**Scheme/Structure of the Programme B.Sc. with Mathematics as one subject**

1. **Name of the Programme (Course): B.Sc.**
2. **Definitions/ Abbreviations:**

**1 credit=1 Hour Theory Lecture (L) per week**

**1 credit= 2 Hours Practical (P) per week**

**1 credit = 25 marks**

**2 Hours = 3 periods of 45/40 minutes**

**3 Hours = 4 periods of 45/40 minutes**

**CC = Core Course**

**DSC = Discipline Core Course**

**AECC = Ability Enhancement Compulsory Course**

**SEC = Skill Enhancement Course**

**DSE = Discipline Specific Elective Course**

**GE = Generic Elective**

1. **One Batch(Practical Group) will consist of 15 students.**
2. **Scheme will be effective from the session 2020-21 in phased manner.**
3. **Each End Term Examination will be of three hours.**

**Credit Distribution for Mathematics subject in the B.Sc. Programme**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Core Courses (CC) | Ability Enhancement Compulsory Courses (AECC) | Discipline Specific Elective Courses(DSE) | Skill Enhancement Courses(SEC) | Total Credits |
| Theory  | 24 | - | 8 | 4 | 36 |
| Practical  | 8 | - | 4 | - | 12 |
| Total | 32 | - | 12 | 4 | 48 |

**Semester wise Distribution of Credits in the subject of Mathematics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | First year Credit | Second year Credit | Third year Credit |  | Total Credits |
| 1st Sem | 2nd Sem | 3rd Sem | 4th Sem | 5th Sem |  | 6thSem |  |  |
| Ability Enhancement Compulsory Courses(AECC) | - | - |  |  | - |  | - |  | - |
| Core Courses (CC) | 8 | 8 | 8 | 8 | - |  | - |  | 32 |
| Discipline Specific Elective Courses(DSE) | - | - | - | - | 6 |  | 6 |  | 12 |
| Skill Enhancement Courses(SEC) | - | - | 2 | - | 2 |  | - |  | 4 |
| Total | 8 | 8 | 10 | 8 | 8 | 20 | 6 |  | 48 |

**Contact hours for Mathematics subject in the B.Sc. Programme**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Core Courses (CC) | Ability Enhancement Compulsory Courses (AECC) | Discipline Specific Elective Courses(DSE) | Skill Enhancement Courses(SEC) | Total hours |
| Theory  | 24 | - | 8 | 4 | 36 |
| Practical  | 16 | - | 8 | - | 24 |
| Total | 40 | - | 16 | 4 | 60 |

**Program Outcomes (PO) for Under Graduate Programme (CBCS) in the Faculty of Sciences, Kurukshetra University, Kurukshetra**

|  |  |  |
| --- | --- | --- |
| **PO1** | Knowledge | Capable of demonstrating comprehensive disciplinary knowledge gained during course of study |
| **PO2** | Communication | Ability to communicate effectively on general and scientific topics with the scientific community and with society at large  |
| **PO3** | Problem Solving | Capability of applying knowledge to solve scientific and other problems  |
| **PO4** | Individual and Team Work | Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.  |
| **PO5** | Investigation of Problems | Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions |
| **PO6** | Modern Tool usage | Ability to use and learn techniques, skills and modern tools for scientific practices |
| **PO7** | Science and Society | Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices |
| **PO8** | Life-Long Learning | Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout the life |
| **PO9** | Environment and Sustainability | Ability to design and developmodern systems which are environmentally sensitive and to understand the importance of sustainable development. |
| **PO10** |  Ethics | Apply ethical principles and professional responsibilities in scientific practices |
| **PO11** | Project Management | Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects  |

**Program Specific Outcomes (PSO) for Under Graduate CBCS Programme in the subject of Mathematics**

After successful completion of the programme, a student will be able to:

|  |  |
| --- | --- |
| **PSO1** | Have basic understanding and knowledge in different core areas of Mathematics such as algebra, analysis, calculus, differential equations, mechanics, numerical analysis and in some of the other elective areas. Demonstrate understanding of the concepts /theories/methods from such areas of Mathematics.  |
| **PSO2** | 1. Have **a broad background** in Mathematics and develop the essential mathematical reasoning, knowledge, skills and aptitude to pursue further studies and research in Mathematics.
 |
| **PSO3** | Communicate mathematics effectively and precisely by written, computational and graphical means. |
| **PSO4** | 1. Apply knowledge, understanding, methods, techniques and skills of Mathematics to analyse, evaluate and solve problems of Mathematics and/or the mathematical problems having applications in engineering/science/technology/life sciences/social sciences so as to enhance career prospects in different fields.
 |

**Scheme/Structure of the Programme B.Sc. with Mathematics subject w.e.f. the session 2020-21 in phased manner**

**Semester-I**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course****Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam. Hours** |
| **Ext.** | **Int.** | **Total** |
| AECC-1 |  | AECC Course-I |  | 2 |  |  |  |  |  |
| Core CourseMathematics-I | B-MAT 101 | Mathematics Theory Course 1 | Calculus | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT102 | Mathematics Theory Course 2 | Algebra and Number Theory | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT103 | Mathematics Practical Course 1 | Practical-I | 2 | 4 | 40 | 10 | 50 | 3 |
| Core Course(Elective Discipline 1)-I |  |  |  |  |  |  |  |  |  |
| Core Course(Elective Discipline 2)-I |  |  |  |  |  |  |  |  |  |

**Semester-II**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course****Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam. Hours** |
| **Ext.** | **Int.** | **Total** |
| AECC-2 |  | AECC Course-II |  | 2 |  |  |  |  |  |
| Core CourseMathematics- II | B-MAT 201 | Mathematics Theory Course 3 | Advanced Calculus | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT202 | Mathematics Theory Course 4 | Differential Equations | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT203 | Mathematics Practical Course 2 | Practical-II | 2 | 4 | 40 | 10 | 50 | 3 |
| Core Course(Elective Discipline 1)-II |  |  |  |  |  |  |  |  |  |
| Core Course(Elective Discipline 2)-II |  |  |  |  |  |  |  |  |  |

**Semester-III**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** |  **Course Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam Hours** |
| **Ext.** | **Int.** | **Total** |
| AECC-3 |  | AECC Course-III |  | 2 |  |  |  |  |  |
| SEC-1 | B-MAT 301 | Mathematics/ Comp. Sc.Theory Course 5 | Programming Skills with C | 2 | 2 | 40 | 10 | 50 | 3 |
| Core CourseMathematics- III | B-MAT 302 | Mathematics Theory Course 6 | Real Analysis -I | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT303 | Mathematics Theory Course 7 | Mechanics -I | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT304 | Mathematics Practical Course 3 | Practical -III | 2 | 4 | 40 | 10 | 50 | 3 |
| Core Course(Elective Discipline 1)-III |  |  |  |  |  |  |  |  |  |
| Core Course(Elective Discipline 2)-III |  |  |  |  |  |  |  |  |  |

**Semester-IV**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam Hours** |
| **Ext.** | **Int.** | **Total** |
| SEC-2 |  | SEC Course-II |  |  |  |  |  |  |  |
| Core Course Mathematics -IV | B-MAT 401 | Mathematics Theory Course 8 | Abstract Algebra | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT402 | Mathematics Theory Course 9 | Numerical Analysis | 3 | 3 | 60 |  15 | 75 | 3 |
| B-MAT403 | Mathematics Practical Course 4 | Practical IV | 2 | 4 | 40 | 10 | 50 | 3 |
| Core Course(Elective Discipline 1)-IV |  |  |  |  |  |  |  |  |  |
| Core Course(Elective Discipline 2)-IV |  |  |  |  |  |  |  |  |  |

**Semester-V**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam Hours** |
| **Ext.** | **Int.** | **Total** |
| SEC-3 Mathematics | B-MAT 501 |  Mathematics Theory Course 10 | Vector Calculus | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 502 | Special Functions |
| Discipline Specific Elective- Mathematics-I | B-MAT 503 | Mathematics Theory Course 11 | Linear Algebra | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 504 | Partial Differential Equations and Integral Transforms |
| B-MAT 505 | Mathematics Theory Course 12 | Analytical Geometry | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 506 | Mechanics -II |
| B-MAT 507 | Mathematics Practical Course 5 | Practical -V | 2 | 4 | 40 | 10 | 50 | 3 |
| Discipline Specific Elective (Elective Discipline 1)-I |  |  |  |  |  |  |  |  |  |
| Discipline Specific Elective (Elective Discipline 2)-I |  |  |  |  |  |  |  |  |  |

**Semester-VI**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam Hours** |
| **Ext.** | **Int.** | **Total** |
| SEC-4 |  | Skill Enhancement Course-IV |  |  |  |  |  |  |  |
| Discipline Specific Elective Mathematics-II | B-MAT 601 | Mathematics Theory Course 13 | Real Analysis -II | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 602 | Complex Analysis |
| B-MAT 603 | Mathematics Theory Course 14 | Linear Programming | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 604 | Probability and Statistics |
| B-MAT 605 | Mathematics Practical Course 6 | Practical -VI | 2 | 4 | 40 | 10 | 50 | 3 |
| Discipline Specific Elective (Elective Discipline 1)-II |  |  |  |  |  |  |  |  |  |
| Discipline Specific Elective (Elective Discipline 2)-II |  |  |  |  |  |  |  |  |  |

 **CO-PSO matrix for the course B-MAT 101: Calculus**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 101.1** | 3 | 3 | 3 | 3 |
| **B-MAT 101.2** | 3 | 3 | 3 | 3 |
| **B-MAT 101.3** | 3 | 3 | 3 | 3 |
| **B-MAT 101.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 101: Calculus**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 101.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 101.2** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | 3 |
| **B-MAT 101.3** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | - | 2 |
| **B-MAT 101.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **Average** | **3** | **3** | **3** | **2.75** | **2.75** | **3** | **2.5** | **3** | **2.5** | **-** | **2.75** |

**CO-PSO matrix for the course B-MAT102 : Algebra and Number Theory**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT102.1** | 3 | 3 | 3 | 3 |
| **B-MAT 102.2** | 3 | 3 | 3 | 3 |
| **B-MAT 102.3** | 3 | 3 | 3 | 3 |
| **B-MAT 102.4** | 3 | 3 | 2 | 2 |
| **Average** | **3** | **3** | **2.75** | **2.75** |

