M.Sc. Mathematics (Five-Year) Programme

Regulations & Curriculum-2019

DST-FIST Assisted
Department of Mathematics
These Regulations are common to all the students admitted to the Five Year Integrated Master’s Programmes in the Faculties of Arts, Science, Languages, Marine Sciences, and Education 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 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 of 90 working 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 Experiential Learning is a process of learning through experience. It is specifically defined as “learning through reflection on doing”.

1.15 Extension activities are the activities that provide a link between the University and the community such as lab-to-land, literacy, population education, and health awareness programmes. These are integrated within the curricula with a view to sensitise the students about Institutional Social Responsibility (ISR).

1.16 Credit refers to the quantum of course work in terms of the 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.

1.17 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.
1.18 **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.

1.19 **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.

1.20 **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.

1.21 **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.

1.22 **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.

1.23 **Cumulative Grade Point Average (CGPA)** is a measure of the overall cumulative performance of a student in all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters.

1.24 **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, and RA.

2. **Programmes Offered and Eligibility Criteria**

The Department of Mathematics offers a Five Year M.Sc. Mathematics Programme.

<table>
<thead>
<tr>
<th>Faculty of Science</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Sc. Mathematics</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto with a minimum aggregate of 40% marks under academic stream in the following subjects viz. Mathematics, Physics &amp; Chemistry.</td>
</tr>
</tbody>
</table>

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

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 Five Year Master’s Programmes consist of five academic years and ten semesters.

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 Five Year Integrated Programme consists of Language Courses, Core Courses, Allied Courses, Elective Courses, Soft Skills, Experiential Learning and Project. Students shall also participate in Extension Activities as part of their curriculum.

5.2 **Language Courses**

5.2.1 Each student shall take two languages of four courses each, one in each semester for the first two years of the programme.

5.2.2 Language-I shall be Tamil or another language such as Hindi or French.

5.2.3 Language-II shall be English.
5.3 Core courses
5.3.1 These are a set of compulsory courses essential for each programme.

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

5.4 Allied Courses
5.4.1 Each student shall take courses in two disciplines allied to the main subject (Allied-I and Allied-II) of the programme in the first four semesters.

5.4.2 In Arts, Languages, and Education, there will be three Theory Courses each for Allied-I and Allied-II.

5.4.3 In Science and Marine Sciences, there will be two Theory courses and one Practical course each for Allied-I and Allied-II.

5.5 Elective Courses
5.5.1 Departmental Electives (DEs) are the electives that students can choose from a range of Electives offered within the Parent Department offering the Programme.

5.5.2 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.

5.5.3 Students shall take a combination of both DEs and IDEs.

5.6 Soft Skills
5.6.1 Soft skills are intended to enable students to acquire attributes that enhance their performance and achieve their goals with complementing hard skills.

5.6.2 Soft skills include communication skills, computer skills, social skills, leadership traits, team work, development of emotional intelligence quotients, among others.

5.6.3 Each student shall choose four courses on soft skills from a range of courses offered from the First to the Sixth Semester.

5.7 Value Education
All students shall take a course on Value Education that includes human values, sustainable development, gender equity, ethics and human rights.

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

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

5.9 Extension Activities
5.9.1 It is mandatory for every student to participate in extension activities.

5.9.2 All the students shall enrol under NSS/NCC/YRC/RRC or any other Service Organisation in the University.

5.9.3 Students shall put in a minimum attendance of 40 hours in a year duly certified by the Programme Co-ordinator.

5.9.4 Extension activities shall be conducted outside the class hours.
5.10 Project
5.10.1 Each student shall undertake a Project in the final semester.

5.10.2 The Head of the Department shall assign a Project Supervisor to the student.

5.10.3 The Project Supervisor shall assign a topic for the project and monitor the progress of the student periodically.

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

5.11 Value Added Courses (VACs)
5.11.1 Students may also opt to take Value Added Courses beyond the minimum credits required for the award of the Degree. VACs are outside the normal credit paradigm.

5.11.2 VACs enhance the students’ employability and life skills. VACs are listed on the University website and in the Handbook on Interdepartmental Electives and VACs.

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

5.11.4 Classes for VACs are conducted beyond the regular class hours and preferably in the VIII and IX Semesters.

5.12 Online Courses
5.12.1 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.

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

5.12 Credit Distribution
The credit distribution is detailed in the Table.

<table>
<thead>
<tr>
<th></th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester I to VI</td>
<td></td>
</tr>
<tr>
<td>Language-I (Tamil or any other Language)</td>
<td>12</td>
</tr>
<tr>
<td>Language-II (English)</td>
<td>12</td>
</tr>
<tr>
<td>Core Courses</td>
<td>60-65</td>
</tr>
<tr>
<td>Allied-I</td>
<td>10</td>
</tr>
<tr>
<td>Allied-II</td>
<td>10</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Soft skills</td>
<td>12</td>
</tr>
<tr>
<td>Environmental studies (UGC mandated)</td>
<td>2</td>
</tr>
<tr>
<td>Value Education</td>
<td>2</td>
</tr>
<tr>
<td>Experiential learning</td>
<td>4</td>
</tr>
<tr>
<td>Extension activities</td>
<td>1</td>
</tr>
<tr>
<td>Total Credits (Semester I to VI)</td>
<td>140-145</td>
</tr>
<tr>
<td>Semester VII to X</td>
<td></td>
</tr>
<tr>
<td>Core Courses</td>
<td>65-75</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>6-8</td>
</tr>
<tr>
<td>Total Credits (Semester VII to X)</td>
<td>90-95</td>
</tr>
<tr>
<td>Total Credits Semester I to X (Minimum requirement for the award of Degree)</td>
<td>230-240</td>
</tr>
</tbody>
</table>
*Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 230-240 credits.

5.13 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 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.

6 Attendance
6.1 Each faculty handling a course shall be responsible for the maintenance of *Attendance and Assessment Record* for students 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 organisation of lesson plan of the Course Instructor.

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

6.4 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.

6.5 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.

6.6 Each student should earn a minimum of 75% attendance in 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.

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 a 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, seminars, and viva-voce that would be suitable for the course. 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 pattern of question paper will be decided by the respective faculty.

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

8.4.5 CIA Tests will be for one to three 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.

8.5 **End Semester Examinations (ESEs)**

8.5.1 The ESEs for the odd semester will be conducted in November and for the even semester in May.

8.5.2 A candidate who does not pass the examination in any course(s) will be permitted to reappear in such course(s) in the subsequent semester/year.

8.5.3 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 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.

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 constitute 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:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I &amp; Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Seminar</td>
<td>5</td>
</tr>
<tr>
<td>Assignment</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

9.2.3 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>

9.3 **Assessment of End-Semester Examinations**

9.3.1 Double Evaluation for the ESE is done by the University Teachers.

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

9.4 **Assessment of Project/Dissertation**

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

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

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

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 of the Head of the Department, Project Supervisor, and a senior faculty.

9.4.7 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>

9.5 **Assessment of Value Added Courses**

9.5.1 VACs shall be evaluated completely by Internal Examiners.

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

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

9.5.4 The grades obtained in VACs will not be included for calculating the GPA.
9.6 Passing Minimum

9.6.1 A candidate is declared to have passed in each course if he/she secures not less than 40% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.6.4 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 of 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 from the first semester to the current semester.

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, \( C_i \) 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.

11.4 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.

11.5 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>
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 8.25 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).

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

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

11.6.4 Candidates who obtain highest marks in all examinations at the first appearance alone will be considered 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 candidate 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 completed successfully, 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 student has re-appeared.

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 or more 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.

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

12.4 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.

12.5 Withdrawal is not granted for arrear examinations of courses in previous semesters (for which the student has secured RA Grade) and for the final semester examinations.

12.6 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) in the subsequent semester.

12.7 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the student 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 department library or computer resources, stealing other students’ notes/assignments, 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.

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 Five Year Integrated 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.
<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</td>
<td>P</td>
</tr>
<tr>
<td><strong>Semester-I</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19ITAC11</td>
<td>Language-I: Course 1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19IENC12</td>
<td>Language-II: Course 1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19ICEC13</td>
<td>Civics, Environmental Awareness and Health Sciences</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19IPHY14</td>
<td>Ancillary- Physics -I</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>19IMAT15</td>
<td>Core 1: Classical Algebra</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Elective: Matrices</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Semester-II</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19ITAC21</td>
<td>Language-I: Course 2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19IENC22</td>
<td>Language-II: Course 2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19ICAC23</td>
<td>Computer Applications – I</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19IPHY24</td>
<td>Ancillary-Physics –II</td>
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<td>4</td>
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<tr>
<td></td>
<td>Ancillary–Physics Practical</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>19IMAT25</td>
<td>Core 2: Trigonometry</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>19IMAT26</td>
<td>Core 3: Differential Calculus</td>
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<td>5</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Semester-III</strong></td>
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<td></td>
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</tr>
<tr>
<td>19ITAC31</td>
<td>Language-I: Course 3</td>
<td>3</td>
<td>3</td>
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Value Added Courses
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.

### Elective Courses

#### Department Elective (DE)

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**Value Added Course**

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19IMAT - Core Course;
Elective Course (IDE) - Inter Department Elective Course;
Elective Course (DE) - Department Elective Course;
19IMAP - Practical;
19IMAD - Project (Dissertation & Viva-voce);
IA – Internal Assessment Evaluation Marks;
E - End Semester examination marks.
* - 75 Marks = 50 [Valuation of Dissertation] + 25 [Viva]

Students can take courses available in MOOC / SWAYAM portal and the marks obtained in the courses are added in the mark statement under the head “Extra Credit Courses”.

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Programme Outcomes

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

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

- **PSO1**: Improve the problems solving skills.
- **PSO2**: Collaborate with the other related areas of science.
- **PSO3**: Improve the theoretical knowledge of Mathematical concepts.
- **PSO4**: Creatively applying the knowledge of Mathematics in selected real life situations.
Syllabus

Language-I – தமிழ்

Course 1 - 19ITAC11: நவீன இலக்கியமும் நாடகமும்

முடிவுப் பெற்றது: 75

கிரடை: 3

குருக்கள்: குருக்களும் செயலாளரினரும் தமிழ் துறையில் வேட்டையாடும் கருத்துறை விளக்கங்களை வேளாண்டுதல் - குருக்கள் பிரிவுகளிடம் - குருக்கள் துறையில் வேட்டையாடும் விளக்கங்களை வேளாண்டுதல். துறையில் வேட்டையாடும் கருத்துறை வேளாண்டுதலுக்கு முன்னர் பொருள் புகைப்படுத்தும் புகைப்படுத்தும் புகைப்படுத்தும் புகைப்படுத்தும்.

அலகு – 1: விளக்கம்
1. பத்தேவுப்புக்கள் - புத்தரமலர் பிரிவு
2. சின்னநாயகமாள் - கதை
3. அரசியல்கள் - புரட்சிக்கட்டியங்கள்
4. கருவடை கோரமாட்டு - பி.பி.சு. கதை
5. வைதிகத்துவம் வாங்குகார்கள் - சிறுமியர் பி.பி.

அலகு – 2: பத்தேக்லிகை
1. பாடல்வரை - பத்தேல்லேக்லிகை
2. பாடல்வரைகள் - தமிழ் வரககள்
3. வேலைகள் வரைகள் கோட்டாக - பெட்டின் வாரகுக்கள்
4. வேலைகள் கோட்டாக - புரட்சிகள்
5. அறிவுத் துறை - புத்தரமலர் (பாரம்பரியம் 20 மாணந்து)
6. பிரதேசங்கள் - புத்தரமலர் (பாரம்பரியம் 20 மாணந்து)

அலகு – 3: பதிவு
1. பாடல்வரைப் பதிவு - பாடல்வரைப் பதிவு

அலகு – 4: தொகும்
1. சின்னநாயகமாள் - கதை

அலகு – 5: துறையில் வாழ்த்துக்கள்
துறையில் வாழ்த்துக்கள் - துறையில் வாழ்த்துக்கள் ஆசிரியர் - புத்தேக்லிகை. துறையில் வாழ்த்துக்கள் ஆசிரியர் - புத்தேக்லிகை. துறையில் வாழ்த்துக்கள் ஆசிரியர் - புத்தேக்லிகை. துறையில் வாழ்த்துக்கள் ஆசிரியர் - புத்தேக்லிகை.

