essential elements of GD - different characters in GD - traits tested in a GD - GD etiquette - areas to be concentrated while preparing for a GD - imitating a GD - techniques to initiate a GD - Non-verbal communication in GD – movement and gestures to be avoided in a GD-topics for GD.

Interview skills
Introduction – why an interview?- types of interview - interview panel-types of questions asked-reason for selecting a candidate –reason for rejecting a candidate – on the day of interview– on the interview table – attending job fair-common mistakes that you wouldn’t want to do-questions the candidate should not ask during the interview – post- interview etiquette-how does one follow up?-telephonic interview –dress code at interview – typical questions asked – interview mistakes –quick tips- how to present well in interview –tips to make a good impression in an interview – job interview-basic tips-how to search for job effectively – interview quotations.
Unit-5:

**Time management**

Introduction- the 80:20 rule- take a good look at the CO1ple around you- examine your work-sense of time management – time is money – features of time- three secrets of time management - time management matrix- analysis of time matrix-effective scheduling – grouping of activities – five steps to successful time management –difficulties in time management- evils of not planning - time management is a myth – overcoming procrastination – ways of find free time - time management tips for students – interesting facts about time- ideal way of spending a day- time savers – realizing the value of time-time circle planner.

**Text Book:**

**Supplementary Books:**

**Course Outcomes (COs):**

<table>
<thead>
<tr>
<th>CO1:</th>
<th>The students community enrich the knowledge in the field of soft skills</th>
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<tbody>
<tr>
<td>CO2:</td>
<td>They can able to cope up with recent development in business world</td>
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<td>CO3:</td>
<td>The students will have the powerful knowledge in attitude and personality</td>
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**Outcome Mapping:**

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19PDSE34: 33 - Financial Risk Analytics And Management

Credits : 3
Hours:3

**Learning Objectives (LO):**

- To identify the different risks involved in Finance arena.
- To understand and solve the different risks pertaining to stock market and its instruments.
- To analyze the legal issues affecting the business.

**Unit-1:**

Introduction to Risk -Understanding Risk- Nature of Risk, Source of Risk, Need for risk
management, Benefits of Risk Management, Risk Management approaches. Risk Classification- credit risk, market risk, operational risk and other risk

Unit-2:
Risk Measurements - Measurement of Risk – credit risk measurement, market risk measurement, interest rate risk measurement, Asset liability management, measurement of operational risk

Unit-3:
Risk Management- Risk management- Managing credit risk, managing operational risk, managing market risk, insurance

Unit-4:
Risk in Instruments - Tools for risk management – Derivatives, combinations of derivative instruments, Neutral and volatile strategies, credit derivatives, credit ratings, swaps

Unit-5:
Regulation and Other Issues: Other issues in risk management – Regulatory framework, Basel committee, legal issues, accounting issues, tax issues, MIS and reporting, integrated risk management

Text Book:

Supplementary Books:

Course Outcomes (COs):
Students will be able to:

<table>
<thead>
<tr>
<th>CO1:</th>
<th>Identify and categorize the various risks faced by an organization.</th>
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<td>CO2:</td>
<td>Explore the tools and practices needed to assess and evaluate financial risks.</td>
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<td>CO3:</td>
<td>Explore risk management practices in an industry.</td>
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<td>CO4:</td>
<td>Identify and solve legal issues that impact financial and other risk affecting business.</td>
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Outcome Mapping:

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19PDSE35: 41 - Image and Video Analytics

Credits: 3
Hours: 3

Learning Objectives (LO):
To teach the fundamentals of digital image processing, image and video analysis.
To understand the real time use of image and video analytics.
To demonstrate real time image and video analytics applications and others.

Unit-1:


Unit-2:


Unit-3:


Unit-4:


Unit-5:

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

Textbook:

Supplementary Books:

Course Outcomes (COs):

Students will be able to:

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<td>Describe the fundamental principles of image and video analysis and have an idea of their application.</td>
<td>Apply image and video analysis in real world problems.</td>
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</table>

Outcome Mapping:

| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
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| CO1 | ✔   | ✔   | ✔   | ✔   | ✔   | ✔   | ✔   | ✔   | ✔     | ✔     | ✔     | ✔     | ✔     | ✔     | ✔     | ✗     |
| CO2 | ✔   | ✔   | ✔   | ✔   | ✔   | ✔   | ✔   | ✔   | ✔     | ✔     | ✔     | ✔     | ✔     | ✔     | ✔     | ✔     |
Learning Objectives (LO):
identify and articulate some basic ethical and policy-based frameworks
understand the relationship between data, ethics, and society
be able to critically assess their own work and education in the area of data science

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 dataveillance practices, Techniques of data ethics, Getting from data to individuals: Internet traces and Geofingerprints.

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.

Text Book:
1. Ethics and Data Science by DJ Patil, Hilary Mason, Mike Loukides, Publisher: O'Reilly Media, Inc., 2018.

Supplementary Books:

Course Outcomes (COs):

<table>
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<tr>
<th>CO1:</th>
<th>Know the ethics of data science.</th>
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<tr>
<td>CO2:</td>
<td>Apply data representation and techniques to solve real-world problems.</td>
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<td>CO3:</td>
<td>Explore the different performance issues and tasks in parallel and distributed computing.</td>
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</table>
Learning Objectives (LO):
To learn how to use Cloud Services.
To implement Virtualization
To implement Task Scheduling algorithms.
Apply Map-Reduce concept to applications.
To build Private Cloud.

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:

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.

Text Book:

Supplementary Books:
Course Outcomes (COs):

| 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 |

Outcome Mapping:

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19PDSE42: 51 - Distributed and Parallel Computing |

Learning Objectives (LO):

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

Unit-1:


Unit-2:


Unit-3:


Unit-4:


Unit-5:
**High-Performance Computing:** Molecular Sciences- Communication- Multimedia Applications for Parallel and Distributed Systems- Distributed File Systems.

**Textbook**

**Supplementary Books:**

**Course Outcomes (COs):**
Students will be able to:

| CO1: | Explore the methodologies adopted for concurrent and distributed environment. |
| CO2: | Analyse the networking aspects of Distributed and Parallel Computing. |

**Outcome Mapping:**

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**19PDSE42: 52 - Healthcare Data Analytics**

**Credits : 3**

**Hours:3**

**Learning Objectives (LO):**
To explore the various forms of electronic health care information.
To learn the techniques adopted to analyse health care data.
To understand the predictive models for clinical data

**Unit -1:**

**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

**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.

**Textbook:**

**Supplementary Books:**

**Course Outcomes (COs):**

Students 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. |

**Outcome Mapping:**

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19PDSE42: 53- Business Intelligence

**Learning Objectives (LO):**

The student should be made to:
- Be exposed with the basic rudiments of business intelligence system
- Understand the modelling aspects behind Business Intelligence
- Understand of the business intelligence life cycle and the techniques used in it
- Be exposed with different data analysis tools and techniques

**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:


Text Books:

Supplementary Books:

Course Outcomes (COs):

| 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. |

Outcome Mapping:

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