**CO-PO matrix for the course B-MAT 102 : Algebra and Number Theory**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT102.1** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | -- | 2 |
| **B-MAT 102.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 2 |
| **B-MAT 102.3** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | -- | 2 |
| **B-MAT 102.4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | -- | 2 |
| **Average** | **3** | **3** | **3** | **2.75** | **2.75** | **2.5** | **2.25** | **3** | **2.5** | **--** | **2** |

**CO-PSO matrix for the course B-MAT103 : Practical -I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 103.1** | 3 | 3 | 3 | 3 |
| **B-MAT 103.2** | 3 | 3 | 3 | 3 |
| **B-MAT 103.3** | 3 | 3 | 3 | 3 |
| **B-MAT 103.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 103 : Practical -I**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 103.1** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | 2 |
| **B-MAT 103.2** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | 2 |
| **B-MAT 103.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 103.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **2.5** | **3** | **2.5** | **-** | **2.5** |

**CO-PSO matrix for the course B-MAT201: Advanced Calculus**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 201.1** | 3 | 3 | 3 | 3 |
| **B-MAT 201.2** | 3 | 3 | 3 | 3 |
| **B-MAT 201.3** | 3 | 3 | 3 | 3 |
| **B-MAT 201.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 201: Advanced Calculus**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 201.1** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | - | 2 |
| **B-MAT 201.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 201.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 2 |
| **B-MAT 201.4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | - | 3 |
| **Average** | **3** | **3** | **3** | **2.75** | **2.75** | **2.75** | **2.5** | **3** | **2.75** | **-** | **2.5** |

**CO-PSO matrix for the course B-MAT202 : Differential Equations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 202.1** | 3 | 3 | 3 | 3 |
| **B-MAT 202.2** | 3 | 3 | 3 | 3 |
| **B-MAT 202.3** | 3 | 3 | 3 | 3 |
| **B-MAT 202.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 202 : Differential Equations**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 202.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 202.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 202.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 202.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **3** |

**CO-PSO matrix for the course B-MAT203 : PRACTICAL-II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 203.1** | 3 | 3 | 3 | 3 |
| **B-MAT 203.2** | 3 | 3 | 3 | 3 |
| **B-MAT 203.3** | 3 | 3 | 3 | 3 |
| **B-MAT 203.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 203 : PRACTICAL-II**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 203.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 203.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 203.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 203.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **--** | **3** |

**CO-PSO matrix for the course B-MAT301 :Programming Skills with C**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 301.1** | 2 | 3 | 3 | 2 |
| **B-MAT 301.2** | 2 | 3 | 3 | 3 |
| **B-MAT 301.3** | 2 | 3 | 3 | 3 |
| **B-MAT 301.4** | 2 | 3 | 3 | 3 |
| **Average** | **2** | **3** | **3** | **2.75** |

**CO-PO matrix for the course B-MAT 301 : Programming Skills with C**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 301.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 301.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 301.3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | - | 3 |
| **B-MAT 301.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | - | **3** |

**CO-PSO matrix for the course B-MAT302 : Real Analysis -I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 302.1** | 3 | 3 | 2 | 3 |
| **B-MAT 302.2** | 3 | 3 | 3 | 3 |
| **B-MAT 302.3** | 3 | 3 | 3 | 3 |
| **B-MAT 302.4** | 3 | 3 | 2 | 2 |
| **Average** | **3** | **3** | **2.5** | **2.75** |

**CO-PO matrix for the course B-MAT 302 : Real Analysis –I**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 302.1** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | - | 2 |
| **B-MAT 302.2** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | - | 3 |
| **B-MAT 302.3** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | -- | 3 |
| **B-MAT 302.4** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | - | 2 |
| **Average** | **3** | **3** | **3** | **2** | **3** | **2** | **2** | **3** | **2** | **-** | **2.5** |

**CO-PSO matrix for the course B-MAT303 : Mechanics -I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 303.1** | 3 | 3 | 3 | 3 |
| **B-MAT 303.2** | 3 | 3 | 3 | 3 |
| **B-MAT 303.3** | 3 | 3 | 3 | 3 |
| **B-MAT 303.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 303 : Mechanics -I**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 303.1** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 303.2** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | -- | 2 |
| **B-MAT 303.3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 303.4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | -- | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **--** | **2.75** |

**CO-PSO matrix for the course B-MAT304 : Practical -III**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 304.1** | 2 | 3 | 3 | 3 |
| **B-MAT 304.2** | 2 | 3 | 3 | 3 |
| **B-MAT 304.3** | 2 | 3 | 3 | 3 |
| **B-MAT 304.4** | 2 | 3 | 3 | 3 |
| **Average** | **2** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 304 : Practical -III**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 304.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 304.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 304.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 304.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **-** | **3** |

**CO-PSO matrix for the course B-MAT401 : Abstract Algebra**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cos** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT401.1** | 3 | 3 | 3 | 3 |
| **B-MAT 401.2** | 3 | 3 | 2 | 2 |
| **B-MAT 401.3** | 3 | 3 | 2 | 3 |
| **B-MAT 401.4** | 3 | 3 | 2 | 2 |
| **Average** | **3** | **3** | **2.25** | **2.5** |

**CO-PO matrix for the course B-MAT 401 : Abstract Algebra**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT401 .1** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | - | - | 2 |
| **B-MAT 401 .2** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | - | - | 2 |
| **B-MAT 401 .3** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | -- | -- | 2 |
| **B-MAT 401 .4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | - | - | 2 |
| **Average** | **3** | **3** | **3** | **2** | **2.5** | **2** | **2.25** | **3** | **-** | **-** | **2** |

**CO-PSO matrix for the course B-MAT402 : Numerical Analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 402.1** | 3 | 3 | 3 | 3 |
| **B-MAT 402.2** | 3 | 3 | 3 | 3 |
| **B-MAT 402.3** | 3 | 3 | 3 | 3 |
| **B-MAT 402.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 402 : Numerical Analysis**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 402.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 402.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 402.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 402.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **3** |

**CO-PSO matrix for the course B-MAT403 : PRACTICAL-IV**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 403.1** | 2 | 3 | 3 | 3 |
| **B-MAT 403.2** | 3 | 3 | 3 | 3 |
| **B-MAT 403.3** | 2 | 3 | 3 | 3 |
| **B-MAT 403.4** | 3 | 3 | 3 | 3 |
| **Average** | **2.5** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 403 : PRACTICAL-IV**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 403.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 403.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 403.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 403.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **--** | **3** |

**CO-PSO matrix for the course B-MAT 501: Vector Calculus**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 501.1** | 3 | 3 | 3 | 3 |
| **B-MAT 501.2** | 3 | 3 | 3 | 3 |
| **B-MAT 501.3** | 3 | 3 | 3 | 3 |
| **B-MAT 501.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 501: Vector Calculus**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 501.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 501.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 501.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 501.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **-** | **3** |

**CO-PSO matrix for the course B-MAT 502: Special Functions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 502.1** | 3 | 3 | 3 | 3 |
| **B-MAT 502.2** | 3 | 3 | 3 | 3 |
| **B-MAT 502.3** | 3 | 3 | 3 | 3 |
| **B-MAT 502.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 502: Special Functions**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 502.1** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | 2 |
| **B-MAT 502.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 502.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 502.4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | 2 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **2.5** | **3** | **2** | **-** | **2.5** |

**CO-PSO matrix for the course B-MAT503 : Linear Algebra**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 503.1** | 3 | 3 | 3 | 2 |
| **B-MAT 503.2** | 3 | 3 | 3 | 3 |
| **B-MAT 503.3** | 3 | 3 | 3 | 3 |
| **B-MAT 503.4** | 3 | 3 | 3 | 2 |
| **Average** | **3** | **3** | **3** | **2.5** |

**CO-PO matrix for the course B-MAT 503 : Linear Algebra**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 503.1** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | - | -- | 2 |
| **B-MAT 503.2** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | -- | 3 |
| **B-MAT 503.3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | -- | 3 |
| **B-MAT 503.4** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | - | -- | 2 |
| **Average** | **3** | **3** | **3** | **2.5** | **3** | **2.5** | **2** | **3** | **2** | **--** | **2.5** |

**CO-PSO matrix for the course B-MAT 504 :Partial Differential Equations and Integral Transforms**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 504 .1** | 3 | 3 | 3 | 3 |
| **B-MAT 504 .2** | 3 | 3 | 3 | 3 |
| **B-MAT 504 .3** | 3 | 3 | 3 | 3 |
| **B-MAT 504 .4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 504 :Partial Differential Equations and Integral Transforms**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 504 .1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 504 .2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 504 .3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 504 .4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2.75** | **-** | **3** |

**CO-PSO matrix for the course B-MAT 505 : Analytical Geometry**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 505.1** | 3 | 3 | 3 | 3 |
| **B-MAT 505.2** | 3 | 3 | 3 | 3 |
| **B-MAT 505.3** | 3 | 3 | 3 | 3 |
| **B-MAT 505.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 505 : Analytical Geometry**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 505.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 |
| **B-MAT 505.2** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 505.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 505.4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | - | 2 |
| **Average** | **3** | **3** | **3** | **2.5** | **2.75** | **2.75** | **2.75** | **3** | **2.5** | **-** | **2.5** |

**CO-PSO matrix for the course B-MAT 506 : Mechanics -II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 506.1** | 3 | 3 | 3 | 3 |
| **B-MAT 506.2** | 3 | 3 | 3 | 3 |
| **B-MAT 506.3** | 3 | 3 | 3 | 3 |
| **B-MAT 506.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 506 : Mechanics -II**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 506.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 506.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 2 |
| **B-MAT 506.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 506.4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | -- | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **2.75** | **3** | **3** | **2.5** | **--** | **2.75** |