பாடல் களிப்
1. பாடல்வரை - பாடல்வரைகள் கதைகலாகம், இவை செய்தல் பக பாறை, ச௏லோர
2. பாடல்வரைகள் - பாடல்வரைகள் கதைகலாகம், மூழ்கலகால் பக்கப்படுத்து, ச௏லோர
3. வேலைகள் வரைகள் - பெட்டின் வாரகுகள் வார்த்தை, மூழ்கலாகம் பக்கப்படுத்து, ச௏லோர
4. வேலைகள் வரைகள் - பெட்டின் வாரகுகள் வார்த்தை, மூழ்கலாகம் பக்கப்படுத்து, ச௏லோர
5. கதை - கதையாக பாறை பக்கப்படுத்து, பாலராம், சென்றால்
6. பாடல்வரை - பாடல்வரைகள் கதைகலாகம், இவை செய்தல் பக பாறை, ச௏லோர
Learning Objective (LO):
By introducing the course, it is intended to:

LO1: Develop the Language ability of the students
LO2: Enable students to understand the passage, to read fluently, to enrich their vocabulary, and to enjoy reading and writing
LO3: Make the students proficient in the four language skills
LO4: Make the students read with correct pronunciation, stress, intonation, pause, and articulation of voice
LO5: Develop their inquiry skill

Unit-1:
Stephen Leacock  “With the Photographer”
Winston S. Churchill “Examinations”
Grammar: Introduce the Parts of speech Nouns, Verbs, Adjectives, and Adverbs

Unit-2:
G.B. Shaw “Spoken English and Broken English”
M.K. Gandhi “Voluntary Poverty”
Grammar: Articles

Unit-3:
Robert Lynd “On Forgetting”
Virginia Woolf “Professions for Woman”
Grammar: Pronouns

Unit-4:
A. G. Gardiner “On Umbrella Morals”
R.K. Narayan “A Snake in the Grass”
Grammar: Prepositions

Unit-5:
Martin Luther King (Jr.) “I Have a Dream”
George Orwell “The Sporting Spirit”
Grammar: Conjunctions & Interjections
Text Book:

Course Outcomes:
At the end of the course, the students will be able to:
   CO1: Competency in communication both in written and oral skills
   CO2: Fluency in the English language
   CO3: Knowledge about construction of sentence structures
   CO4: English Vocabulary to use the English language effectively
   CO5: Proficiency in the four communication skills

Semester-I 19IMAT15: Classical Algebra Credits: 5 Hours: 5

Learning Objective (LO): In this course students are exposed to topics like Theory of Equations, Summation of Series, Matrices and Elementary Number Theory. The stress is on the development of problem solving skills.

Unit-1: Theory of Equations
Polynomial Equations - Symmetric Functions of roots in terms of Coefficients - Sum of $r$-th powers of roots - Reciprocal Equations - Transformation of Equations.

Unit-2: Theory of Equations (Contd...)

Unit-3: Summation of Series
Summation of series using Binomial - Exponential and Logarithmic series (Theorems without proofs) - Approximation using Binomial & Exponential series.

Unit-4: Elementary Number Theory
Prime Number - Composite Number - Decomposition of a Composite Number as a Product of Primes uniquely (without proof) - Divisors of a Positive Integer - simple problems.

Unit-5: Elementary Number Theory (Contd.)
Congruence Modulo n - Euler Function (without Proof) - Highest Power of a Prime Number $p$ contained in $n!$ - Fermat's and Wilson’s Theorems (statements only).

Text Books:

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Apply the fundamental concept of theory of equations and to find solutions.
CO3: Apply summation of series using Binomial, Exponential and Logarithmic series for finding approximations.
CO4: Apply the elementary number theory for highest power of prime number.
CO5: Apply the elementary number theory for Fermat's and Wilson's theorem.

Outcome Mapping:

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Semester-I Elective: Matrices Credits: 3
Hours: 3

Learning Objective (LO): In this course students are trained to develop skills in finding rank, inverse, Eigen values, Eigen vectors and quadratic forms.

Unit-1:
Rank of the Matrix – Inverse of the Matrix.

Unit-2:

Unit-3:
Eigen values – Eigen vectors – Cayley Hamilton theorem.

Unit-4:
Diagonalisation by similarity transformation.

Unit-5:
Quadratic Forms – Nature of Quadratic Forms.

Text Book:

Supplementary Reading:
Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Find the rank and inverse of a matrix.
CO2: Find Eigen Values and Eigen Vectors.
CO3: Diagonalize the matrix using similarity transformation.
CO4: Find the nature of Quadratic forms.

Outcome Mapping:

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Language - I – தமிழ்
Course 2 - 19ITAC21: பக்தி இலக்கியம் சிவிலிகியம்

75

பக்தி இலக்கியம்:

1. கிருஷ்ணன் இவர்கள் - கிருஷ்ணன் - பக்த புத்தம் (பதின் 5 பாடல்கள்)
2. கிருஷ்ணன் - கிருஷ்ணன் (சலிபெட்டிமா மண்டகம், மபருகுகாநம, அந்தன் தம்பூம், அந்தன் பாதாகுமரத்கூரை, தது தைத்தி காலைசூர் பாடல்)
3. திவேந்தன் - திவேந்தன் (5 பாடல்கள்)

அலகு - 2: பக்தி இலக்கியம்
1. கோயில்கள் - கோயில்கள் (பதின் 5 பாடல்கள்)
2. தலைந்தவர் - தலைந்தவர் - புரேஷாகா முக்கியலூர்

அலகு - 3: பக்தி இலக்கியம்
1. தேங்கான் ஒல்கள் - பதின் ஒல்கள்
2. தேங்கான் ஒல்கள் - பாற்றாக்க பதின் ஒல்கள்

அலகு - 4: சிவிலிகியம்
1. மண்டகம் ஒல்கள் - மண்டகம் ஒல்கள் (மார்சு தருக்கம்... பாடல்கள்)
2. கோயில்கள் ஒல்கள் - தன்னை ஒல்கள்

அலகு - 5: சிவிலிய மராத்தி
பக்தி சிவிலிகியம் மராத்தி - சிவிலிகியம் தமிழ் குரு - பால் வல்லுறவு வகைக் குரு - கலன் பார்த்தி சமை சிவிலிகியம் குரு -
PART- II: Language - II – English
Credits: 3
Hours: 3

Learning Objective (LO):
By introducing the course, it is intended to:

LO1: Develop the ability of the learner to comprehend and appreciate poems in English
LO2: Enhance the competence of the learner in using the English language
LO3: Improve the interest of the learner in human values and perceptions
LO4: Enable students to study and analyze the use of language in poetry
LO5: Provide learners with the theoretical and practical understanding of grammar

Unit-1:
William Shakespeare  “Sonnet 116”
William Blake  “Lamb”
Robert Burns  “A Red, Red Rose”
Grammar  Finite & Non-finite verbs

Unit-2:
PB Shelley  “To Wordsworth”
John Keats  “Sonnet to Sleep”
Thomas Hardy  “Neutral Tones”
Grammar  Strong and Weak Verbs, Auxiliaries and Modals
Unit-3:
Robert Frost  
“Stopping By Woods on a Snowy Evening”
Wilfred Owen  
“Anthem for Doomed Youth”
Emily Dickinson  
“A Narrow Fellow in the Grass”
Grammar  
Transitive, Intransitive Verbs, Active and Passive Voice

Unit-4:
Sri Aurobindo  
“The Tiger and the Deer”
AK Ramanujan  
“Obituary”
Sarojini Naidu  
“Queen’s Rival”
Grammar  
Concord

Unit-5:
Roger Mc Gough  
“My Bus Conductor”
Maya Angelou  
“Still I Rise”
Langston Hughes  
“The Negro Speaks of Rivers”
Grammar  
Tenses and their forms

Supplementary Reading:

Course Outcomes:
At the end of the course, the students will be able to:
- **CO1:** Competency in communication, both in written and oral skills
- **CO2:** Fluency in English language
- **CO3:** Knowledge about construction of sentence structures
- **CO4:** Vocabulary to use the English language effectively
- **CO5:** Acquire the aesthetic sense for appreciating poetry

Semester-II  
19IMAT25: Trigonometry  
Credits: 5  
Hours: 5

**Learning Objective (LO):** This course is a fundamental one for many courses of this Degree Programme. This covers topics on the expansions of trigonometric functions, hyperbolic functions, inverse circular, inverse hyperbolic functions and it aims to develop computational skills.

**Unit-1:**

**Unit-2:**
Powers of sines and cosines of \( \theta \) in terms of functions of multiples of \( \theta \) – expansions of \( \sin \theta \) and \( \cos \theta \) in a series of ascending powers of \( \theta \) – Approximations.

**Unit-3:**
Definition – Relation between Hyperbolic Functions – Inverse Hyperbolic Functions.

**Unit-4:**
Resolution into Factors – simple problems only – DeMoivre’s property on the Circle and Cote’s Property on the Circle. Logarithm of complex quantities.

**Unit-5:**

**Text Book:**

Unit– I Chapter III sections 1 to 3
Unit– II Chapter III sections 4 and 5
Unit– III Chapter IV
Unit– IV Chapter V
Unit– V Chapter VI sections 1 to 3

**Supplementary Reading:**

**Course Outcomes:**
On successful completion of the course, the student will be able to:
CO1 : Apply for finding expansions of \( \cos n\theta \, \sin n\theta \, \text{and} \, \tan n\theta \) and formation of equations.
CO2: Apply for finding \( \cos \theta \, \sin \theta \) in a series of ascending powers of \( \theta \) and their approximation.
CO3: Apply for finding Hyperbolic and inverse Hyperbolic functions.
CO4: Apply for resolution into factors and study De-Moivre’s property.
CO5: Apply to evaluate the summation of trigonometric series and their differences, Gregory series and Euler series.

**Outcome Mapping:**

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**Semester-II** 19IMAT26: Differential Calculus  Credits: 5
**Learning Objective (LO):** This course develops problem solving skills in differential calculus and applications of differential calculus.

**Unit-1:**

The nth derivative, Leibnitz theorem and its applications, Total differential, \( \frac{d^2y}{dx^2} \) and \( \frac{dy}{dx} \) in terms of partial derivatives of \( f \) when \( f(x,y)=0 \), Jacobians.

**Unit-2:**

Maxima and minima of functions of two independent variables, Necessary and sufficient conditions, Lagrange’s method, Problems on maxima and minima (second order conditions must be verified for maxima and minima).

**Unit-3:**

Polar coordinates - Angle between radius vector and tangent, Angle of intersection of two curves, Slope of the tangent, Pedal equation of a curve, Simple problems.

**Unit-4:**

Curvature: Radius of curvature – Cartesian formula for radius of curvature – Parametric formula for radius of curvature – Radius of curvature in polar co-ordinates – Centre of curvature in Polar co-ordinates.

**Unit-5:**

Envelope of one parameter family of curves - Envelope of two parameter family – Asymptotes – Definition – Methods of finding Asymptotes to plane algebraic curves.

**Text Book:**

**Supplementary Reading:**

**Course Outcomes:**

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

**CO1:** Apply Leibnitz theorem for \( n^{th} \) derivative, total differentials in terms of partial derivatives and Jacobians.

**CO2:** Apply maxima and minima functions for two and three independent variables.

**CO3:** Apply for finding, angle between vectors, pedal equations and finding solutions.

**CO4:** Apply for finding radius of curvature and centre of curvature.

**CO5:** Apply for finding envelope and Asymptotes.

**Outcome Mapping:**

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Course 3 - 19ITAC31: மொழிப் பணியில் கருப்பியம்

பங்க்கு: 75

1. சில்பக்கல் - புலிய, புதுக்காலதமம், காப்பியூட்டு, தெரு

2. புதுமென்று தண்டனை - கலங்கு

3. பாதுகாக்கியம் - மூன்றாம் தோன்றிய காப்பியம்

4. பாதுகாக்கியம் - மூன்றாம் தோன்றிய காப்பியம்

5. காப்பியம் - மூன்றாம் பாதுகாக்கியம்

6. காப்பியம் - மூன்றாம் பாதுகாக்கியம்

7. காப்பியம் - மூன்றாம் பாதுகாக்கியம்

PART- II: Language - II – English
Learning Objective (LO):
By introducing the course, it is intended to:

LO1: Enhance the conversational competence of the learners by introducing drama in English.
LO2: Make the students understand characteristics of the Elizabethan Age.
LO3: Make the students appreciate Shakespearean drama.
LO4: Make the students learn the key elements of sentence structures.
LO5: Make the students master the mechanics of writing.

Unit-1:
William Shakespeare  The Tempest (Act I)
Grammar  “Phrases and Clauses”

Unit-2:
William Shakespeare  The Tempest (Act II)
Grammar  “Simple, Compound, and Complex Sentences”

Unit-3:
William Shakespeare  The Tempest (Act III)
Grammar  “Transformation of Sentences”

Unit-4:
William Shakespeare  The Tempest (Act IV)
Grammar  “Sequence of Tenses and Reported Speech”

Unit-5:
William Shakespeare  The Tempest (Act V)
Grammar  “Punctuation and Capitals”

Text Books:

Supplementary Reading:

Course Outcomes:
At the end of the course, the students will be able to:
CO1: Obtain a literary acumen to answer MCQs of NET/SET Examinations and other competitive examinations.
CO2: Appreciate conversational English.
CO3: Recognize the dramatic elements of Shakespearean dramas.
CO4: Use punctuations and capitals effectively in their Composition.
CO5: Recognize the elements of the spoken discourses.

Semester-III 19ISAT33: Mathematical Statistics – I Credits: 4

Hours: 4

Learning Objective (LO): The objective is to train students in some concepts in mathematical statistics. The notion of random variables, distribution function and characteristic functions are introduced. Some examples of discrete and continuous random variables are introduced and their properties are studied.

Unit-1: Random Variables
The concept of a random variable, The distribution function, Random variables of the discrete type and the continuous type, functions of random variables, Multi dimensional random variables, Marginal distributions, Conditional distributions, Independent random variables, Functions of multi dimensional random variables.

Unit-2: Parameters of the distribution of a random variable
Expected values, Moments, The Chebyshev inequality, Absolute moments, Order parameters, Moments of random vectors, Regression of first type, Regression of the second type.

Unit-3: Characteristic Functions
Properties of characteristic functions, The characteristic functions and moments, Emi invariants, The characteristic function of the sum of independent random variables, Determination of the distribution function by the characteristic function, The characteristic function of multidimensional random vectors, Probability generating functions.

Unit-4: Some Probability Distributions

Unit-5: Some Probability Distributions (Continued)

Text Book:

Unit – I Chapter 2: Sections 2.1 to 2.9.
Unit – II Chapter 3: Sections 3.1 to 3.8.
Unit – III Chapter 4: Sections 4.1 to 4.7.
Unit – IV Chapter 5: Sections 5.1 to 5.5.
Unit – V Chapter 5: Sections 5.6 to 5.12.

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the students will be able to:
CO1: Gains working knowledge related to the problems of theoretical statistics
CO2: Apply the fundamental concept of statistical methods to solve some real life problems
CO3: Gains a basic knowledge for study advanced courses in this area.

Outcome Mapping:

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Semester-III  
19IMAT34: Analytical Geometry 2D  
Credits: 5  
Hours: 5

Learning Objective (LO): Students are exposed to fundamental aspects of Two Dimensional Analytical Geometry and it develops logical and systematic computational skills.

Unit-1: Parabola  
Equation of a Parabola, Different forms, The Pole of line with Parabola.

Unit-2: Ellipse  
Equation of an Ellipse, Tangents and Normals drawn from ellipse.

Unit-3: Hyperbola  
Equation of Hyperbola, with other properties of hyperbola.

Unit-4: Polar Equations  
Transformation of polar co-ordinates into Cartesian co-ordinates and vice versa with other properties.

Unit-5: General Equation of the Second degree tracing of conics.

Text Book:

Unit – I: Chapter VI (Fully)  
Unit-II: Chapter VII (Fully)  
Unit- III: Chapter VII (Fully)  
Unit- IV: Chapter IX (Fully)  
Unit- V: Chapter X (Fully)

Supplementary Reading:

Course Outcomes:  
On a successful completion of the course, the students will able to  
CO1: Explain the fundamental concepts of analytical geometry in 2D about parabola, Equation of a Parabola, the pole of line with Parabola, Ellipse, equation of an Ellipse, tangent and normal drawn from Ellipse.  
CO2: Hyperbola, Equation of Hyperbola, Co-ordinates of a point on the Hyperbola in terms of a single parameter tangent and normal drawn from Hyperbola, Rectangular Hyperbola.
CO3: Transformation of polar co-ordinates into Cartesian co-ordinates and vice versa, parallel straight lines, the polar equation of a conic, general equation of the second degree tracing of conics.

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Semester-III 19IMAT35: Vector Analysis Credits: 5 Hours: 5

Learning Objective (LO): The objective of the module is to introduce and develop the methods of vector analysis. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also a fundamental tool in many theories of Applied Mathematics.

Unit-1: Vector Algebra
Vectors, Operations with vectors, Space coordinates, Resolution of vectors, Direction cosines and Direction ratios, Section formulae, Products of two vector, Scalars or dot product,

Unit-2: Vector Algebra contd.
Vector or cross product, Physical application, Product of three or more vectors, Scalar product of three vectors, Vector product of three vectors.

Unit-3: Differential Vector Calculus
Differentiation of a Vector - Geometrical Interpretation of the Derivative - Differentiation Formulae - Differentiation of dot and Cross Products - Partial Derivatives of Vectors - Differentials of Vectors.

Unit-4: Gradient, Divergence and Curl

Unit-5: Vector Integration
The Line Integral - Surface Integral and its Physical Meaning - Surface Integral and the Concept of Divergence of a Vector - Equivalence of two Definitions of Divergence - Statements of Gauss Divergence Theorem and Green’s Theorem (only) and Problems - Line Integral - The Concept of the Curl of a Vector - Statement of Stoke’s Theorem (only) and Problems.

Text Book:

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the students will be able to:
CO1: explain the fundamental concepts of vectors, direction cosines, direction ratios and workout scalar and vector products of two and three vector.
CO2: differentiate vector functions of a single variable, find the gradient, divergence and curl and prove identities involving them.
CO3: integrate vectors, compute line, surface and volume integrals in a vector field and verify Gauss, Stoke’s and Green’s theorem.

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Semester-III

Elective: Integral Calculus

Credits: 3
Hours: 3

Learning Objective (LO): In this paper the student is exposed to the idea of integration and different methods of integration. The application of integration to the evaluation of areas and volumes is also introduced.

Unit-1:
Introduction, Definite integral, Methods of integration, Integrals of the form

\[
\int \frac{f'(x)}{f(x)} \, dx
\]

\[
\int F[f(x)]f'(x) \, dx
\]

\[
\int \frac{dx}{ax^2+bx+c}
\]

\[
\int \frac{dx}{ax^2+bx+c}
\]

Unit-2:
Integration by parts, Bernoulli's formula, Reduction formula for the following types
\[ I_n = \int x^n e^{ax} \] for \( n \rightarrow +\text{ve integer} \)
\[ I_n = \int \cos^n x \, dx \] for \( n \), positive integer
\[ I_n = \int \sin^n x \, dx \]
\[ I_{m,n} = \int \sin^m x \cos^n x \, dx \]

**Unit-3:**
Change of order of integration – Properties of definite integrals.

**Unit-4:**

**Unit-5:**
Application of double and triple integrals – area, volume.

**Text Book:**

**Supplementary Reading:**

**Course Outcomes:**
On successful completion of the course, the students will be able to:
CO1: Solve problems using the different methods of integration.
CO2: Solve problems in double and triple integrals.
CO3: Apply double and triple integrals in finding area and volume.

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**Language-I – தமிழ்**

Course 3 - 19ITAC41: சங்க இலக்கியமும் சசம்சமாழி வரலாறும்

மேற்கைப்பட்டியல்

: 75

கணிப்பு: 3

சொகுத்தியல்: இந்த சமையல்நிலையின் வரலாறுக் கூறுகள் பெருக்கம். தமிழ் சிற்றியக்கோணம் குழு சிற்றியக்கோணம் காலத்தில் செப்பாள்ளுற்ற விளக்கம் - தமிழ் சிற்றியக்கோணம் சிற்றியக்கோணம் முன்பைன் விளக்கத்தை விளக்கம்.
அலகு - 1: குற்றியங்கள்
1. குற்றியக்க - 125, 129, 177, 302, 397 (பநய்தல்)
2. குற்றியக்க - 206, 217, 304, 334, 382 (குறிஃ)
3. குற்றியக்க - 17, 18, 71, 75, 96 (பநய்தல்)
4. குற்றியக்க - 147, 303, 370 (பநய்தல்)
5. குற்றியக்க - 104, 105 (பநய்தல்)

அலகு - 2: புற இலக்கியங்கள்
1. புறக் - பலோப்பனப்பறுப்புகள்
76, 83, 133, 146, 178, 188, 227, 261, 264, 278

அலகு - 3: குறுந்பதோரக

அலகு - 4: குறுந்பதோரக

அலகு - 5: பொண்டுப்பதோரக

பார்தவ நூல்கள்:
1. ச.வ.கிலாச்சுப்பிரமணியன் - குறுந்பதோரக, புத்தகப் புதிதல்

பார்தவ நூல்கள்:
2. ப.வ.கிலாச்சுப்பிரமணியன் - குறுந்பதோரக, புத்தகப் புதிதல்
4. ப.வ.கிலாச்சுப்பிரமணியன் - குறுந்பதோரக, புத்தகப் புதிதல், புத்தகப் புதிதல், 1987
PART- II: Language - II – English
Semester-IV Paper – IV – 19IENC42: English Through Literature IV: Short Story
Credits: 3
Hours: 3

Learning Objective (LO):
By introducing the course, it is intended to:
LO1: Develop the communicative competence of learners in the English Language through training them in the skills of listening, speaking, reading, and writing.
LO2: Enable the students to know about the origin and development of short story.
LO3: Write objectively, avoiding vague, prejudice, and exaggeration.
LO4: The broad aim of this course is to enable the learner to function through the written mode of English language in all situations including classroom, library, laboratory etc.
LO5: It also aims at different levels of a short story, such as discovering an author's purpose, drawing conclusions about certain events, evaluating cause and effect, and understanding point of view.

Unit-1:
1. O’ Henry
2. Ken Liu
   Grammar
   “The Gift of The Magi”
   “The Paper Menagerie”
   Synonyms and Antonyms

Unit-2:
1. Flora Annie Steel
2. Oscar Wilde
   Grammar
   “Valiant Vicky”
   “Happy Prince”
   Words often confused

Unit-3:
1. R. K. Narayan
2. Mahasweta Devi
   Grammar
   “The Martyr’s Corner”
   “Draupati”
   Paragraph-Writing

Unit-4:
1. Leo Tolstoy
2. Somerset Maugham
   Grammar
   “How much Land Does a Man Need?”
   “The Verger”
   Letter-Writing

Unit-5:
1. Langston Hughes
2. Premchand
   Grammar
   “On the Road”
   “BakthiMarg”
   Precis-Writing

Supplementary Reading:
Course outcomes:
At the end of the course, the students will be able to:
CO1: Use more vocabularies while writing.
CO2: Learner can ensure about the history and development.
CO3: The learner has a development in flow of writing.
CO4: Students can come up with new ideas while reading stories from different perspectives.
CO5: Write in a style appropriate for communicative purposes.

Semester-IV 191SAT43: Mathematical Statistics – II  Credits: 4
Hours: 4

Learning Objective (LO): The objective is to train students in some concepts in mathematical statistics. The theory of sample moments, significant test, sampling theory and analysis of variance are introduced. Practical problems are solved.

Unit-1: Sample Moments and their Functions
The notion of a sample- The notion of a statistic – the distribution of the arithmetic mean of independent normally distributed random variables – The x2 distribution – The distribution of the statistic (X, S) – Student’s t-distribution

Unit-2: Sample Moments and their Function (Contd...)

Unit-3: Significance Tests
The concept of a statistical test – Parametric tests for small samples – Parametric tests for large samples – The x² test – Independence tests by contingency tables.

Unit-4: Theory of sampling

Unit-5: Analysis of variance
One-way classification – Multiple classification – A modified regression problem.

Text Book:
Unit – I Chapter 9: Sections 9.1 to 9.6.
Unit - II Chapter 9: Sections 9.7 to 9.11.
Unit - III Chapter 12: Sections 12.1 to 12.4 & 12.7.
Unit - IV Chapter 13: Sections 13.1 to 13.5.
Unit - V Chapter 15: Sections 15.1 to 15.3.

Supplementary Reading:
Course Outcomes:
On successful completion of the course, the students will be able to:
CO1: Gains working knowledge related to the problems of theoretical statistics.
CO2: Apply the fundamental concept of statistical methods to solve some real life problems.
CO3: Gains a basic knowledge for study advanced courses in this area.

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Semester-IV 19IMAT44: Statics Credits: 5 Hours: 5

Learning Objective (LO): This course aims to provide basic skills and problem solving techniques in forces acting at a point, coplanar forces, moment of a set of concurrent forces, couples, reduction of coplanar system of forces, friction and equilibrium of strings and chains.

Unit-1:
Forces acting at a point, Resultant and components, Parallelogram of forces, Analytical expression for the resultant of two forces acting at a point, Triangle of forces, The polygon of forces, Lami’s theorem, An extended form of the Parallelogram law of forces, Resolution of a force, Components of a force, Resultant of any number of forces acting at a point, Conditions of equilibrium of any number of forces acting upon a particle.