**CO-PSO matrix for the course B-MAT 507 : Practical- V**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 507.1** | 3 | 3 | 3 | 3 |
| **B-MAT 507.2** | 3 | 3 | 3 | 3 |
| **B-MAT 507.3** | 2 | 2 | 3 | 2 |
| **B-MAT 507.4** | 2 | 2 | 3 | 2 |
| **Average** | **2.5** | **2.5** | **3** | **2.5** |

**CO-PO matrix for the course B-MAT 507 : Practical- V**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 507.1** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | -- | 3 |
| **B-MAT 507.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 507.3** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | - | -- | 3 |
| **B-MAT 507.4** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | - | -- | 3 |
| **Average** | **3** | **3** | **2.5** | **3** | **2.5** | **2.75** | **2.75** | **3** | **2** | **--** | **3** |

**CO-PSO matrix for the course B-MAT 601: Real Analysis -II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 601.1** | 3 | 3 | 2 | 3 |
| **B-MAT 601.2** | 3 | 3 | 3 | 3 |
| **B-MAT 601.3** | 3 | 3 | 2 | 3 |
| **B-MAT 601.4** | 3 | 3 | 2 | 2 |
| **Average** | **3** | **3** | **2.25** | **2.75** |

**CO-PO matrix for the course B-MAT 601: Real Analysis -II**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 601.1** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | - | -- | 2 |
| **B-MAT 601.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 601.3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | - | -- | 2 |
| **B-MAT 601.4** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | - | -- | 2 |
| **Average** | **3** | **3** | **3** | **2.75** | **3** | **2.25** | **2.5** | **3** | **2** | **--** | **2.25** |

**CO-PSO matrix for the course B-MAT602 : Complex Analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 602.1** | 3 | 3 | 2 | 3 |
| **B-MAT 602.2** | 3 | 3 | 3 | 3 |
| **B-MAT 602.3** | 3 | 3 | 3 | 3 |
| **B-MAT 602.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **2.75** | **3** |

**CO-PO matrix for the course B-MAT 602 : Complex Analysis**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 602.1** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | - | 2 |
| **B-MAT 602.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 602.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | -- | 3 |
| **B-MAT 602.4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | - | 2 |
| **Average** | **3** | **3** | **3** | **2.75** | **2.75** | **2.5** | **2.75** | **3** | **2** | **-** | **2.5** |

**CO-PSO matrix for the course B-MAT 603: Linear Programming**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 603.1** | 3 | 3 | 3 | 3 |
| **B-MAT 603.2** | 3 | 3 | 3 | 3 |
| **B-MAT 603.3** | 3 | 3 | 3 | 3 |
| **B-MAT 603.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 603: Linear Programming**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 603.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 |
| **B-MAT 603.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 603.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 603.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2.75** | **-** | **2.75** |

**CO-PSO matrix for the course B-MAT 604 : Probability and Statistics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 604.1** | 3 | 3 | 3 | 3 |
| **B-MAT 604.2** | 3 | 3 | 3 | 3 |
| **B-MAT 604.3** | 3 | 3 | 3 | 3 |
| **B-MAT 604.4** | 3 | 3 | 3 | 3 |
| **Average** | **3** | **3** | **3** | **3** |

**CO-PO matrix for the course B-MAT 604 : Probability and Statistics**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 604.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 604.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| **B-MAT 604.3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | - | 3 |
| **B-MAT 604.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **2.75** | **3** | **3** | **3** | **2.5** | **-** | **3** |

**CO-PSO matrix for the course B-MAT 605: Practical- VI**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **B-MAT 605.1** | 3 | 3 | 3 | 3 |
| **B-MAT 605.2** | 3 | 3 | 3 | 3 |
| **B-MAT 605.3** | 2 | 2 | 3 | 2 |
| **B-MAT 605.4** | 2 | 2 | 3 | 2 |
| **Average** | **2.5** | **2.5** | **3** | **2.5** |

**CO-PO matrix for the course B-MAT 605 : Practical- VI**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **B-MAT 605.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 605.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| **B-MAT 605.3** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | - | -- | 3 |
| **B-MAT 605.4** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | - | -- | 3 |
| **Average** | **3** | **3** | **2.5** | **3** | **2.5** | **3** | **3** | **3** | **3** | **--** | **3** |

**Table 4 CO-PO-PSO mapping matrix of Mathematics Subject B.Sc. Programme**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| B-MAT 101 | **3** | **3** | **3** | **2.75** | **2.75** | **3** | **2.5** | **3** | **2.5** | **-** | **2.75** | **3** | **3** | **3** | **3** |
| B-MAT 102 | **3** | **3** | **3** | **2.75** | **2.75** | **2.5** | **2.25** | **3** | **2.5** | **--** | **2** | **3** | **3** | **2.75** | **2.75** |
| B-MAT 103 | **3** | **3** | **3** | **3** | **3** | **3** | **2.5** | **3** | **2.5** | **-** | **2.5** | **3** | **3** | **3** | **3** |
| B-MAT 201 | **3** | **3** | **3** | **2.75** | **2.75** | **2.75** | **2.5** | **3** | **2.75** | **-** | **2.5** | **3** | **3** | **3** | **3** |
| B-MAT 202 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **3** | **3** | **3** | **3** | **3** |
| B-MAT 203 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **--** | **3** | **3** | **3** | **3** | **3** |
| B-MAT 301 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | - | **3** | **2** | **3** | **3** | **2.75** |
| B-MAT 302 | **3** | **3** | **3** | **2** | **3** | **2** | **2** | **3** | **2** | **-** | **2.5** | **3** | **3** | **2.5** | **2.75** |
| B-MAT 303 | **3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **--** | **2.75** | **3** | **3** | **3** | **3** |
| B-MAT 304 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **-** | **3** | **2** | **3** | **3** | **3** |
| B-MAT 401 | **3** | **3** | **3** | **2** | **2.5** | **2** | **2.25** | **3** | **-** | **-** | **2** | **3** | **3** | **2.25** | **2.5** |
| B-MAT 402 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **3** | **3** | **3** | **3** | **3** |
| B-MAT 403 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **--** | **3** | **2.5** | **3** | **3** | **3** |
| B-MAT 501 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **-** | **3** | **3** | **3** | **3** | **3** |
| B-MAT 502 | **3** | **3** | **3** | **3** | **3** | **3** | **2.5** | **3** | **2** | **-** | **2.5** | **3** | **3** | **3** | **3** |
| B-MAT 503 | **3** | **3** | **3** | **3** | **3** | **3** | **2.5** | **3** | **2** | **-** | **2.5** | **3** | **3** | **3** | **2.5** |
| B-MAT 504 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2.75** | **-** | **3** | **3** | **3** | **3** | **3** |
| B-MAT 505 | **3** | **3** | **3** | **2.5** | **2.75** | **2.75** | **2.75** | **3** | **2.5** | **-** | **2.5** | **3** | **3** | **3** | **3** |
| B-MAT 506 | **3** | **3** | **3** | **3** | **3** | **2.75** | **3** | **3** | **2.5** | **--** | **2.75** | **3** | **3** | **3** | **3** |
| B-MAT 507 | **3** | **3** | **2.5** | **3** | **2.5** | **2.75** | **2.75** | **3** | **2** | **--** | **3** | **2.5** | **2.5** | **3** | **2.5** |
| B-MAT 601 | **3** | **3** | **3** | **2.75** | **3** | **2.25** | **2.5** | **3** | **2** | **--** | **2.25** | **3** | **3** | **2.25** | **2.75** |
| B-MAT 602 | **3** | **3** | **3** | **2.75** | **2.75** | **2.5** | **2.75** | **3** | **2** | **-** | **2.5** | **3** | **3** | **2.75** | **3** |
| B-MAT 603 | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2.75** | **-** | **2.75** | **3** | **3** | **3** | **3** |
| B-MAT 604 | **3** | **3** | **3** | **3** | **2.75** | **3** | **3** | **3** | **2.5** | **-** | **3** | **3** | **3** | **3** | **3** |
| B-MAT 605 | **3** | **3** | **2.5** | **3** | **2.5** | **3** | **3** | **3** | **3** | **--** | **3** | **2.5** | **2.5** | **3** | **2.5** |

**Scheme of the Programme B.A. with Mathematics as one subject**

1. **Name of the Programme (Course): B.A. with Mathematics**
2. **Definitions/ Abbreviations:**

**1 credit=1 Hour Theory Lecture (L) per week**

**1 credit= 2 Hours Practical (P) per week**

**1 credit = 25 marks**

**2 Hours = 3 periods of 45/40 minutes**

**3 Hours = 4 periods of 45/40 minutes**

**CC = Core Course**

**DSC = Discipline Core Course**

**AECC = Ability Enhancement Compulsory Course**

**SEC = Skill Enhancement Course**

**DSE = Discipline Specific Elective Course**

**GE = Generic Elective**

1. **One Batch(Practical Group) will consist of 15 students**
2. **The scheme will be effective from the session 2020-2021 in phased manner.**
3. **Each End Term Examination will be of three hours.**

**Credit Distribution for Mathematics subject in the B.A. Programme**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Core Courses (CC) | Ability Enhancement Compulsory Courses (AECC) | Discipline Specific Elective Courses(DSE) | Skill Enhancement Courses(SEC) | Total Credits |
| Theory  | 24 | - | 8 | 4 | 36 |
| Practical  | 8 | - | 4 | - | 12 |
| Total | 32 | - | 12 | 4 | 48 |

**Semester wise Distribution of Credits in the subject of Mathematics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | First year Credit | Second year Credit | Third year Credit |  | Total Credits |
| 1st Sem | 2nd Sem | 3rd Sem | 4th Sem | 5thSem |  | 6thSem |  |  |
| Ability Enhancement Compulsory Courses(AECC) | - | - |  |  | - |  | - |  | - |
| Core Courses (CC) | 8 | 8 | 8 | 8 | - |  | - |  | 32 |
| Discipline Specific Elective Courses(DSE) | - | - | - | - | 6 |  | 6 |  | 12 |
| Skill Enhancement Courses(SEC) | - | - | 2 | - | 2 |  | - |  | 4 |
| Total | 8 | 8 | 10 | 8 | 8 | 20 | 6 |  | 48 |

**Contact hours for Mathematics subject in the B.A. Programme**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Core Courses (CC) | Ability Enhancement Compulsory Courses (AECC) | Discipline Specific Elective Courses(DSE) | Skill Enhancement Courses(SEC) | Total hours |
| Theory  | 24 | - | 8 | 4 | 36 |
| Practical  | 16 | - | 8 | - | 24 |
| Total | 40 | - | 16 | 4 | 60 |

**Program Outcomes (PO) for the B.A. Programme**

|  |  |  |
| --- | --- | --- |
| **PO1** |  |  |
| **PO2** |  |  |
| **PO3** |  |  |
| **PO4** |  |  |
| **PO5** |  |  |
| **PO6** |  |  |
| **PO7** |  |  |
| **PO8** |  |  |
| **PO9** |  |  |
| **PO10** |  |  |
| **PO11** |  |  |

**Program Specific Outcomes (PSO) for Under Graduate CBCS Programme in the subject of Mathematics**

After successful completion of the programme, a student will be able to:

|  |  |
| --- | --- |
| **PSO1** | Have basic understanding and knowledge in different core areas of Mathematics such as algebra, analysis, calculus, differential equations, mechanics, numerical analysis and in some of the other elective areas. Demonstrate understanding of the concepts /theories/methods from such areas of Mathematics.  |
| **PSO2** | 1. Have **a broad background** in Mathematics and develop the essential mathematical reasoning, knowledge, skills and aptitude to pursue further studies and research in Mathematics.
 |
| **PSO3** | Communicate mathematics effectively and precisely by written, computational and graphical means. |
| **PSO4** | 1. Apply knowledge, understanding, methods, techniques and skills of Mathematics to analyse, evaluate and solve problems of Mathematics and/or the mathematical problems having applications in engineering/science/technology/life sciences/social sciences so as to enhance career prospects in different fields.
 |

**Scheme/Structure of the Programme B.A. with Mathematics subject w.e.f. the session 2020-21 in phased manner**

**Semester-I**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course****Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam. Hours** |
| **Ext.** | **Int.** | **Total** |
| AECC-1 |  | AECC Course-I |  |  |  |  |  |  |  |
| Core CourseEnglish-I |  | English |  |  |  |  |  |  |  |
| Core CourseHindi-I |  | Hindi |  |  |  |  |  |  |  |
| Core Course (Elective 1) -I |  | CC Elective1-I |  |  |  |  |  |  |  |
| Core Course Mathematics-I | B-MAT 101 | Mathematics Theory Course 1 | Calculus | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT102 | Mathematics Theory Course 2 | Algebra and Number Theory | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT103 | Mathematics Practical Course 1 | Practical-I | 2 | 4 | 40 | 10 | 50 | 3 |

**Semester-II**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course****Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam. Hours** |
| **Ext.** | **Int.** | **Total** |
| AECC-2 |  | AECC Course-II |  |  |  |  |  |  |  |
| Core CourseEnglish-II |  | English-II |  |  |  |  |  |  |  |
| Core CourseHindi-II |  | Hindi-II |  |  |  |  |  |  |  |
| Core Course (Elective 1) -II |  | Elective1-II |  |  |  |  |  |  |  |
| Core Course Mathematics-II | B-MAT 201 | Mathematics Theory Course 3 | Advanced Calculus | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT202 | Mathematics Theory Course 4 | Differential Equations | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT203 | Mathematics Practical Course 2 | Practical-II | 2 | 4 | 40 | 10 | 50 | 3 |

**Semester-III**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course****Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam. Hours** |
| **Ext.** | **Int.** | **Total** |
| SEC-1 | B-MAT 301 | Mathematics/ Comp. Sc.Theory Course 5 | Programming Skills with C | 2 | 2 | 40 | 10 | 50 | 3 |
| Core CourseEnglish-III |  | English-III |  |  |  |  |  |  |  |
| Core CourseHindi-III |  | Hindi-III |  |  |  |  |  |  |  |
| Core Course (Elective 1) -III |  | Elective1-III |  |  |  |  |  |  |  |
| Core Course Mathematics-III | B-MAT 302 | Mathematics Theory Course 6 | Real Analysis -I | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT303 | Mathematics Theory Course 7 | Mechanics –I | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT304 | Mathematics Practical Course 3 | Practical –III | 2 | 4 | 40 | 10 | 50 | 3 |

**Semester-IV**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course****Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam. Hours** |
| **Ext.** | **Int.** | **Total** |
| SEC-2 |  | SEC Course-II |  |  |  |  |  |  |  |
| Core CourseEnglish-IV |  | English-IV |  |  |  |  |  |  |  |
| Core CourseHindi-IV |  | Hindi-IV |  |  |  |  |  |  |  |
| Core Course (Elective 1) –IV |  | Elective1-IV |  |  |  |  |  |  |  |
| Core Course Mathematics-IV | B-MAT 401 | Mathematics Theory Course 8 | Abstract Algebra | 3 | 3 | 60 | 15 | 75 | 3 |
| B-MAT402 | Mathematics Theory Course 9 | Numerical Analysis | 3 | 3 | 60 |  15 | 75 | 3 |
| B-MAT403 | Mathematics Practical Course 4 | Practical IV | 2 | 4 | 40 | 10 | 50 | 3 |

**Semester-V**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam Hours** |
| **Ext.** | **Int.** | **Total** |
| Skill Enhancement Course -Mathematics | B-MAT 501 |  Mathematics Theory Course 10 | Vector Calculus | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 502 | Special Functions |
| GE-1 |  | Generic Elective-I |  |  |  |  |  |  |  |
| DSE-1 |  | DSE Elective1-I |  |  |  |  |  |  |  |
| Discipline Specific Elective- Mathematics-I | B-MAT 503 | Mathematics Theory Course 11 | Linear Algebra | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 504 | Partial Differential Equations and Integral Transforms |
| B-MAT 505 | Mathematics Theory Course 12 | Analytical Geometry | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 506 | Mechanics –II |
| B-MAT 507 | Mathematics Practical Course 5 | Practical –V | 2 | 4 | 40 | 10 | 50 | 3 |

**Semester-VI**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Course Code** | **Subject** | **Course Nomenclature** | **Credits** | **Teaching Hours/ week** | **Marks** | **Duration of Exam Hours** |
| **Ext.** | **Int.** | **Total** |
| SEC-4 |  | Skill Enhancement Course-IV |  |  |  |  |  |  |  |
|  |  |  |
| GE-2 |  | Generic Elective-II |  |  |  |  |  |  |  |
| DSE-3 |  | DSE Elective1-II |  |  |  |  |  |  |  |
| Discipline Specific Elective Mathematics-II | B-MAT 601 | Mathematics Theory Course 13 | Real Analysis -II | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 602 | Complex Analysis |
| B-MAT 603 | Mathematics Theory Course 14 | Linear Programming | 2 | 2 | 40 | 10 | 50 | 3 |
| B-MAT 604 | Probability and Statistics |
| B-MAT 605 | Mathematics Practical Course 6 | Practical -VI | 2 | 4 | 40 | 10 | 50 | 3 |

**B-MAT 101: Calculus**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Calculate the limit of functions, examine the continuity of functions, understand differentiability of different type of functions, successive differentiation of functions and series expansions.
2. Understand concepts of tangents, normals, asymptotes, curvature, evolutes and involutes of a curve; the geometrical meanings of these terms and to solve related problems
3. Determine singular points of a curve and their types. To understand rectification of curves and to apply the reduction formulae.
4. Determine area bounded by curves and volumes and surface area of solids formed by revolution of curves

**Unit-I:**

*ε-δ* definition of limit and continuity of a real valued function, basic properties of limits, types of discontinuities. Differentiability of functions. Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions

**Unit-II:**

Tangents and normals (Cartesian and parametric equations). Asymptotes in Cartesian and polar coordinates, intersection of a curve and its asymptotes. Curvature and radius of curvature of curves in Cartesian, polar and parametric forms. Newton’s method. Radius of curvature for pedal curves. Centre of curvature. Circle of curvature. Evolutes and involutes.

**Unit-III:**

Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points.

Reduction formulae. Rectification.

**Unit-IV:**

Quadrature, Sectorial area. Area bounded by closed curves. Volumes and surfaces of solids of revolution. Theorems of Pappu’s and Guilden.

**Recommended Text Books:**

1. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus*(10th edition). Wiley India.
2. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.
3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.
4. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd.
5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas*’ *Calculus* (14th edition). Pearson Education.
6. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). *Calculus* (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

**B-MAT 102: Algebra and Number theory**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Determine rank of a matrix, eigen values, eigen vectors, characteristic equation and characteristic polynomial of square matrices. Understand unitary and orthogonal matrices and to solve related problems.
2. Find solution of homogeneous and non-homogeneous system of linear equations using matrices. Determine relation between roots and coefficients of a general polynomial equation.
3. Identify multiple roots. Application of Descarte’s rule of sign. Solve cubic and biquadratic equations.
4. Understand the basic concepts of number theory and their applications in problem solving. Prove Fermat and Wilson’s theorems and their applications.

**Unit–I:**

Rank of a matrix. Row rank and column rank of a matrix. Eigen values, eigen vectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix. Unitary and Orthogonal Matrices.

**Unit–II:**

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations.

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots.

**Unit–III:**

Common roots and multiple roots. Nature of the roots of an equation Descarte’s rule of signs. Solutions of cubic equations (Cardon’s method). Biquadratic equations and their solutions.

**Unit–IV:**

Divisibility, Greatest Common Divisor(GCD), Least Common Multiple (LCM). Prime numbers, Fundamental Theorem of Arithmetic. Linear Congruences, Fermat’s theorem. Wilson’s theorem and its converse. Linear Diophantine equations in two variables. Greatest integer function [x]. The number of divisors and the sum of divisors of a natural number n (The functions d(n) and σ(n)).