Unit-2:
Parallel forces and Moments, The resultant of two like and unlike parallel forces acting on a rigid body, Resultant of a number of parallel forces acting on a rigid body, Conditions of equilibrium of three coplanar parallel forces, Centre of two parallel forces, Moment of a force, Varignon’s theorem of moments, Generalized theorem of moments.
Couples, Definition, Equilibrium of two couples, Equivalence of two couples, Couples in parallel planes, Representation of a couple by a vector, Resultant of a coplanar couples, Resultant of a couple and a force.

Unit-3:
Equilibrium of three forces acting on a rigid body, Rigid body subjected to any three forces, Three coplanar forces, Conditions of equilibrium, Procedure to be followed in solving any statical problem, Two trigonometrical theorems, Some artifices, Problems on parallel forces.

Unit-4:
Coplanar forces, Reduction of coplanar forces in general, Reduction of any number of coplanar forces, Conditions and alternative conditions for a system of forces to reduce to a single force or to a couple, Change of the base-point, Equation to the line of action of the resultant, Equation to the line of action of the resultant, General conditions of equilibrium.
Friction, Statical, Dynamical and Limiting frictions, Laws of friction, Coefficient of friction, Angle of friction, Cone of friction, Numerical values, Equilibrium of a particle on a rough inclined plane, Equilibrium of a body on a rough inclined plane.

Text Book:

Unit I - Chapters 2 all sections.
Unit II - Chapter 3 Sections 1to13 and
Chapter 4 all sections.
Unit III - Chapter 5 Sections 1 to 7.
Unit IV - Chapter 6 Sections 1 to 13.
Unit V - Chapter 7 Sections 1 to 13.

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to:

CO1: Apply the fundamental concept of statics to
   a. demonstrate the application of vectors for the analysis of static equilibrium ;
   b. analyze static equilibrium to particles and rigid bodies and apply the principles of
      equilibrium for analyzing beams.

CO2: Solve equations involving frictional, statistical, dynamical and limiting frictions.

CO3: Illustrate the mathematical aspects that provide the skills and problem solving in forces
      acting at a point, coplanar forces and equilibrium of strings and chains.

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Semester-IV  19IMAT45: Fourier Series and Fourier Transform

Learning Objective (LO): Introduce the Fourier series and its application and the concepts of
Fourier transforms.

Fourier Series:
Unit-1:
Introduction, Dirichlet conditions, Euler’s Formulae for Fourier Series, Theorem for the
convergence of Fourier series, Fourier Series for functions of period 2π . Examples.
Unit-2:
Change of Interval -Fourier Series for functions of period 2l, Dirichlet's conditions, Examples. Fourier Series of a function with its periodic extension.

Unit-3:

Fourier Transform:

Unit-4:

Unit-5:
Theorem Fourier Cosine & Sine Transforms and their properties, Parseval's Identity for Fourier Transform, Convolution Theorem for Fourier Transform, Examples.

Text Books:

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Find the Fourier series representation of a function of one variable.
CO2: Find the solution of the wave, diffusion and Laplace equations using the Fourier series.
CO3: Demonstrate the use of Fourier Transform to connect the time domain and frequency domain.

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Learning Objective (LO): To understand various limiting behavior of sequences and series to explore the various limiting processes viz. continuity, uniform continuity, differentiability and integrability and to enhance the mathematical maturity and to work comfortably with concepts.

Unit-1: Functions & Sequences

Unit-2: Sequences [Contd...]

Unit-3: Series of Real Numbers
Convergence and Divergence – Series with non negative terms – Alternating series – conditional convergence and Absolute convergence – Test for Absolute convergence.

Unit-4: Series of Real Numbers [Contd...], Limits and Metric Spaces
Series whose terms form a non increasing sequence – The class ℓ2 – Limit of a function on the real line – Metric spaces – Limits in Metric spaces.

Unit-5: Continuous Functions on Metric Spaces
Functions Continuous at a point on the real line – Reformulation – Functions Continuous on a Metric Spaces – Open Sets – Closed Sets.

Text Book:

Unit – I Chapter 1 Sections 1.4 to 1.7, 2.1 to 2.3
Unit – II Chapter 2 Sections 2.4 to 2.10
Unit – III Chapter 3 Sections 3.1 to 3.4 and 3.6
Unit – IV Chapter 3 Sections 3.7, 3.10, 4.1 to 4.3
Unit – V Chapter 5 Sections 5.1 to 5.5

Supplementary Reading:

Course Outcomes:
Students will be introduced to and have knowledge of many mathematical concepts
CO1: examples and counter examples
CO2: proof techniques
CO3: problem solving
studied in real analysis such as
• Real Valued Functions
• Convergence Sequence
• Cauchy Sequence
• Series of Real Numbers

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Semester-V  19IMAT52: Differential Equations and Applications  Credits: 5  Hours: 5

Learning Objective (LO): This course aims to provide logical skills in the formation of differential equations, to expose to different techniques of finding solutions to these equations and in addition stress is laid on the application of these equations in geometrical and physical problems. It also aims to provide logical skills in the formation and solutions techniques of partial differential equations.

Unit-1: Ordinary Differential Equations

Unit-2: Ordinary Differential Equations [Contd...]
Method of Variation of Parameters – 2nd order Differential Equations with Constant Coefficients for finding the P.I’s of the form eax V, where V is sin(mx) or cos(mx) and xn – Equations reducible to Linear equations with constant coefficients – Cauchy’s homogeneous Linear Equations – Legendre’s Linear Equations – Linear Dependence of Solutions – Simultaneous Equations with Constant Coefficients.

Unit-3: Laplace Transform
Laplace Transform, Inverse Laplace transform, Application to the first and second order linear differential equations and Simultaneous linear differential equations, Simple problems.

Unit-4: Partial Differential Equations
Partial differential equations: Formation of P.D.E. by eliminating arbitrary constants and arbitrary functions, Complete, Singular and General integral. Solution of equations of standard types: f(p,q)=0, f(x,p,q)=0, f(y,p,q)=0, f(z,p,q)=0, f(x,p)=f(y,q), and Clairaut's form. Lagrange's equation Pp+Qq=R, Simple problems.

Unit-5: Series Solution
Series solutions of first order equations, Second order linear equations, Ordinary points, Regular Singular Points and Legendre polynomials, Properties of Legendre polynomials and Bessel functions and their differential equations.

Text Books:
Content and treatment as in the following books:
   - Unit I  Chapter 2.
   - Unit II  Chapter 3.
   - Unit III  Chapter 7.
Unit IV - Chapter 5.


Unit V - Chapter 5 Sections 26 – 29
Chapter 8 Sections 44, 45 and 46
(except Gamma function)

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Explain the fundamental concepts of ordinary differential equations and their role in modern mathematics.
CO2: Use ordinary differential equations to model simple electric circuits, population growth and mass-spring systems, as well as other applications.
CO3: Demonstrate accurate and efficient use of the Laplace transforms and their applications in the solution of ordinary differential equations.
CO4: Apply problem-solving using concepts and techniques from ordinary differential equations and Laplace transforms relevant to diverse situations in physics, engineering, financial mathematics and in other mathematical contexts.

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Semester-V 19IMAT53: Dynamics Credits: 5 Hours: 5

Learning Objective (LO): This course aims to provide basic skills and problem solving techniques in kinematics of point and Newton's laws of motion. Projectiles and simple harmonic motions are studied in detail. Problems in moment of inertia are also considered. The course enhances the problem solving skill of the student.

Unit-1:
Kinematics, Speed, Displacement, Velocity, Composition of velocities; Parallelogram law, Resolution of Velocities, Components of a velocity along two given directions, Triangle of velocities, Theorem, Polygon of velocities, Theorem, Resultant of several simultaneous coplanar velocities of a particle, Relative velocity, Angular velocity, Angular velocity of a particle, Relative angular velocity, Change of velocity, Acceleration, Variable acceleration, Parallelogram law of accelerations, Relative acceleration, Motion in a straight line under uniform acceleration, Motion in a straight line with variable acceleration, Space-times graph, Velocity-time curve, Velocity-space graph, To derive graphically the equations of motion of a particle under constant acceleration,
Acceleration of falling bodies, Vertical motion under gravity, Bodies freely falling downward, Motion of a particle down a smooth inclined plane, Theorem, Lines of quickest descent, Theorem.

Unit-2:

Unit-3:
Projectiles: Two fundamental principles, Path of a projectile, Characteristics of the motion of a projectile, The horizontal range, The velocity at time t, Range on an inclined plane.

Unit-4:
Simple harmonic motion: Simple harmonic motion in a straight line, General solution of the S.H.M. equation, Geometrical representation of a simple harmonic motion, Change of origin, Composition of two simple harmonic motions of the same period and in the same straight line, Composition of two simple harmonic motions of the same period in two perpendicular directions, Force necessary to produce simple harmonic motion, Motion of a particle suspended by a spiral spring, Horizontal oscillations of a particle tied to an elastic spring.

Unit-5:
Moment of Inertia: The definition of parallel axes, The theorem of perpendicular axes, Moments of inertia in some particular cases, Dr. Routh’s rule, Equimomential systems.

Text Book:

Unit I - Chapter 3 all sections
Unit II - Chapter 4 all sections
Unit III - Chapter 6 sections 1 to 15
Unit IV - Chapter 10 sections 1 to 10
Unit V - Chapter 12 all sections

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to:

CO1: Apply the fundamental concept of dynamics to
a. demonstrate their understanding of the principles of kinematics and kinetics of particles and planar rigid bodies;
b. analyze planar rigid body kinematics and kinetics.

CO2: Solve equations of projectiles, moment of inertia and simple harmonic motions.

CO3: Illustrate the mathematical aspects that provide the skills and problem techniques in
kinematics of point and Newton’s laws of motion.
Learning Objective (LO): The prime aim of this paper is to enrich the knowledge of movements of celestial objects using mathematical concepts.

Unit-1: Spherical Trigonometry - Spherical Triangle - The fundamental formulae of Spherical Trigonometry, the sine, cosine, four parts and Napier formulae (without proof).
The Celestial Sphere: Celestial coordinators - Diurnal motion - Rising and setting of a star - Sidereal time - Circumpolar star - Morning and Evening stars - Twilight - Earth - Length of the day.


Unit-3: Kepler's Laws - Verification of Kepler's Laws - True anomaly, Mean Anomaly - Eccentric Anomaly, Relation between them - Time - Equation of Time - Seasons - Converson of Time.

Unit-4: Moon - Sidereal Month, Lunation and Relation between them - Phases of the Moon - Lunar Libration - Surface of the Moon - Metonic Cycle - Tides - Eclipses - Shadow Cone - Minimum and Maximum number of Eclipses.


Text Book:

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to understand
CO1: the concepts of Celestial movements,
CO2: application of Spherical Trignomentry,
CO3: application of three dimensional geometry.

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Learning Objective (LO): The roll of numerical analysis is to develop and analyze the numerical techniques. In this paper, different methods for finding the roots of algebraic and transcendental equations, solutions of simultaneous equations, solutions of differential equations are concentrated. Numerical solutions of partial differential equations such as Elliptic, Poisson and Laplace equations are discussed. Numerical differentiation and integration are also evaluated.

Unit-1: Finite Differences and Difference Equations
Finite difference operator: E-Solution of first and second order linear difference equations with constant coefficients, Non-homogeneous linear difference equations with constant coefficients.

Unit-2: Interpolation, Numerical Differentiation and Integration
Interpolation, Gregory - Newton forward and backward interpolation formula, Newton’s divided difference formula, Lagrange’s interpolation formula for unequal intervals, Gauss interpolation formula, Numerical differentiation, Numerical Integration, Trapezoidal rule.

Unit-3: Numerical solution of algebraic and transcendental equations

Unit-4: Numerical solution of ordinary differential equation

Unit-5: Numerical solution of partial differential equation

Text Book:
Unit I - Chapter V and X.
Unit II - Chapters VI and IX.
Unit III - Chapters III and IV.
Unit IV - Chapter XI.
Unit V - Chapter XII.

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the students will be able to:
CO1: explain finite difference operator, solve the first and second order linear difference equations with constant coefficients and non homogenous equations of the same kind.

CO2: interpolate using Newton's and Lagrangian formulae, do numerical differentiation and integration, find solutions to algebraic and transcendental equation using bisection method, approximation method, regula falsi method, Newton Raphson method and Bairstow method.

CO3: solve ODE and PDE using the methods mentionable in the syllabus.