**Recommended Text Books:**

1. A.I. Kostrikin (1984). *Introduction to Algebra*. Springer Verlag.
2. Bernard Kolman & David R. Hill (2003). *Introductory Linear Algebra with Applications* (7th edition). Pearson Education Pvt. Ltd. India.
3. S. H. Friedberg, A. L. Insel and L.E. Spence (2004). *Linear Algebra*, Prentice Hall of India Pvt. Ltd.
4. David C. Lay, Steven R. Lay & Judi J. McDonald (2016). *Linear Algebra and its Applications* (5th edition). Pearson Education Pvt. Ltd. India.
5. Gareth A. Jones & J. Mary Jones (2005). *Elementary Number Theo*ry. Springer.
6. Neville Robbins (2007). *Beginning Number Theory* (2nd edition). Narosa.
7. I. Niven (2012). *An Introduction to the Theory of Numbers* (5th edition). John Wiley & Sons.
8. H.S. Hall and S.R. Knight (2016). *Higher Algebra*, Arihant Publications.
9. Leonard Eugene Dickson (2009). *First Course in the Theory of Equations*. The Project Gutenberg EBook (<http://www.gutenberg.org/ebooks/29785>)

**B-MAT 103: PRACTICAL-I**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Practical)** | **Practical Hours per week** | **Internal Assessment Marks** | **External Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |

**Note:** This course has two components, Problem Solving and Practicals using MAXIMA software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (a) and two questions from the part (b) by taking course outcomes (COs) into consideration. The examinee will be required to solve one problem from the part (a) and to execute one problem successfully from the part (b). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

**Course Outcomes:** This course will enable the students to:

1. Handle practical problems of tracing of curves when equations are given in Cartesian, polar coordinates or in parametric form.
2. Solve practical problems of finding length of given curves, calculating volume of solids generated by revolution of curves and solving cubic and biquadratic equations.
3. Have hand on experience to find derivative and integral of different functions and to solve algebraic equations by using built in functions of MAXIMA software.
4. Attain skills to find inverse, eigen values of matrices and to solve system of linear equations by using built in functions of MAXIMA software.
5. **Problem Solving**- Questions related to the following problems will be solved and record of those will be maintained in the Practical Notebook:
6. Problems of curve tracing when equation is given in Cartesian coordinates.
7. Problems of curve tracing when equation is given in parametric form.
8. Problems of curve tracing when equation is given in polar coordinates.
9. Problem solving of determination of length of a curve expressed in Cartesian coordinates.
10. Problem solving of determination of length of a curve expressed in polar coordinates.
11. Problems of determination of volume of solids generated by revolution of curves expressed in Cartesian coordinates.
12. Problems of determination of volume of solids generated by revolution of curves expressed in polar coordinates.
13. Problems of determination of volume of solids generated by revolution of curves expressed in parametric form.
14. Problems of solving cubic equations by Cardon’s method.
15. Problems of solving biquadratic equations by Ferrari’ method.
16. **Practicals with Free and Open Source Software (FOSS) Tools-** The following practicals will be done using MAXIMA Software and record of those will be maintained in the practical Note Book:
17. To simplify expression, factor expression, expand expression and to do trigonometric simplification and complex simplification by making use of MAXIMA.
18. To find derivatives of functions using MAXIMA.
19. To find indefinite and definite integrals of different functions using MAXIMA.
20. To find roots of algebraic equations using MAXIMA.
21. To find the value of a determinant using MAXIMA.
22. To compute inverse of a square matrix using MAXIMA.
23. To find Eigen values and Eigen vectors of a square matrix using MAXIMA.
24. To solve system of linear equations using MAXIMA.

**B-MAT 201: Advanced Calculus**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand and to prove Rolle’s Theorem, mean value theorems and their geometrical interpretations. To determine indeterminate forms.
2. Learn conceptual variations while advancing from one variable to several variables in calculus, limit and continuity, partial differentiation of such functions. To understand composite functions, homogeneous functions and to solve related problems.
3. Understand differentiability of real valued functions of two variables and to prove associated results. To determine maximum and minimum of functions of two variables and to apply multivariable calculus in optimization problems.
4. Evaluate double and triple integrals. To learn about Dirichlet integrals, Beta and Gamma functions and to solve related problems.

 **Unit-I:**

Mean value theorems: Rolle’s Theorem and Lagrange’s mean value theorem and their geometrical interpretations, Cauchy mean value theorem. Taylor’s Theorem with various forms of remainders, Darboux intermediate value theorem for derivatives. Indeterminate forms.

**Unit-II:**

Functions of several variables, Level curves and surfaces, Limits and continuity. Partial differentiation. Total Differentials; Composite functions & implicit functions. Chain rule. Change of variables. Homogenous functions & Euler’s theorem on homogeneous functions. Taylor’s theorem for functions of two or more variables.

**Unit-III:**

Differentiability of real valued functions of two variables. Schwarz and Young’s theorem. Implicit function theorem. Extrema of functions of two and more variables; Maxima, Minima critical points, Method of Lagrange multipliers. Constrained optimization problems

**Unit-IV:**

Double integration over rectangular and nonrectangular regions, Double integrals in polar co-ordinates. Jacobian. Change of order of integration. Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates. Dirichlet integrals. Beta and Gamma functions.

**Recommended Text Books:**

1. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus*(10th edition). Wiley India.
2. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.
3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.
4. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd.
5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas*’ *Calculus* (14th edition). Pearson Education.
6. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). *Calculus* (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.
7. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). *Basic Multivariable Calculus*, Springer India Pvt. Limited.
8. James Stewart (2012). *Multivariable Calculus* (7th edition). Brooks/Cole. Cengage.

**B-MAT 202: Differential Equations**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** The course will enable the students to:

1. Understand the basic concepts of ordinary differential equations and to learn various techniques of finding exact solutions of certain solvable first order differential equations. and.
2. Develop the skills of solving homogeneous and non-homogeneous second order linear ordinary differential equations with constant coefficients and with variable coefficients.
3. Understand total differential equations and basic concepts of partial differential equations. To learn methods and techniques for solving linear PDEs of first order.
4. Apply theory of PDEs to determine integral surfaces through a given curve and to find orthogonal surfaces. To understand compatible systems and Charpit method, Jacobi method methods for solving PDEs. To learn techniques of solving second order PDEs.

**Unit-I:**

Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, equations reducible to homogeneous, Linear differential equations and equations reducible to linear form. Exact differential equations, Integrating factor. First order higher degree equations solvable for *x*, *y* and *p*. Clairaut’s form and singular solutions. Orthogonal trajectories of one-parameter families of curves in a plane.

**Unit-II:**

Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, linear non-homogeneous differential equations. Linear differential equation of second order with variable coefficients. Method of reduction of order, method of undetermined coefficients, method of variation of parameters. Cauchy-Euler equation.

**Unit-III:**

Solution of simultaneous differential equations, total differential equations.

Genesis of Partial differential equations (PDE), Concept of linear and non-linear PDEs. Complete solution, general solution and singular solution of a PDE. Linear PDE of first order. Lagrange’s method for PDEs of the form: *P(x,y,z) p + Q(x,y,z) q = R(x,y,z),* where *p=∂z/∂x* and *q=∂z/∂y*.

**Unit-IV:**

Second Order Partial Differential Equations with Constant Coefficients. Integral surfaces passing through a given curve. Surfaces orthogonal to a given system of surfaces. Compatible systems of first order equations. Charpit’s method, Special types of first order PDEs, Jacobi’s method. Solutions of second order linear partial differential equations (homogeneous and non-homogeneous) with constant coefficients. Solution of PDEs with variable coefficients reducible to equations with constant coefficients.

**Recommended Text Book:**

1. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). J. Wiley & Sons
2. B. Rai & D. P. Choudhury (2006). *Ordinary Differential Equations - An Introduction*. Narosa Publishing House Pvt. Ltd. New Delhi.
3. Shepley L. Ross (2007). *Differential Equations* (3rd edition). Wiley.
4. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3rd edition). CRC Press. Taylor & Francis.
5. Ian N. Sneddon (2006). *Elements of Partial Differential Equations*. Dover Publications.

**B-MAT 203: PRACTICAL-II**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Practical)** | **Practical Hours per week** | **Internal Assessment Marks** | **External Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |

**Note:** This course has two components, Problem Solving and Practicals using MAXIMA software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (a) and two questions from the part (b) by taking course outcomes (COs) into consideration. The examinee will be required to solve one problem from the part (a) and to execute one problem successfully from the part (b). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

**Course Outcomes:** This course will enable the students to:

1. Practical problems of checking continuity and differentiability, finding maxima and minima of functions of several variables, evaluating double and triple integrals.
2. Develop skills of solving ODEs and PDEs.
3. Hands-on experience to find partial derivatives, total derivative and to plot graphs of functions by using built in functions of MAXIMA software.
4. Hands-on experience to evaluate double and triple integrals, solve ordinary differential equations by using built in functions of MAXIMA software.
5. **Problem Solving**- Questions related to the following problems will be solved and record of those will be maintained in the Practical Notebook:
6. Problems of finding continuity of functions of several variables.
7. Problems of finding differentiability of functions of several variables.
8. Problems of finding maxima and minima of functions of two variables.
9. Solving optimization problems.
10. Problem solving of determination surface area through application of double integrals in Cartesian and polar coordinates.
11. Problems of determination of volume using triple integrals.
12. Problems of solving differential equations which are reducible to homogeneous.
13. Problems of solving differential equations which are reducible to linear.
14. Problems of solving differential equations by method of undetermined coefficients.
15. Problems of solving different PDEs using Lagrange’s method.
16. Problems of solving PDEs with Charpit’s method.
17. Problems of solving second order PDEs with variable coefficients which can be reduced to those with constant coefficients.
18. **Practicals with Free and Open Source Software(FOSS) Tools-** The following practicals will be done using MAXIMA Software and record of those will be maintained in the practical Note Book:
19. To find partial derivatives of a function using MAXIMA.
20. To find total differential of a function of several variables using MAXIMA.
21. To find partial derivatives by chain rule and implicit differentiation.
22. To plot a curve in two dimensions, three dimensional plots and level surfaces using MAXIMA.
23. To find exact solutions of first and second order ODEs using ode2 and ic1/ic2 built in functions of MAXIMA.
24. To find exact solutions of first and second order ODEs using desolve and atvalue built in functions of MAXIMA.
25. To evaluate double and triple integrals using MAXIMA.
26. To find numerical solution of a first order ODE using plotdf built in function of MAXIMA.

**B-MAT 301:** **PROGRAMMING SKILLS WITH C**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Familiarize with C programming language. Learn elements of C, data types, constants and variables, operations and operators, statements and expressions. Use these tools for writing C programs.
2. Learn Input/ Output functions in C, to write reading and writing statements in C, decision making statements and structures in C. Apply this knowledge to use as tools in writing C programs.
3. Understand loops and arrays, their types, characteristics and structures. Attain the skill to write C programs which involve arrays and multiple iterations.
4. Learn strings of characters, their declaration, input/ output, operations on strings and functions which handle strings. Learn declaration, types and calling of user defined functions in C.

Be ready to attain the skills of programming by making use of tools and knowledge mentioned in the Cos 1 to 4.

**Unit-I:**

Overview of C: Introduction and importance of C, Basic structure of a C program, Executing a C program. Elements of C: C character set, C tokens, Identifiers and keywords, Constants and Variables, Data types, Assignment statement, Symbolic constants.

 Operators & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, conditional operators and special operators. Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associativity.

**Unit-II**

Input/output: Unformatted & formatted I/O function, Input functions viz. scanf(), getch(), getche(), getchar(), gets(); output functions viz. printf(), putch(), putchar(), puts().

Decision making & branching: Decision making with IF statement, IF…ELSE statement, Nested IF statement, ELSE-IF ladder, SWITCH statement, GOTO statement.

 **Unit-III:**

Decision making & looping: For, while, and do-while loop, jumps in loops, break, continue statement.

 Arrays: Definition, types, initialization, processing an array.

**Unit-IV:**

Character Strings: Declaration and initialization, Reading and writing, Arithmetic Operations on Characters, Putting strings together, Comparison of strings, String handling Functions.

User defined functions: Need for user defined functions, form of C functions, return values and their types, calling a function, category of functions, nesting of functions, Recursion, Functions with arrays, scope of variables in functions, ANSI C functions.

 **Recommended Text Books:**

1. B.W. Kernighan and D.M. Ritchie : The C Programming Language, 2nd Edition
2. V. Rajaraman : Programming in C, Prentice Hall of India, 1994
3. Byron S. Gottfried : Theory and Problems of Programming with C, Tata McGraw-Hill Publishing Co. Ltd., 1998
4. Programming in ANSI C, E. Balagurusamy, Tata McGraw-Hill Publishing Co. Ltd.

**B-MAT 302: Real Analysis -I**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

* 1. Understand basic concepts of real number system and set theory. Preliminary results on neighbourhood of a point, interior and limit points, open sets, closed sets etc.
	2. Learn real sequences, their limit, boundedness and convergence. To find convergence and divergence of a sequence. To understand Cauchy sequence, subsequence and to prove related theorems.
	3. Understand infinite series and its basic properties. Attain skills to determine convergence of a series of real numbers by applying various tests.
	4. Understand absolute and conditional convergence of alternating series and related tests. Learn the basic concepts of pointwise convergence and uniform convergence of sequence and series of functions.

**Unit-I:**

Finite and infinite sets, countable and uncountable sets, bounded and unbounded sets in $R$. Least upper bound (supremum), greatest lower bound (inﬁmum) of a set and their properties. The set of real numbers ($R$) as an ordered field, Least upper bound properties of $R$**,** Metric property and completeness of $R$. Archimedean property of $R$. Neighbourhood of a point, interior points, isolated points, limit points. Open sets, closed sets, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem.

**Unit-II:**

Sequences in $R$**,** Convergent sequence and its limit, Limit theorems, Bounded and monotonic sequences in $R.$ Cauchy’s theorem on limits, Monotone convergence theorem, Limit superior and limit inferior, Cauchy sequence, Cauchy’s convergence criterion. Subsequences, Subsequential limits.

**Unit-III:**

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, Cauchy’s general principle of Convergence of series, Convergence and divergence of geometric series, Hyper Harmonic series or p-series. D-Alembert’s ratio test, Raabe’s test, Logarithmic test, Abel’s test, Cauchy’s nth root test, Gauss Test, Cauchy’s integral test, Cauchy’s condensation test.

**Unit-IV:**

 Alternating series, Absolute and conditional convergence, Leibniz test, Rearrangements of series.

Pointwise and uniform convergence of sequence and series of functions, Mn-test, Weierstrass’s M-test. Uniform continuity. Uniform convergence and continuity.

**Recommended Text Books:**

1. T. M. Apostol (2008). *Mathematical Analysis: A Modern Approach to Advanced Calculus*. Pearson Education.
2. Charalambos D. Aliprantis & ‎Owen Burkinshaw (1998). *Principles of Real Analysis* (3rd edition). Academic Press.
3. Robert G. Bartle & Donald R. Sherbert (2015). *Introduction to Real Analysis* (4th edition).Wiley India.
4. Gerald G. Bilodeau, Paul R. Thie & G. E. Keough (2015). *An Introduction to Analysis* (2nd edition), Jones and Bartlett India Pvt. Ltd.
5. E. Hewitt & ‎K. Stromberg (2013). *Real and Abstract Analysis.*  Springer-Verlag.
6. K. A. Ross (2013). *Elementary Analysis***:** *The Theory of Calculus* (2nd edition). Springer.
7. Walter Rudin. *Principles of Mathematical Analysis* (3rd edition), Tata McGraw Hill.

**B-MAT 303: Mechanics -I**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand basic concepts of forces, their resultant and moment; couples and their moments. To attain the problem solving skill for scientific problems.
2. Learn the concepts of friction and laws of friction, centre of mass and centre of gravity and to solve problems related to these concepts.
3. Learn fundamentals of dynamics like velocity, acceleration, angular velocity and acceleration, Newton’s laws of motion, simple harmonic motion and to develop the skill of solving simple dynamical problems.
4. Understand concepts of work, power, energy and projectile motion and to solve related problems. Learn about Kepler’s laws of the planetary motions.

**Unit-I:**

Composition and resolution of forces, Parallel forces, Couples, Moment of force and a couple about a point and a line.

**Unit-II:**

Concept of friction, Laws of friction, Problems of equilibrium under forces including friction. Concepts of centre of mass and centre of gravity, Centre of gravity of an uniform arc, plane area and solids of revolution.

**Unit-III:**

 Velocity and acceleration of a particle along a curve: radial and transverse components, tangential and normal components, Relative velocity and acceleration, Angular velocity and acceleration. Newton’s laws of motion. Simple harmonic motion and elastic strings.

**Unit-IV:**

Work, Power and Energy. Projectile motion. Kepler’s laws of planetary motion (Statements and articles only).

**Recommended Text Books:**

1. R. S. Varma (1962). *A Text Book of Statics*. Pothishala Pvt. Ltd.
2. P.L. Srivastava (1964). *Elementary Dynamics*. Ram Narain Lal, Beni Prasad Publishers Allahabad.
3. J. L. Synge & B. A. Griffith (1949). *Principles of Mechanics*. McGraw-Hill.
4. S.L. Loney (1995). *An Elementary Treatise on Statics,* Radha Publishing House.
5. S.L. Loney (2006). *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies*. Read Books.
6. A. S. Ramsey (2009). *Statics*. Cambridge University Press.
7. A. S. Ramsey (2009). *Dynamics*. Cambridge University Press.
8. A.P. Roberts (2003). *Statics and Dynamics with Background in Mathematics*. Cambridge University Press.

**B-MAT 304: PRACTICAL-III**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Practical)** | **Practical Hours per week** | **Internal Assessment Marks** | **External Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |

**Note:** The examiner will set 4 questions at the time of practical examination by taking course outcomes (COs) into consideration. The examinee will be required to write two programs and execute one program successfully. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

**Course Outcomes:** This course will enable the students to:

1. Demonstrate understanding of syntax and structure of simple programs in C.
2. Attain skill of writing codes in the C programming language.
3. Learn to write, enter and executing elementary programs in the programming language C.
4. Have hands-on experience to run and debug programs in C for different mathematical and other practical problems of daily or scientific use.

**Note-** The following practicals will be done using the programming language C and record of those will be maintained in the practical Note Book:

1. To find greatest and smallest of three numbers.
2. To find the roots of a quadratic equation.
3. To check whether a given year is leap year or not.
4. To check a given number for being palindrome or Armstrong.
5. To generate Fibonacci sequence.
6. To find sum of cosine series and sine series up to n terms.
7. To find sum of any n numbers.
8. To find transpose of a matrix.
9. To find sum and product of two matrices.
10. To find area of circle, triangle and rectangle depending on choice using switch statement.
11. To find factorial of a number using
12. iteration (b) function.
13. To find Greatest Common Divisor of two numbers using recursion.
14. Write a function to check a given number for being prime number. Use the same to generate the prime numbers less than or equal to a given number m.
15. To search the element in an array of n elements using

(a) Linear search method

(b) Binary search.

1. To sort given numbers in ascending/descending order using
2. selection sort (b) bubble sort
3. To prepare electricity bill.
4. To find gross salary of an employee.
5. To perform following operations on strings:

 (a) Show address of each character in string

(b) Concatenate two strings

(c) Compare two strings

(e) Calculate the length of strings

(f) Convert all lowercase characters to uppercase

(g) Convert all uppercase characters to lowercase.

(h) Calculate number of vowels

(i) Reverse the string

1. To arrange string data (name of students) in alphabetical order using bubble sort.
2. To calculate the Letter grades and Grade points of a student according to marks obtained in 4 subjects on the basis of following table:

|  |  |  |
| --- | --- | --- |
| Marks | Grade Point | Letter Grade |
| 85-100 | 10 | O (Outstanding) |
| 75-84 | 9 | A+ (Excellent) |
| 65-74 | 8 | A (Very Good) |
| 55-64 | 7 | B+ (Good) |
| 50-54 | 6 | B (Above Average) |
| 41-49 | 5 | C (Average) |
| 40 | 4 | P (Pass) |
| <40 | 0 | F (Fail) |

**B-MAT 401: Abstract Algebra**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** The course will enable the students to:

1. Recognize the mathematical objects called groups, their elementary properties, order of a group, subgroup, cyclic groups and their properties.
2. Understand the notions of cosets, normal subgroups, and quotient groups. Know homomorphisms, isomorphisms and their properties and to prove three isomorphism theorems.
3. Learn about ring, subring, integral domain, field and ideal and related results.
4. Understand quotient rings, Euclidean ring, ring homomorphisms, ring isomorphisms and fundamental isomorphism theorems.