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Semester-V Elective: Analytical Geometry 3D Credits: 3 Hours: 3

Learning Objective (LO): This paper aims to understand the fundamental concepts of Analytical Geometry in Three Dimension.

Unit-1: Rectangular Cartesian Co-ordinates: Direction Cosines of a line.

Unit-2: The Plane.

Unit-3: The Straight Line.

Unit-4: The Sphere.

Unit-5: The Central Quadrics and Cone.

Text Book:

Unit – I: Chapter 1 (Fully)

Unit-II: Chapter 2 (Fully)

Unit- III: Chapter 3 (Fully)

Unit- IV: Chapter 4 (Fully)

Unit- V: Chapter 5 (Fully)

Supplementary Reading:


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

CO1: explain fundamental concepts of analytical geometry in 3D, about direction cosines of a line and the plane, equation and plane.

CO2: The straight line, symmetric form of equation of a line, equation of a line passing through two given points, the plane and the straight line, intersection of three planes.

CO3: Sphere, the length of the tangent form of point to sphere equation of a circle on a sphere,
intersection of two spheres, cone, cylinder and central quadrics.

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Semester-VI

**19IMAT61: Real Analysis – II**

**Credits:** 5

**Hours:** 5

**Learning Objective (LO):** To understand Integration process of Riemann to develop the understanding of point wise and uniform convergence of sequence and series of functions. To enhance the mathematical maturity and to work comfortably with concepts.

**Unit-1: Connectedness, Completeness**

Open Sets – Connected Sets – Bounded Sets and Totally Bounded Sets – Complete Metric Spaces.

**Unit-2: Compactness**

Compact Metric Space – Continuous Functions on Compact Metric Spaces - Continuity of Inverse Functions – Uniform Continuity.

**Unit-3: Riemann Integration**


**Unit-4: Riemann Integration [Contd...]**

Rolle’s Theorem – The law of mean – Fundamental theorems of calculus – Taylor’s theorem.

**Unit-5: Sequences and Series of Functions**

Pointwise convergence of sequences of functions – Uniform convergence of sequences of functions – consequences of uniform convergence – Convergence and uniform convergence of series of functions.

**Text Book:**


- Unit – I Ch. 6.1 to 6.4
- Unit – II Ch. 6.5 to 6.8
- Unit – III Ch. 7.1, 7.2, 7.4, 7.5
- Unit – IV Ch. 7.6 to 7.8 and 8.5
- Unit – V Ch. 9.1 to 9.4

**Supplementary Reading:**

Course Outcomes:
On successful completion of the course, the students will be able to:
CO1: Describe fundamental properties of matric spaces that lead to the formal development of matric spaces.
CO2: Demonstrate an understanding of a set of measure zero and how that are used in Riemann integral.
CO3: Differentiate point wise convergence and uniform convergence of a sequence of functions and series of functions.

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Semester-VI 19IMAT62: Complex Analysis Credits: 5 Hours: 5

Learning Objective (LO): This paper is an introduction to the theory of analytic functions of one complex variable. Properties of analytic functions, results on linear transformations, problems on complex integration are discussed. Calculus of residues are also studied.

Unit-1:

Unit-2:
Conformal mapping, Bilinear transformation, Special bilinear transformation, Stereo graphical projection.

Unit-3:
Integration in the complex plane, Complex integration, Cauchy’s integral theorem, Extension of Cauchy’s integral theorem, Cauchy’s integral formula, Derivatives of analytic functions, Morera’s theorem, Cauchy’s inequality, Liouville’s theorem, Fundamental theorem of algebra, Maximum modulus theorem.

Unit-4:
Expansion of functions in power series, Taylor’s theorem, Laurent’s theorem, Singular points; Pole, essential singularity and removable singularity, Weirstrass theorem, Meromorphic function, Argument principle, Rouche’s theorem.

Unit-5:

Text Book:

Unit I - Chapter 1 and 2 all sections
Unit II - Chapter 3 all sections
Unit III - Chapter 4 all sections
Unit IV - Chapter 5 all sections
Unit V - Chapter 6 all sections
Supplementary Reading:

Course Outcomes:
Students will be introduced to and have knowledge of many mathematical concepts
CO1: examples and counter examples
CO2: proof techniques
CO3: problem solving
studied in complex analysis such as
    Analytic function,
    Some mappings,
    Complex integration,
    Power series.

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Semester-VI 19IMAT63: Algebra
Credits: 5
Hours: 5

Learning Objective (LO): Modern algebra plays a major role in other branches of Mathematics. Properties of groups, various subgroups such as normal subgroups, quotient groups are studied. Homomorphism of groups and rings, automorphisms of groups are discussed. The properties of rings, ideals, quotient rings and Euclidean rings are discussed.

Unit-1: Group Theory
Definition and examples of groups, Some preliminary Lemmas, Subgroups.

Unit-2: Group Theory (continued)
A Counting principle, Normal subgroups and Quotient groups, Homomorphisms.

Unit-3: Group Theory (continued)
Automorphisms, Cayley's theorem, Permutation groups.

Unit-4: Ring Theory
Definition and examples of rings, Some special classes of rings, Homomorphisms, Ideals and quotient rings.

Unit-5: Ring Theory (continued):
More on ideals and quotient rings, The field of quotients of an integral domain.

Text Book:

Unit I - Chapter 2: Sections 1 to 4.
Unit II- Chapter 2: Sections 5 to 7.
Unit III- Chapter 2: Sections 8 to 10.
Unit IV - Chapter 3: Sections 1 to 4.
Unit V - Chapter 3: Sections 5 and 6.

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the students will be able to:
CO1: explain the fundamental concepts of algebra such as groups, subgroups, quotient groups, homomorphism, automorphisms and using these ideals, Cayley's theorem and permutation groups.
CO2: demonstrate accurate and efficient use of a ring with examples, some classes of a ring, homomorphism of a ring, ideals, quotient rings and integral domain.
CO3: solve problems in the above related topic.

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Semester-VI 19IMAT64: Discrete Mathematics Credits: 5 Hours: 5

Learning Objective (LO): Students must understand mathematical reasoning in order to read, comprehend and construct mathematical arguments. Mathematical logic, which serves as foundation for subsequent discussion is discussed. Discrete structures such as sets and permutations are studied. Discrete probability, recurrence relations, conquer relations and principles of inclusion and exclusion are studied.

Unit-1: Logic and Counting
Propositions and logical operations, Conditional statements, Methods of Proof, Mathematical Induction. Permutations, Combinations, Pigeonhole Principle, Elements of Probability, Recurrence Relations.

Unit-2: Relations and Digraphs
Product sets and partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of relations, Equivalence Relations, Computer Representation of Relations and Digraphs, Operations on Relations, Transitive Closure and Warshall's Algorithm.

Unit-3: Functions
Functions, Functions for Computer Science, Growth of Functions, Permutation Functions.

Unit-4: Order Relations and Structures

Unit-5:
Languages and Finite State Machine.

Text Book:

Unit I  Chapter 2 Sections 1 to 4, Chapter 3 Sections 1 to 5.
Unit II  Chapter 4 Sections 1 to 8.
Unit III  Chapter 5 Sections 1 to 4.
Unit IV  Chapter 6 Sections 1 to 6.
Unit V  Chapter 10 Sections 3 to 5.

Supplementary Reading:

Course Outcomes:
Students will be introduced to and have knowledge of many mathematical concepts
CO1: examples and counter examples
CO2: Proof techniques
CO3: problem solving
studied in Discrete Mathematics such as
  Logic
  Relations
  Functions
  Some Algebraic structure

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Semester-VI  19IMAT65:  Optimization Techniques  Credits: 5  Hours: 5

Learning Objective (LO): Mathematical programming finds applications in diverse fields including Engineering, Management Sciences, Computer Science and Economics. In this course, the general linear programming problem, simplex computation procedure, revised simplex method, duality problems in linear programming and some nonlinear programming problems are covered.

Unit-1:
The General Linear Programming problem; The linear programming problem, properties of solution to the linear programming problem, Generating extreme - point solutions. The Simplex Computational procedure: Development of a minimum feasible solution, computational procedure.

Unit-2:
The Artificial – Basis Technique: A first feasible solution using slack variables, Geometric Interpretation of the simplex procedure.

Unit-3:
The Revised Simplex method: The General form of the inverse, The Product form of the inverse, Computational considerations.
The Duality problems of linear programming: The unsymmetric Primal - Dual problems, the symmetric primal-dual problems, Economic Interpretation of the Primal, Dual problems.

Unit-4:
Additional computational Technique: Determining a first feasible solution, The dual simplex method, Integer programming.
The Transportation problem: The General Transportation problem, Computational procedure for solving the transportation problem, Variations of the transportation problem.

Unit-5:
Non-Linear Programming: The General problem of mathematical programming, Mathematical background, the convex programming problem, Quadratic programming, Separable programming.

Text Book:

Unit I - Chapter 3 Sections 1, 2 and 3 and Chapter 4 Sections 1 and 2
Unit II - Chapter 4 Sections 3, 4 and 5 and Chapter 7 Sections 1, 2 and 3
Unit III - Chapter 5 Sections 1, 2 and 3 and Chapter 6 Sections 1,2 and 3
Unit IV - Chapter 9 Sections 1, 2 and 3 and Chapter 10 Sections 1, 2 and 3
Unit V - Chapter 12 Sections 1 to 5

Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Apply for finding solutions of general linear programming by Simplex computational procedure
CO2: Apply for finding feasible solutions by Artificial technique and by Perturbation technique.
CO3: Apply for finding solutions using revised simplex method and duality problems.
CO4: Apply for finding solutions by additional computational technique and transportation problems.
CO5: Apply for finding solutions of Non-linear programming.

Supplementary Reading:

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Learning Objective (LO): This course aims to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study of certain structures called groups and some related structures. Some advanced concept of groups, Dihedral groups are introduced. Homomorphisms and Isomorphisms, cyclic groups, permutation groups, Sylow's theorem, direct and semi-direct products are studied.

Unit-1: Introduction to groups:
Dihedral groups - Symmetric groups - Matrix groups - Homomorphisms and Isomorphisms - Group actions.
Subgroups: Definition and Examples - Centralizers and Normalizers, Stabilizers and Kernels.

Unit-2: Subgroups (Continued):
Cyclic groups and Cyclic subgroups of a group.
Quotient Groups and Homomorphisms: Definitions and Examples - More on cosets and Lagrange’s Theorem - The isomorphism theorems - Transpositions and the Alternating group.

Unit-3: Group Actions:
Group actions and permutation representations - Groups acting on themselves by left multiplication - Cayley's theorem - Groups acting on themselves by conjugation - The class equation - Automorphisms.

Unit-4: Group Actions (Continued):
The Sylow theorems - The simplicity of An.
Further topics in group theory: p-groups, Nilpotent groups and Solvable groups.

Unit-5: Direct and semi-direct products and abelian groups: Direct Products - The fundamental theorem of finitely generated abelian groups - Table of groups of small order - semi direct products.

Text Book:
Unit I: Chapter 1: (Sections 1.2, 1.3, 1.4, 1.6, 1.7) and
Chapter 2: (Sections 2.1, 2.2)
Unit II: Chapter 2: (Section 2.3) and
Chapter 3: (Sections 3.1, 3.2, 3.3, 3.5)
Unit III: Chapter 4: (Sections 4.1, 4.2, 4.3, 4.4)
Unit IV: Chapter 4: (Sections 4.5, 4.6) and
Chapter 6: (Section 6.1)
Unit V: Chapter 5: (Sections 5.1, 5.2, 5.3, 5.5)

Supplementary Reading:

Course Outcomes:
At the end of the course, the student will be able to:

CO1: examples and counter examples
CO2: proof techniques
CO3: problem solving

of various concepts in:
- Groups,
- Quotient Groups,
- Homomorphism of Groups,
- Group Actions,
- Direct products of Groups.

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Semester-VII 19IMAT72: Advanced Real Analysis  Credits: 5  Hours: 5

Learning Objective (LO): The concept of derivatives of real valued functions and their properties are studied. Properties of monotonic functions, functions of bounded variations are also introduced. The concept of Riemann-Stieltjes integral and its properties are studied. The notion of convergence and uniform convergence of real valued functions and infinite series of functions are also studied.

Unit-1: Functions of Bounded Variation:
Properties of monotonic functions, Functions of bounded variation, Total variation, Additive property of total variation, Total variation on [a, x] as a function of x, Functions of bounded variation expressed as the difference of increasing functions, Continuous functions of bounded variation. Riemann-Stieltjes Integral: The definition of the Riemann-Stieltjes integral, Linear properties, Integration by parts.

Unit-2: Riemann-Stieltjes Integral (Continued):
Change of variable in a Riemann-Stieltjes integral, Reduction to a Riemann integral, Step functions as integrators, Reduction of a Riemann-Stieljes integral to a finite sum, Euler's summation formula, Monotonically increasing integrators, Upper and lower integrals, Additive and linearity properties of upper and lower integrals, Reimann's condition, Comparison theorems, Integrators of bounded variation.

Unit-3: Riemann-Stieltjes Integral (Continued):
Sufficient conditions for existence of Riemann-Stieltjes integrals, Necessary conditions for existence of Riemann-Stieltjes integrals, Mean value theorems for Riemann-Stieltjes integrals, The integral as a function of the interval, Second fundamental theorem of integral calculus, Change of variable in a Riemann integral, Second mean-value theorem for Riemann integrals, Riemann-Stieltjes integrals depending on a parameter, Differentiation under the integral sign, Interchanging the order of integration.

Unit-4: Sequence of functions:
The Taylor's series generated by a function, Bernstein's theorem, Abel's limit theorem, Tauber's theorem.
Multivariable differential calculus: The directional derivative, directional derivatives and continuity, the total derivative, the total derivative expressed in terms of partial derivatives.

Unit-5: Multivariable differential calculus (Continued):
The Jacobian matrix.
Implicit functions: Functions with non-zero Jacobian determinant, the inverse function theorem, the implicit function theorem.

Text Book:

Unit – I
Chapter 6 Sections 6.1 to 6.8;
Chapter 7 Sections 7.1 to 7.5;

Unit – II
Chapter 7 Sections 7.6 to 7.15;

Unit – III
Chapter 7 Sections 7.16 to 7.25;

Unit – IV
Chapter 9 Sections 9.19; 9.20, 9.22, and 9.23;
Chapter 12 Sections 12.1 to 12.5;

Unit – V
Chapter 12: Section 12.8;
Chapter 13 Sections 13.1 to 13.4.

Supplementary Reading:

Course Outcomes:
At the end of the course, the student will be able to introduced to and have knowledge of many mathematical concepts

CO1: examples and counter examples
CO2: proof techniques
CO3: problem solving

studied in real analysis such as
- Functions of bounded variations,
- Riemann –Stieltjes Integral,
- Sequence of functions,
- Multivariate Differential Calculus.

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Semester-VII 19IMAT73: Advanced Differential Equations Credits: 5 Hours: 5

Learning Objective (LO): This Course aims to provide problem solving techniques in ordinary differential equations with variable coefficients and some special partial differential equations of Mathematical Physics such as Elliptic and Parabolic equations.

Unit-1: Linear Equation with Variable Coefficients
Initial value problems - Existence and uniqueness theorems - Solutions to solve a non-homogeneous equation - Wronskian and linear dependence - reduction of the order of a homogeneous equation - homogeneous equation with analytic coefficients - The Legendre equation.

Unit-2: Linear Equation with Regular Singular Points
Euler equation - Second order equations with regular singular points - Exceptional cases - Bessel Equation.
Unit-3: Existence and Uniqueness of Solutions to First Order Equations
Equation with variable separated - Exact equations - method of successive approximations - the Lipschitz condition - convergence of the successive approximations and the existence theorem.

Unit-4: Elliptic Differential Equations
Derivation of Laplace and Poisson equation - BVP - Separation of Variables - Dirichlet Problem and Newmann Problem for a rectangle - Interior and Exterior Dirichlet problems for a circle - Interior Newmann problem for a circle - Solution of Laplace equation in Cylindrical and spherical coordinates - Examples.

Unit-5: Parabolic Differential Equations
Formation and solution of Diffusion equation - Dirac-Delta function - Separation of variables method - Solution of Diffusion Equation in Cylindrical and spherical coordinates - Examples.

Text Books:
   Unit-I Chapter 3: Sections 1 to 8 [Omit Section 9]
   Unit-II Chapter 4: Sections 1 to 4 and 6 to 8 [Omit Sections 5 and 9]
   Unit-III Chapter 5: Sections 1 to 6 [Omit Sections 7 to 9]
   Unit-IV Chapter 2: Sections 2.1, 2.2, 2.5 to 2.13 (omit Sections 2.3 and 2.4)
   Unit-V Chapter 3: Sections 3.1 to 3.7 and 3.9 (omit Section 3.8)

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Apply the fundamental concept of ordinary and partial differential equation to
   a. demonstrate their understanding of how physical phenomena are modeled by
      second order differential equations and dynamical systems;
   b. perform operations with Bessel, Hermite and Legendre differential equations
      along with the corresponding recurrence formulas of different functions.
CO2: Solve various first order and higher orders differential equations with their
   applications.
CO3: Illustrate the mathematical aspects that contribute to the solution of heat, wave and
   diffusion equations.

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Semester-VII 19IMAT74: Differential Geometry Credits: 5
Learning Objective (LO): To introduce space curves, surfaces, curves on surfaces and study some of their properties. To study the notion of geodesic and its properties. To understand some type of special surfaces such as developables and minimal surfaces.

Unit–1: Space curves
Space curves, Arc length, Tangent, normal and binormal, Curvature and torsion of a curve given as the intersection of two surfaces.

Unit–2: Space curves (continued)
Contact between curves and surfaces, Tangent surface, involutes and evolutes, Intrinsic equations, Fundamental existence theorem for space curves, Helices.

Unit–3: Metric
Surface, Curves on a surface, Metric, Direction coefficients, Geodesics, Canonical geodesic equations, Normal property of geodesics, Geodesic curvature.

Unit–4: Metric (continued)
Gauss-Bonnet theorem, Gaussian curvature, Surfaces of constant curvature, Conformal mapping, Only statements of Dini’s theorem and Tissot’s theorem.

Unit–5: Second Fundamental form
Second fundamental form, Developables, Developables associated with space curves, Developables associated with curves on surfaces, Minimal surfaces.

Text Book:

Unit-I Chapter 1 Sections 1 to 5
Unit-II Chapter 1 Sections 6 to 9
Unit-III Chapter 2 Sections 1, 2, 5, 6, 10, 11, 12 and 15
Unit-IV Chapter 2 Sections 16 to 20
Unit-V Chapter 3 Sections 1, 4, 5, 6, 7.

Supplementary Reading:

Course Outcomes:
After successful completion of the course the student will be able to:

CO1: understand the concept of a space curve in 3D and compute the curvature and torsion of space curves;
CO2: understand the fundamental existence theorem for space curves;
CO3: find geodesics equations on a surface;
CO4: understand surfaces of constant curvature (Minding’s theorem) and Gaussian curvature;
CO5: determine the second fundamental form and developables associated with space curves.

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Semester-VIII 19IMAT81: Advanced Abstract Algebra – II Credits: 5
Learning Objective (LO): This course aims to provide a continuation of Advanced Abstract Algebra-I. The focus of the course will be the study of Rings, Polynomial rings, Euclidean ring, Unique factorization domains, Module Theory, Field theory and Splitting fields.

Unit-1: Introduction to Rings:
Examples: Polynomial rings - Matrix rings and group rings - Ring Homomorphisms and quotient rings - Properties of Ideals - Rings of fractions - The Chinese remainder theorem.

Unit-2: Rings (continued):
Euclidean domains, principal ideal domains and unique factorization domains.
Polynomial rings: Definitions and basic properties – Polynomial rings over fields.

Unit-3: Polynomial rings (continued):
Polynomial rings that are unique factorization domains – Irreducibility criteria – Polynomial ring over fields.
Introduction to Module Theory: Basics definitions and examples – Quotient modules and Module homomorphism.

Unit-4: Field theory:
Basic Theory of field extensions - Algebraic Extensions.

Unit-5: Field theory (continued):
Splitting fields and Algebraic closures - Separable and inseparable extensions - Cyclotomic polynomials and extensions.

Text Book:
Unit I: Chapter 7: (Sections 7.2,7.3,7.4,7.5,7.6)
Unit II: Chapter 8: (Sections 8.1,8.2,8.3) and
   Chapter 9: (Sections 9.1,9.2)
Unit III: Chapter 9: (Sections 9.3,9.4,9.5),
   Chapter 10: (Sections 10.1,10.2)
Unit IV: Chapter 13: (Sections 13.1,13.2)
Unit V: Chapter 13: (Sections 13.4,13.5,13.6)

Supplementary Reading:

Course Outcomes:
Students will be introduced to and have knowledge of many mathematical concepts
   CO1: examples and counter examples
   CO2: proof techniques
   CO3: problem solving

   studied in Abstract Algebra such as
   • Rings,
   • Irreducibility,
   • Modules, a generalization of vector spaces,
   • Fields.

Outcome Mapping:
Learning Objective (LO): The concept of Lebesgue measure is introduced. Measure space and integration with respect to a measure are introduced. Convergence in measure and properties of $L^p$ space are discussed.

Unit-1:
Lebesgue Outer measure, Measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability.

Unit-2:
Integration of nonnegative functions, General integral, Integration of series, Riemann and Lebesgue integrals.

Unit-3:
Continuous non-differentiable functions, Lebesgue differential theorem (statement only), Differentiation and Integration, Lebesgue set, Convergence in measure, Almost uniform convergence.

Unit-4:
Measures and outer measures, Extension of a measure, Uniqueness of the extension, Completion of a measure, Measure spaces, Integration with respect to a measure.

Unit-5:

Text Book:

Unit – I Chapter 2: Sections 2.1 to 2.5
Unit – II Chapter 3: Sections 3.1 to 3.4
Unit – III Chapter 4: Sections 4.2, 4.4 to 4.6 and
Chapter 7: Sections 7.1, 7.2
Unit – IV Chapter 5: Sections 5.1 to 5.6
Unit – V Chapter 6: Sections 6.1 to 6.5.

Supplementary Reading:

Course Outcomes:
Students will be introduced to and have knowledge of many mathematical concepts studied in Measure theory & Integration such as
- Measurable sets and Measurable functions,
- Integration with respect to Measure,
• Convergence in Measure.

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Semester-VIII 19IMAT83: Advanced Complex Analysis Credits: 5 Hours: 5

Learning Objective (LO): This course aims to train the students to get essential knowledge in functions of a complex variable. Analytic functions and their properties, Residue theorem and its applications, Riemann mapping theorem are discussed in detail.

Unit–1: Complex integration:
Line integrals, Rectifiable arcs, Line integrals as functions of arcs, Cauchy’s theorem for a rectangle, Cauchy’s theorem in a Disc.
Cauchy's integral Formula:
The index of a point with respect to a closed curve, The integral formula, Higher derivatives.

Unit–2: Local Properties of Analytic Functions:
The General Form of Cauchy's Theorem:
Chains and cycles, Simple connectivity, Locally exact differentials, Multiply connected regions.

Unit–3: Harmonic Functions:
Definition and basic properties, The mean-value property, Poisson's Formula, Schwarz's theorem, The Reflection principle.
Power Series Expansions:

Unit–4: Partial Fractions and Factorization:
Partial fractions, Infinite products and Canonical products.
Normal Families:

Unit–5: The Riemann Mapping Theorem:
Statement and Proof
Conformal mapping of Polygons:
The behavior at an angle, The Schwarz-Christoffel formula, Mapping on a rectangle, The triangle functions of Schwarz.
A Closer look at Harmonic Functions:
Functions with the Mean-value Property, Harmack’s Principle.

Text Book:
Unit-I Chapter 4 Sections 1 & 2.
Unit-II Chapter 4 Sections 3, 4 (4.1, 4.2, 4.6 and 4.7 only).
Unit-III Chapter 4 Section 6; Chapter 5 Section 1.
Unit-IV Chapter 5 Section 2 (2.1, 2.2 and 2.3 only).
Chapter 5 Section 5.
Unit-V Chapter 6 Sections 1 (1.1 only), 2 and 3.

Supplementary Reading:

Course Outcomes:
After successful completion of the course the student will be able to
CO1: use Cauchy's integral theorem or formula to compute complex line integrals;
CO2: compute the Taylor’s theorem, to determine the nature of the removable
    singularities;
CO3: explain the convergence of power series and develop analytical capabilities
    in Taylor or Laurent series in a given domain;
CO4: determine the concept of conformal mapping of polygons, to find Schwarz –
    Christoffel formula.

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Semester-VIII 19IMAP84: C++ Computer Practical Credits: 4 Hours: 2

Learning Objective (LO): The objective are acquire the practical knowledge to solve problems including the fields of optimization, number theory and matrix theory.

1. Solution of Linear Programming Problem.

2. Deterministic Inventory Models.
   i. Single-item Static Model.
   ii. Single-item Static Model with Price Breaks.
   iii. Multi-item Static Model with Storage Limitation.