**UNIT-I**

Definition and examples of a group including Permutation group, quaternion group, Abelian and Non-abelian groups. The Group Zn of integers under addition modulo n and under multiplication modulo n . Elementary properties of groups. Order of a group. Order of an element of a group . Subgroup and Subgroup tests. Centralizer, Normalizer, Center of a group. Cyclic group and properties of cyclic groups. Cycle notation for permutations. Properties of permutations. Even and odd permutations. Alternating groups.

**UNIT –II**

Cosets. Index of a subgroup , Lagrange’s theorem , Normal subgroup , Quotient groups . Group homomorphism, Group isomorphisms. Cayley’s theorem. Properties of isomorphisms. First, Second and Third isomorphism theorems for groups.

**UNIT-III**

Definition and examples of rings. Commutative and non-commutative rings. Rings from number system ,Zn ring of integers modulo n , Ring of matrices. Properties of rings. Subrings. Characteristic of a ring. Integral Domain and Field. Examples of fields: Zn, Q, R and C.

Ideals. Ideal generated by a subset of a ring. Prime and maximal ideals.

**UNIT-IV**

Quotient ring. Ring homomorphisms. Properties of ring homomorphisms. First, Second and Third Isomorphism theorems for rings. Euclidean ring.

**Recommended Text Books:**

1. Joseph A. Gallian (2013). *Contemporary Abstract Algebra* (8th ed.). Cengage Learning India Private Limited, Delhi.
2. John B. Fraleigh (2002). *A First Course in Abstract Algebra* (7th ed.). Pearson**.**
3. M. Artin (2011). *Abstract Algebra* (2nd ed.). Pearson.
4. Rotman, Joseph J. (1995). *An Introduction to The Theory of Groups* (4th ed.). Springer Verlag, New York.
5. Beachy, John A., & Blair, William D. (2006). *Abstract Algebra* (3rd ed.). Waveland Press.

**B-MAT 402: Numerical Analysis**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **3**  | **3**  | **15** | **60** | **75** | **3 Hours** |
| **B.A.** | **3**  | **3** | **15** | **60** | **75** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 6 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. Non-programmable scientific calculators will be allowed during examination.**

**Course Outcomes:** This course will enable the students to:

1. Understand errors and their types. Learn techniques to obtain numerical solutions of algebraic and transcendental equations.
2. Attain numerical skills to find solutions of system of linear equations by different methods.
3. Learn different interpolation and extrapolation methods and their applications. Apply numerical methods to obtain derivatives.
4. Understand numerical methods for evaluating integrals and solving differential equations and to develop skill of applying these methods for future use in scientific problems.

**Unit-I:**

Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence. Numerical methods for solving algebraic and transcendental Equations: Bisection method, false position method, fixed point iteration method, Newton-Raphson method and secant method. Newton’s iterative method for finding pth root of a number.

**Unit-II:**

Numerical methods for solving simultaneous linear equations: Gauss-elimination method, Gauss-Jordan method, Triangularization method (LU decomposition method). Crout’s method, Cholesky Decomposition method. Iterative method; Jacobi’s method, Gauss-Seidal method, relaxation method.

 **Unit-III:**

Finite Differences operators and their relations. Interpolation with equal intervals: Gregory−Newton forward and backward difference interpolations. Interpolation with unequal intervals: Newton’s divided difference formulae, Lagrange’s Interpolation formulae.

Central Differences: Gauss forward and Gauss’s backward interpolation formulae. Sterling formula, Bessel’s formula.

Piecewise linear interpolation, Cubic spline interpolation.

Numerical Differentiation: First and second derivative of a function using interpolation formulae.

**Unit-IV:**

Numerical Integration: Newton-Cote’s Quadrature formula, Trapezoidal rule, Simpson’s one- third and three-eighth rule, Chebychev formula, Gauss Quadrature formula.

Numerical solution of ordinary differential equations: Single step methods- Picard’s method. Taylor’s series method, Euler’s method, Runge-Kutta Methods.

**Recommended Text Books:**

1. Brian Bradie (2006), *A Friendly Introduction to Numerical Analysis.* Pearson.
2. C. F. Gerald & P. O. Wheatley (2008). *Applied Numerical Analysis* (7th edition), Pearson Education, India.
3. M.K. Jain, S. R. K. Iyengar & R. K. Jain (2012). *Numerical Methods for Scientific and Engineering Computation* (6th edition). New Age International Publishers.
4. Robert J. Schilling & Sandra L. Harris (1999). *Applied Numerical Methods for Engineers Using* MATLAB *and C*. Thomson-Brooks/Cole.
5. S.D. Conte and Carl de Boor (2017). *Elementary Numerical Analysis: An algorithmic Approach*. SIAM.
6. A. Gupta and S.C. Bose (1989). *Introduction to Numerical Analysis*. Academic Publishers.
7. F.B. Hildebrand (1987). *Introduction to Numerical Analysis*. Dover Publications.

**B-MAT 403: PRACTICAL-IV**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Practical)** | **Practical Hours per week** | **Internal Assessment Marks** | **External Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |

**Note:** The examiner will set 4 questions at the time of practical examination by taking course outcomes (COs) into consideration. The examinee will be required to write two programs and execute one program successfully. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

**Course Outcomes:** This course will enable the students to:

1. Attain skill of computer programming and to use that a tool for problem solving.
2. Solve scientific problems by applying numerical techniques in C programing language.
3. Write and execute programs of numerical methods in C.
4. Apply knowledge of numerical analysis in investigation of problems and solving them at individual level and as member of a group.

**Note-** The following practicals will be done using the programming language C and record of those will be maintained in the practical Note Book:

1. To find roots of algebraic and transcendental equations using Bisection method.
2. To find roots of algebraic and transcendental equations using Newton Raphson method.
3. To find roots of algebraic and transcendental equations using Regula Falsi method.
4. To find solution of system of equations using Gauss Elimination method.
5. To find solution of system of equations using Gauss Seidal method.
6. To find inverse of a square matrix using Gauss Jordan method
7. To find approximate value of a function by Newton Forward Interpolation formula.
8. To find approximate value of a function by Newton Backward Interpolation formula.
9. To find approximate value of a function using Lagrange’s Interpolation formula.
10. To fit a curve by Least Squares Approximation method.
11. To find first and second order derivatives using interpolation formulas.
12. To evaluate a definite integral using Trapezoidal Rule.
13. To evaluate a definite integral using Simpson 1/3 rule.
14. To evaluate a definite integral using Simpson 3/8 rule.
15. To solve an ordinary differential equation using Euler’s method.
16. To find solution of an ordinary differential equation using Euler’s modified method.
17. To solve an ordinary differential equation using Runge-Kutta second order and fourth order methods.

**B-MAT 501:** **Vector Calculus**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand and solve problems related to scalar and vector product of vectors. Learn vector differentiation and directional derivatives and their problem solving.
2. Learn gradient, divergence and curl operators. Apply knowledge and these tools in problem solving.
3. Understand vector identities, Laplacian operator. Learn vector integration and line integral. Solve problems using these concepts.
4. Learn surface and volume integral formulations and their evaluation. Prove Gauss Divergence, Green’s and Stoke’s theorems. Realize importance of Green, Gauss and Stokes’ theorems.

**Unit-I:**

Scalar and vector product of vectors. Vector differentiation; Scalar Valued point functions, vector valued point functions, derivative along a curve, directional derivatives.

**Unit-II:**

Gradient of a scalar point function, geometrical interpretation of grad ***Φ***.

Divergence and curl of vector point function, their characteristics and examples.

**Unit-III:**

Gradient, divergence and curl of sum and product of functions and their related vector identities. Laplacian operator.

Vector integration; Line integral.

**Unit-IV:**

Surface integral, Volume integral.

Theorems of Gauss, Green & Stokes and problems based on these theorems.

**Recommended Text Books:**

1. [Murray Spiegel](https://www.amazon.in/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=Murray+Spiegel&search-alias=stripbooks) and [Seymour Lipschutz](https://www.amazon.in/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&field-author=Seymour+Lipschutz&search-alias=stripbooks) (2017) *Vector Analysis*, Schaum Outline Series.
2. N. Saran and S.N. Nigam (2001). *Introduction to Vector Analysis*. Pothishala Pvt. Ltd., Allahabad.
3. Shanti Narayan and P.K. Mittal (2003). A Text Book of Vector Calculus. S. Chand.
4. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus*(10th edition). Wiley India.
5. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.
6. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas*’ *Calculus* (14th edition). Pearson Education.
7. James Stewart (2012). *Multivariable Calculus* (7th edition). Brooks/Cole. Cengage.
8. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). *Calculus* (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

**B-MAT 502:** **Special Functions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand singular points of a differential equation and to solve such differential equation by power series method. Learn Hypergeometric differential equation, Hypergeometric function and its properties.
2. Know Bessel’s differential equation and its solution. Understand recurrence relations, generating function and othogonality of Bessel’s function. Understand Bessel integral. Attain skills to make use of Bessel functions in scientific problem solving.
3. Familiarise with Legendre’s differential equation and its solution in the form of Legendre functions. Understand recurrence relations, generating function and othogonality of Legendres function, Rodrigues’ formula. Apply knowledge in problem solving.
4. Know Hermite’s differential equation and its solution in the form of Hermite functions. Understand recurrence relations, generating function and othogonality of Hermite function, Rodrigues’ formula. Attain skill to apply these tools for investigation and solution of problems.

**Unit-I**

Series solution of differential equations – Power series method. Hypergeometric Series. Hypergeometric function, its integral representation. Hypergeometric differential equation and solutions. Contiguous function relations, simple transformations.

**Unit-II**

Bessel equation and its solution: Bessel functions and their properties-Convergence, Recurrence relations and generating functions. Bessel’s Integral. Orthogonality of Bessel functions.