3. Number Theory:
   i. Reversing of an integer series.
   ii. Generating Fibonacci series.
   iii. Average and Standard Deviation of numbers.
   iv. Identification of Prime, Even and Odd integers.

4. Matrix Theory
   i. Determinant of a matrix.
   ii. Rank of a matrix.
   iii. Inverse of a matrix.
   iv. Product of matrices.

Text Books:
Content and treatment as in relevant sections of the following books:
Supplementary Reading:

Course Outcome:
By the end of the course,
CO1: the students will be able to gain knowledge between theory and practical.

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Semester-IX 19IMAT91: Topology Credits: 5 Hours: 3

Learning Objective (LO): The idea and method of topology have transformed large parts of geometry and analysis. This subject is of interest in its own right, and it also serves to lay the foundations for future studies in analysis and geometry. In this course we teach the basics of topology including connectedness, compactness, countability, separation axioms, Tychonoff theorem and complete metric spaces.

Unit-1:
Topological spaces, Basis for a topology, The order topology, The product topology on $X \times Y$.

Unit-2:
The subspace topology, Closed sets and limit points, Continuous function, The product topology. The metric topology, Connected spaces, Connected subspaces of the real line, Components and Local connectedness.

Unit-3:
Compact spaces, Compact subspaces of the real line, Limit point compactness, Local compactness.

Unit-4:
Countability axioms, The separation axioms, Normal spaces, Urysohn Lemma, Urysohn metrization theorem, Tietze extension theorem.

Unit-5:
The Tychonoff Theorem, Stone-Cech compactification, Complete metric spaces, Compactness in metric spaces.

Text Book:

Unit – I Chapter 2: Sections 12 to 15.
Unit – II Chapter 2: Sections 16 to 21 and
Chapter 3: Sections 23 to 25.
Unit - III Chapter 3: Sections 26 to 29.
Unit - IV Chapter 4: Sections 30 to 35.
Unit - V Chapter 5: Sections 37 and 38;
Chapter 7: Sections 43 and 45 only.

Supplementary Reading:
Course Outcomes:
Students will be introduced to and have knowledge of many mathematical concepts

CO1: examples and counter examples
CO2: proof techniques
CO3: problem solving

studied in Topology such as
• Connectedness
• Compactness
• Completeness
which are studied in Real Numbers.

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Semester-IX 19IMAT92: Linear Algebra Credits: 5
Hours: 4

Learning Objective (LO): This course aims learning the students to solve systems of linear equations using multiple methods, echelon Matrices, matrix operations, including inverses and invertible matrix using determinants. Applying principles of matrix algebra to linear transformations, double dual, commutative rings, Characteristic values, Annihilating polynomials and Decompositions of Invariant Direct sums are studied.

Unit-1: Linear Equations and Vector spaces

Unit-2: Linear Transformations

Unit-3: Determinants
Commutative rings – Determinant functions – Permutations and the uniqueness of determinants – Classical Adjoint of a (Square) matrix – Inverse of an invertible matrix using determinants.

Unit-4: Canonical Forms
Characteristic values – Annihilating polynomials, Invariant subspaces.

Unit-5: Canonical Forms (continued)

Text Book:
Chapters 1 to 3, Chapter 5 (5.1 to 5.4) and Chapter 6.

Supplementary Reading:
Course Outcomes:
Students will be introduced to and have the knowledge of many mathematical concepts
CO1: examples and counter examples
CO2: proof techniques
CO3: problem solving

studied in Linear Algebra such as
- Systems of linear Equations,
- The algebra of linear transformations,
- Determinant functions,
- Diagonalization,
- Decompositions.

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Semester-IX 19IMAT93: Probability Theory
Credits: 5
Hours: 4

Learning Objective (LO): The objective are (i) acquire quantative skills and an understanding of rigorous concepts and methods in probability theory through measure theoretic approach (ii) acquire understanding of diverse characteristics like convergence, law of large numbers and central limit theorems. (iii) Acquire the ability to solve widely varied problems.

Unit-1: Distribution Function:
Monotone functions, Distribution functions, Absolutely continuous and Singular distributions.
Measure Theory:
Classes of sets, Probability measures and their distribution functions.
Random variable, Expectation, Independence:
General definitions, Properties of mathematical expectation, Independence.

Unit-2: Convergence Concepts:
Various modes of convergence, Almost sure Convergence; Borel-Cantelli lemma, Vague Convergence, Continuation.

Unit-3: Law of Large Numbers. Random series:
Simple limit theorems, Weak law of large numbers, Convergence of series, Strong law of large numbers.

Unit-4: Characteristic Function:
General properties; Convolutions, Uniqueness and inversion, Convergence theorems, Simple applications.

Unit-5: Central limit theorem and its Ramifications:
Liapounov's theorem, Lindeberg-Feller theorem, Ramification of the central limit theorem.

Text Book:

Unit - I
Chapter 1 (Sections 1 to 3).
Chapter 2 (Sections 1 and 2).
Chapter 3 (Sections 1 to 3).
Unit – II Chapter 4 (Sections 1 to 4).
Unit – III Chapter 5 (Sections 1 to 4).
Unit – IV Chapter 6 (Sections 1 to 4).
Unit - V Chapter 7 (Sections 1 to 3).

**Supplementary Reading:**

**Course Outcomes:**
By the end of the course, students will be able to gains
CO1: knowledge related to probability problems
CO2: a basic knowledge for studying advanced courses in this area like stochastic processes.

**Outcome Mapping:**

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**Semester-IX**

**19IMAT94: Numerical Methods Practical**
(Using C++ language)

**Credits: 2**
**Hours: 4**

**Learning Objective (LO):** The objectives are acquire the practical applicability of C++ Programming to some of the problems in numerical mathematics.

1. Solution of transcendental and polynomial equations in one variable:
   i. Method of Bisection
   ii. Method of Regula Falsi
   iii. Newton's Method

2. Solution of Linear Equations:
   i. Jacobi’s Iterative Method
   ii. Gauss-Seidal Iterative Method

3. Numerical Solution of Ordinary Differential Equations:
   i. Euler's Method.
   ii. Modified Euler's Method
   iii. Runge-Kutta Method of order four

4. Numerical Integration:
   i. Simpson's one third rule
   ii. Simpson's three eighth rule
   iii. Weddle's rule.

**Text Book:**

**Course Outcomes:**
By the end of the course:
CO1: students will be able to gain knowledge between theory and practical.
Learning Objective (LO): There are many domains in the broad field of topology. The following are the few viz, the theory of Banach and Hilbert Spaces and their operators and Banach algebras. In this course we teach some results on Banach spaces, Hilbert spaces, operator theory and Banach algebras. Each of these subjects starts from the fundamental knowledge and develops its own methods of dealing with its own characteristic problems.

Unit-1: Linear transformations and Banach spaces  
Linear transformations, Banach spaces, Continuous linear transformations, The Hahn-Banach theorem.

Unit-2: Banach spaces (continued)  
The natural embedding of N into N**, The open mapping theorem, The conjugate of an operator.

Unit-3: Hilbert spaces  
Hilbert space, Orthogonal complements, Orthonormal sets, The Conjugate space H*, The adjoint of an operator, Self adjoint operators, Normal and Unitary operators.

Unit-4: Finite dimensional Spectral theory  
Matrices, Determinants and Spectrum of an operator, The spectral theorem.

Unit-5: Banach algebras  
Definition and some examples, Regular and singular elements, Topological divisors of zero, The spectrum, The formula for the spectral radius.

Text Book:  

Unit-I  Chapter 8: Section 44 only and  
Chapter 9: Sections 46, 47 and 48.

Unit-II  Chapter 9: Sections 49, 50 and 51.

Unit-III  Chapter 10: Sections 52 to 58.

Unit-IV  Chapter 11: Sections 60, 61 and 62.

Unit-V  Chapter 12: Sections 64 to 68.

Supplementary Reading:  

Course Outcomes:  
In the board field of topology, students gaining knowledge related to  
CO1: examples and counter examples  
CO2: proof techniques  
CO3: problem solving  
in Banach space, Hilbert space and spectral operator theory.

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Semester-X  19IMAT101: Functional Analysis  
Credits: 4  
Hours: 4
Learning Objective (LO): The objectives are to (i) acquire the skill of advanced level of mathematical sophistication and enhancing the horizons of knowledge. (ii) acquire understanding of applicability of different concepts of stochastic processes on some physical situation. (iii) to familiarize the students with the use of stochastic models in different areas.

Unit-1: Stochastic Processes:
Markov Chains:
Definition and Examples, Higher Transition Probabilities, Generalization of independent Bernoulli Trials: Sequence of Chain Dependent Trials, Classification of States and Chains.

Unit-2: More on Markov Chains:
Determination of Higher Transition Probabilities, Stability of a Markov System, Markov Chain with Denumerable Number of States, Reducible Chains.


Unit-4: Markov Chains and Markov Processes with Continuous State Space:

Unit-5: Renewal Processes and Theory:

Text Book:

Unit-I Chapter 2: Sections 1 to 4 and
Chapter 3: Sections 1 to 4.
Unit-II Chapter 3: Sections 5,6,8 and 9.
Unit-III Chapter 4: Sections 1 to 5.
Unit-IV Chapter 3: Section 11
Chapter 5: Sections 1 to 5.
Unit-V Chapter 6: Sections 1 to 6.

Supplementary Reading:

Course Outcomes:
By the end of the course, students will be able to gains

CO1: working knowledge related to the problems of uncertainty.

CO2: a basic knowledge for doing research in this area.

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Learning Objective (LO): This course aims to discuss kinematics of fluids in motion, Equations of motion of a fluid, three dimensional flows, two dimensional flows and viscous flows.

Unit-1: Kinematics of Fluids in Motion:
Real fluids and ideal fluids – Velocity of a fluid at a point stream lines – path lines – Steady and unsteady flows – Velocity potential – The velocity vector – Local and particle rates of changes – Equations of continuity – Examples.

Unit-2: Equation of Motion of a fluid:
Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Condition at a boundary of two invicid immersible fluids. Euler’s equation of motion – Discussion of the case of steady motion under conservative body forces.

Unit-3: Some three dimensional flows:

Unit-4: Some two-dimensional flows:
Two dimensional flows – Meaning of two dimensional flow – Use of cylindrical polar co-ordinates – The stream function – Complex potential for two dimensional – Irrational incompressible flow – Complex velocity potential for standard two dimensional flows – Examples.

Unit-5: Viscous flows:

Text Book:

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to,

CO1: Identify and obtain the values of fluid properties and relationship between them and understand the principles of continuity, momentum, and energy as applied to fluid motions.

CO2: Recognize these principles written in form of mathematical equations.

CO3: Apply dimensional analysis to predict physical parameters that influence the flow in fluid dynamics.

Outcome Mapping:
Learning Objective (LO): Graph Theory is an integral part of Discrete Mathematics. It has applications to many fields, including Computer Science, Physics, Chemistry, Psychology and Sociology. In this course we teach basic topics in graph theory such as Trees, Connectivity, Euler tours, Hamilton cycles, Matchings, Colourings, Planar graphs.

Note: Theorems, Propositions and results which are starred are to be omitted.

Unit–1: Basic Concepts:
Connectivity:
Vertex cuts and Edge cuts – Connectivity and edge-connectivity, Blocks.

Unit–2: Trees:
Trees – Characterization and Simple properties.
Independent sets and Matchings:
Vertex Independent sets and Vertex Coverings – Edge-Independent Sets – Matchings and Factors, Matchings in Bipartite Graphs (except the proof of Tutte’s 1-factor theorem).

Unit–3:
Eulerian Graphs.
Hamiltonian Graphs.

Unit–4 : Graph Colorings:
Vertex Colorings – Critical Graphs – Brooks’ Theorem.
Edge Colorings of Graphs – Vizing’s Theorem – Chromatic Polynomials.

Unit–5: Planarity:
Planar and Nonplanar Graphs – Euler’s Formula and its Consequences – $K_5$ and $K_{3,3}$ are Nonplanar graphs – Dual of a Plane Graph – The Four Color Theorem and the Heawood Five-Color Theorem – Hamiltonian plane graphs.

Text Book:
Unit - I Chapter 1: 1.1 to1.6; Chapter 3: 3.1 to 3.3;
Unit - II Chapter 4: 4.1, 4.2; Chapter 5: 5.1 to 5.5;
Unit - III Chapter 6: 6.2, 6.3;
Unit - IV Chapter 7: 7.1, 7.2, 7.3
(except 7.3.2 and 7.3.3), 7.6, 7.9;
Unit - V Chapter 8: 8.1 to 8.6; 8.8.

Supplementary Reading:

Course Outcomes:
Students will be introduced to and have knowledge of many mathematical concepts
CO1: examples and counter examples
CO2: proof techniques
CO3: problem solving
CO4: applications

studied in Graph Theory such as
• Trees,
• Connectivity,
• Euler tours,
• Hamilton cycles,
• Matchings,
• Colourings,
• Planar graphs

Students will be able to solve problems that can be modeled as graphs.

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Semester-X  19IMAT105: Calculus of Variations and Integral Equations  Credits: 4
Hours:  4

Learning Objective (LO): The aim of the course is to introduce to the students the concept of calculus of variations and its applications. Various types of integral equations have been introduced and method of solving these equations are given.

Unit-1:
Calculus of Variations and Applications:
Maxima and Minima - The Simplest case-Illustrative examples-Natural boundary conditions and transition conditions – The variational notation-The more general case.

Unit-2:
Constraints and Lagrange multipliers-Variable end points - Sturm- Liouville problems-Hamilton’s principle-Lagrange’s equations.

Unit-3:

Unit-4:
Linear equation in cause and effect: The influence function – Fredholm equations with separable kernels – Illustrative example.

Unit-5:
Hilbert – Schmidt theory – Iterative methods for solving equations of the second kind – Fredholm theory.

Text Book:
Francis B. Hildebrand, Methods of Applied Mathematics, (Second Edition)
Unit I:  Chapter 2: Sections 2.1 to 2.6
Unit II:  Chapter 2: Sections 2.7 to 2.11
Unit III:  Chapter 3: Sections3 .1 to 3.4
Unit IV:  Chapter 3: Sections3.5 to 3.7
Unit V: Chapter 3: Sections 3.8 to 3.11

Supplementary Reading:

Course Outcomes:
On Successful completion of the course student will be able to
CO1: Recognize the difference between Volterra & Fredholm integral equations, First kind & second kind, homogeneous and inhomogeneous etc.
CO2: They will have a much better understanding of the fundamental concepts related to the space of admissible variations and concepts of a weak and a strong relative minimum of an integral.

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Elective Courses (DE):

Semester-VIII 19IMAT86-1: Programming Language C++ Credits: 3 Hours: 3

Learning Objective (LO): The language C++ is a Object Oriented Programming Language. First the syntax of the language C++ is introduced. This is followed by Control statement, Arrays, Functions, Pointers, Structures and Classes. Many problems are solved after writing algorithms and programs in C++.

Unit-1: C++ Programming Basics:

Unit-2: Loops and Decisions:
Unit-3: Structures:
A simple structure, Specifying the structure, Defining a structure variable, Accessing structure members.

Functions:

Unit-4: Arrays:

Unit-5: Pointers:

Text Book:

Supplementary Reading:

Course Outcomes:
CO1: On Successful completion of C++ course, the students gathered computer knowledge in C++ to write programmes for various types of mathematical problems.

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Semester-IX 19IMAT96-1: Number Theory
Credits: 3
Hours: 3

Learning Objective (LO): The prime aim of this paper is to enrich the knowledge of Number Theory. The concepts of primes, congruences, prime power moduli, power residues, quadratic
residues, greatest integer function, Mobius inversion formula are introduced. Diophantine
equations and their positive solutions are discussed. Simple continued functions are also
considered.

Unit-1: Divisibility and Congruences

Unit-2: Congruences (continued)
Prime power moduli, Prime modulus, Primitive Roots and Power Residues, Congruences of
degree two, Prime Modulus.
Quadratic Reciprocity and Quadratic Forms:
Quadratic Residues, Quadratic reciprocity and the Jacobi symbol.

Unit-3: Some functions of Number Theory
Greatest integer function, Arithmetic functions, The Mobius inversion formula, Recurrence
Functions, Combinatorial Number Theory.

Unit-4: Some Diophantine Equations
The equation ax+by=c, Simultaneous Linear Equations, Pythagorean Triangles, Assorted
Examples, Ternary Quadratic Forms.

Unit-5: Simple Continued Fractions
The Euclidean Algorithm, Uniqueness, Infinite Continued Fractions, Irrational Numbers,
Approximations to Irrational Numbers.

Text Book:
Ivan Niven, H.S. Zuckerman and Hugh L. Montgomery, Contents and treatment as in the book An

Supplementary Reading:
1. Tom M. Apostol, Introduction to Analytic Number Theory, Narosa Pub. Company,
New Delhi, 2013.
3. G.H. Hardy and E.M. Wright, An Introduction to the Theory of Numbers,

Course Outcomes:
On successful completion of the course, the student will be able to understand the concepts
CO1: examples and counter examples
CO2: Proof techniques
CO3: problem solving
of
• Divisibility relation,
• Congruence relation,
• Special number theoretic functions,
• Diophantine equations and
• Algebraic numbers.

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Learning Objective (LO): This course aims to offer fuzzy sets, fuzzy relations, fuzzy logic, fuzzy composition and applications.

Unit-1: Fuzzy sets:
Fuzzy sets – Basic types – Basic concepts - Characteristics – Significance of the paradigm shift – Additional properties of α-Cuts.

Unit-2: Fuzzy Sets Versus CRISP Sets:

Unit-3: Operations on Fuzzy Sets:
Fuzzy intersection – t-norms, Fuzzy unions – t conorms – Combinations of operations – Aggregation operations.

Unit-4: Fuzzy Arithmetic:
Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals – Lattice of Fuzzy numbers.

Unit-5: Constructing Fuzzy Sets:
Methods of construction: An overview – Direct methods with one expert – Direct method with multiple experts – indirect method with multiple experts and one expert – Construction from sample data.

Text Book:

Unit – I Chapter 1: Sections 1.3 to 1.5 and
Chapter 2: Sections 2.1

Unit – II Chapter 2: Sections 2.2 to 2.3 and
Chapter 3: Sections 3.1 to 3.2

Unit – III Chapter 3: Sections 3.3 to 3.6
Unit – IV Chapter 4: Sections 4.1 to 4.4
Unit – V Chapter 10: Sections 10.1 to 10.7

Supplementary Reading:

Course Outcomes:
On successful completion of the course, the student will be able to identify the basic concepts
CO1: examples and counter examples
CO2: Proof techniques
CO3: problem solving

on
• characteristics of fuzzy logic,
• α cuts,
• operations on fuzzy sets,
• extension principles,
• fuzzy norms,
• lattice of fuzzy numbers.
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Electives for other Department students:

Semester- VIII 19MATE815.1: Discrete Mathematics Credits: 3 Hours: 3

Learning Objective (LO): Students must understand mathematical reasoning in order to read, comprehend and construct mathematical arguments. Mathematical logic, which serves as foundation for subsequent discussion is discussed. Discrete structures such as sets and permutations are studied. Discrete probability, recurrence relations, conquer relations and principles of inclusion and exclusion are studied.

Unit-1: Logic and Counting:
Propositions and logical operations, Conditional statements, Methods of Proof, Mathematical Induction. Permutations, Combinations, Pigeonhole Principle, Elements of Probability, Recurrence Relations.

Unit-2: Relations and Digraphs:
Product sets and partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of relations, Equivalence Relations, Computer Representation of Relations and Digraphs, Operations on Relations, Transitive Closure and Warshall’s Algorithm.

Unit-3: Functions:
Functions, Functions for Computer Science, Growth of Functions, Permutation Functions.

Unit-4: Order Relations and Structures:

Unit-5: Semigroups and Groups:
Semigroups, Product and Quotient of Semigroups, Groups, Product and Quotient of Groups.

Text Book:

Unit I Chapter 2 Sections 1 to 4,
                  Chapter 3 Sections 1 to 5.
Unit II Chapter 4 Sections 1 to 8.
Unit III Chapter 5 Sections 1 to 4.
Unit IV Chapter 6 Sections 1 to 6.
Unit V Chapter 9 Sections 1 to 4.

Supplementary Reading:

Course Outcomes:
Every student shall get a good exposure in
CO1: examples and counter examples
CO2: Proof techniques
CO3: problem solving
CO4: applications of various concepts in: Logic and Counting, Relations and Digraphs, Functions, Order Relations and Structures and Semigroups and Groups.

Outcome Mapping:

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Semester-VIII 19MATE815.2: Numerical Methods Credits: 3 Hours: 3

Learning Objective (LO): The roll of numerical analysis is to develop and analyze the numerical techniques. In this paper, different methods for finding the roots of algebraic and transcendental equations, solutions of simultaneous equations, solutions of differential equations are concentrated. Numerical differentiation and integration are also evaluated.

Unit-1: The solution of Numerical Algebraic and Transcendental Equations:

Unit-2: Simultaneous Linear Algebraic Equations:
Gauss Elimination method, Computation of the inverse of a matrix using Gauss elimination method, Method of Triangularisation (Method of Factorization), Crout's method, Iterative methods, Jacobi method of iteration (Gauss-Jacobi Method), Gauss Seidal method of iteration.

Unit-3: Interpolation:
Introduction, Linear interpolation, Gregory Newton Forward and Backward interpolation Formula, Equidistant terms with one or more missing values.

Interpolation with unequal intervals:
Divided Differences, Properties of Divided differences, Newton’s interpolation formula for unequal intervals, Lagrange's interpolation formula, Inverse interpolation.

Unit-4: Numerical Differentiation and Integration:
Introduction, Newton's forward difference formula to compute the derivatives, Newton's backward difference formula to compute the derivatives, Derivatives using Stirling's formula. Trapezoidal rule, Simpson's rule, Practical applications of Simpson's rule, Trapezoidal rules.

Unit-5: Numerical Solution of Ordinary Differential Equations:

Text Book:

Supplementary Reading:

Course Outcomes:
Every student shall get a good exposure in
CO1: examples and counter examples
CO2: problem solving
CO3: applications
of various concepts in: obtaining numerical solutions of Algebraic, Transcendental and Ordinary Differential Equations.

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Semester-IX 19MATE915.1: Differential Equations  Credits: 3
Hours: 3

Learning Objective (LO): This course aims to provide logical skills in the formation of differential equations, to expose to different techniques of finding solutions to these equations and in addition stress is laid on the application of these equations in geometrical and physical problems. It also aims to provide logical skills in the formation and solutions techniques of partial differential equations.

Unit-1: Ordinary Differential Equations:

Unit-2: Ordinary Differential Equations [Contd...]:
Method of Variation of Parameters – 2nd order Differential Equations with Constant Coefficients for finding the P.I’s of the form eax V, where V is sin(mx) or cos(mx) and xn.

Unit-3: Laplace Transform:
Laplace Transform, Inverse Laplace transform, Application to the first and second order linear differential equations.

Unit-4: Partial Differential Equations:
Partial differential equations: Formation of P.D.E. by eliminating arbitrary constants and arbitrary functions, Complete, Singular and General integral. Solution of equations of standard types: f(p,q)=0, f(x,p,q)=0, f(y,p,q)=0, f(x,p)=f(y,q), and Clairaut's form. Lagrange's equation Pp+Qq=R, Simple problems.

Unit-5: Series Solution:
Series solutions of first order equations, Second order linear equations, Ordinary points, Regular Singular Points

Text Books:
Content and treatment as in the following books:
   Unit I - Chapter 1 1(A) & 1 (B)
   Unit II - Chapter 2 2.10 to 2.32
   - Chapter 3 3.15 to 3.23
   Unit III - Chapter 7 except simultaneous equations
   Unit IV - Chapter 5.
   Unit V - Chapter 5 Sections 26 – 29

Supplementary Reading:
2. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand, 2006

Course Outcomes:
At the end of the course the students will able to get
CO1: the skill of the formation of differential equations and partial differential equations.
CO2: the skill to expose different techniques of finding solution of differential equations and partial differential equations.

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Value Added Course:

Semester- VAC: Mathematics For Competitive Examinations Credits: 3
Hours: 3

Learning Objective (LO): To introduce concepts of mathematics with emphasis on analytical ability and computational skill needed in competitive examinations.

Unit-1: Problems on General Arithmetic:
Problems of ages – Ratio and proportions -Inverse ratio-properties (Addendo, subtrahendo, componendo & dividendo) -ratio of four numbers -increasing and decreasing order of fractions.

Unit-2:
Percentages - Gain and loss percents - Partnership problems.

Unit-3: Time, Distance and Work:
Time and work – Time and distance.

Unit-4: Commercial Arithmetic:
Simple interest - Compound interest – Stocks and Shares.

Unit -5: Data Interpretation:
Tabulation – Bar graphs and Pie charts – Line Graphs.

Text Book:
R.S. Agarwal, Content and treatment as in the book Quantitative Aptitude, S. Chand & Co, New Delhi, 2015.

Supplementary Reading:
Course Outcome:
By the end of the course, students will be able to face the Mathematics part of competitive examinations easily.