**Unit-III**

Legendre differentials equation and its solution; Legendre functions and their properties; Recurrence relations and generating functions. Orhogonality of Legendre polynomials. Rodrigues’ Formula for Legendre Polynomials, Laplace Integral Representation of Legendre polynomial.

**Unit-IV**

Hermite differentials equations and its solutions; Hermite function and its properties; Recurrence relations and generating functions. Orhogonality of Hermite polynomials. Rodrigues’ Formula for Hermite Polynomial,

**Recommended Text Books:**

1. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). Wiley.
2. Shepley L. Ross (2007). *Differential Equations* (3rd edition), Wiley India. James Stewart (2012). *Multivariable Calculus* (7th edition). Brooks/Cole. Cengage.
3. Earl. D. Ranvillie (1960). *Special Functions*. Macmillan.
4. W.W. Bell (2004). Special Functions for Scientists & Engineers. Dover Books on Mathematics.
5. L.C. Andrews (1992). Special Functions of Mathematics for Engineers, SPIE Press.

**B-MAT 503: Linear Algebra**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand the concepts of vector spaces, subspaces, bases and their properties; linear transformations and their rank and nullity and to use those concepts for problem solving.
2. Learn to determine eigen values, eigen vectors and characteristic polynomial of linear transformations and their further use in investigation and solution of problems.
3. Have knowledge of inner product spaces, orthogonalization and diagonalization of matrices/ linear transformations and to apply that in further learning and for scientific applications.
4. Learn adjoint operation, Hermitian, unitary, normal and triangular forms of linear transformations and related problem solving.

**Unit-I:**

Vector spaces. Subspaces. Algebra of subspaces. Quotient space. Linear combination of vectors. Linear span. Linear dependence and independence of vectors. Bases and dimension. Dimension of subspaces.

Linear transformations. Matrix representation of a linear transformation. Rank and nullity of a linear transformation.

**Unit-II:**

Transpose of a linear transformation, Eigen vectors and eigen values of a linear transformation, Characteristic polynomial and Cayley−Hamilton theorem, Minimal polynomial.

**Unit-III:**

Inner product spaces and orthogonality, Cauchy−Schwarz inequality, Gram−Schmidt orthogonalization, Diagonalization of symmetric matrices.

**Unit-IV:**

Adjoint of a linear operator; Hermitian, unitary and normal linear transformations; Triangular form, Trace and transpose.

**Recommended Text Books:**

1. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence (2003). *Linear Algebra* (4thedition). Prentice-Hall of India Pvt. Ltd.
2. Kenneth Hoffman & Ray Kunze (2015). *Linear Algebra* (2nd edition). Prentice-Hall.
3. I. M. Gel’fand (1989). *Lectures on Linear Algebra.* Dover Publications.
4. Nathan Jacobson (2009). *Basic Algebra* I & II (2nd edition). Dover Publications.
5. Serge Lang (2005). *Introduction to Linear Algebra* (2nd edition). Springer India.
6. Vivek Sahai & Vikas Bist (2013). *Linear Algebra* (2nd Edition). Narosa Publishing House.
7. Gilbert Strang (2014). *Linear Algebra and its Applications* (2nd edition). Elsevier.

**B-MAT 504: Partial Differential Equations and Integral Transforms**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Learn classification of second order partial differential equations, their canonical forms, and methods of solving those. Find characteristic equations and curves. Apply this knowledge to solve problems of science and society.
2. Model physical phenomena using partial differential equations such as the Laplace, heat and wave equations and to solve these equations. Learn solving non-linear equations by Monge’s method. Apply these methods as a tool for modelling and solving real world problems.
3. Know about Laplace transforms and its properties in detail and to apply those in solving differential equations.
4. Familiarize with Fourier transforms of functions, properties of Fourier transform, inverse Fourier transforms and relation between Laplace and Fourier transforms. Develop skill of applying Fourier transforms to solve differential equations.

**Unit-I:**

Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions. Characteristic equations and characteristic curves of second order partial differential equation.

**Unit-II:**

Solution of linear hyperbolic equations. Monge’s method for solving non-linear second order partial differential equations.

Laplace equation: elementary solutions of Laplace’s equation.

Method of separation of variables: Solution of Laplace’s equation, Wave equation and Diffusion (Heat) equation in one and two dimensions Cartesian Co-ordinate system.

**Unit-III:**

Laplace Transforms – Existence theorem for Laplace transforms, Linearity and shifting properties of the Laplace transforms, Laplace transforms of derivatives and integrals, Convolution theorem, Inverse Laplace transforms, solution of differential equations using Laplace transform.

**Unit-IV:**

Fourier transforms: Linearity and shifting properties, Convolution Theorem, Fourier Transform of Derivatives, Parseval’s identity for Fourier transforms. Solving differential Equations using Fourier Transforms.

**Recommended Text Books:**

1. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). Wiley.
2. Tyn Myint-U & Lokenath Debnath (2013). *Linear Partial Differential Equation for Scientists and Engineers* (4th edition). Springer India.
3. H. T. H. Piaggio (2004). An Elementary Treatise on *Differential Equations and Their Applications.* CBS Publishers.
4. S. B. Rao & H. R. Anuradha (1996). *Differential Equations with Applications*. University Press.
5. Ian N. Sneddon (2006). *Elements of Partial Differential Equations*. Dover Publications.
6. Murray R. Spiegel (2005). *Laplace Transforms*. Schaum’s Outline Series.
7. Ian N. Sneddon (1974). *The Use of Integral Transforms*. McGraw Hill.

**B-MAT 505: Analytical Geometry**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand the concept of a second degree equation representing different conic sections and its classification and properties. Learn terms related to conic sections and their use in problem solving.
2. Know representation of system of conics and confocal conics and related results. Learn general form of equation of a sphere and to solve problems related to intersection of spheres, tangent plane and line, orthogonality, length of tangent and co-axial system of spheres. Apply this knowledge to investigate and solve problems.
3. Learn equations of cones and cylinders and then to solve related problems. Apply knowledge for problem solving and life-long learning.
4. Familiarize with concepts of conicoids and related tangent plane, director sphere, normal, envelop and to make further use thereof.

**Unit-I:**

General equation of second degree: Classification of conic sections; centre, asymptotes, axes, eccentricity, foci and directrices of conics. Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic. Polar equation of a conic, tangent and normal to the conic.

**Unit-II:**

System of conics. Confocal conics.

Sphere: General form, Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, tangent plane and line, polar plane and line, orthogonal spheres.

**Unit-III:**

Cone: Equation of a cone, right circular cone, quadric cone, enveloping cone. Tangent plane and condition of tangency.

Cylinder: Right circular cylinder and enveloping cylinder.

**Unit-IV:**

Central Conicoids: Equation of tangent plane. Director sphere. Normal to the conicoids. Polar plane of a point. Paraboloids.

**Recommended Text Books:**

1. Robert J. T. Bell (1994). *An Elementary Treatise on Coordinate Geometry of Three Dimensions*. Macmillan India Ltd.
2. D. Chatterjee (2009). *Analytical Geometry: Two and Three Dimensions*. Narosa Publishing House.
3. Shanti Narayan and P.K. Mittal (2007). *Analytical Solid Geometry*. S. Chand.
4. J.H. Kindle (1990). *Analytic Geometry*. Schaum Outline Series
5. Gordon Fuller and Dalton Tarwater (1992). *Analytic Geometry*. Pearson.

**B-MAT 506: Mechanics – II**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand the equilibrium of a body acted upon by forces in plane and the principle of virtual work for a system of coplanar forces acting on a rigid body and central axis. Apply this knowledge to investigate and solve scientific problems.
2. Understand three dimensional force system, central axis, wrenches, null lines and planes.
3. Understand conservative and impulsive forces, and particle motion on a smooth or rough path in a plane. Apply theoretical concepts to problem solving.
4. Understand equation of motion of a body moving under a central force and Kepler’s laws of the planetary motions. Solve problems of central orbits and planetary motion.

**Unit-I:**

Equilibrium of Particle and rigid body acted on by forces in plane. Virtual work.

**Unit-II:**

Forces in three dimensions. Poinsot’s central axis. Wrenches. Null lines and planes.

**Unit-III:**

 Concepts of Conservative forces and Impulsive forces. Motion on smooth and rough plane curves.

**Unit-IV:**

 Equation of motion under a central force, Differential equation of the orbit, (p, r) equation of the orbit, Apses and apsidal distances, Areal velocity, Characteristics of central orbits, Kepler’s laws of planetary motion and their relation with Newton’s laws of motion.

**Recommended Text Books:**

1. R. S. Varma (1962). *A Text Book of Statics*. Pothishala Pvt. Ltd.
2. P.L. Srivastava (1964). *Elementary Dynamics*. Ram Narain Lal, Beni Prasad Publishers Allahabad.
3. J. L. Synge & B. A. Griffith (1949). *Principles of Mechanics*. McGraw-Hill.
4. S.L. Loney (1995). *An Elementary Treatise on Statics,* Radha Publishing House.
5. S.L. Loney (2006). *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies*. Read Books.
6. A. S. Ramsey (2009). *Statics*. Cambridge University Press.
7. A. S. Ramsey (2009). *Dynamics*. Cambridge University Press.
8. A.P. Roberts (2003). *Statics and Dynamics with Background in Mathematics*. Cambridge University Press.

**B-MAT 507: PRACTICAL -V**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Practical)** | **Practical Hours per week** | **Internal Assessment Marks** | **External Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |

**Note:** This course has two components, Problem Solving and Practical using LATEX software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (a) and two questions from the part (b) by taking course outcomes (COs) into consideration. The examinee will be required to solve one problem from the part (a) and to execute one program successfully from the part (b). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

**Course Outcomes:** This course will enable the students to:

1. Attain skills to solve practical problems of Vector Spaces.

OR

1. Attain skills to solve practical problems transforming second order PDEs to canonical form and then solving those and to solve non-linear PDEs.
2. Handle practical problems of orthogonalization and diagonalization of matrices.

OR

1. Handle practical problems of solving Laplace, heat and wave equations.
2. Understand basic features and commands of typing software LATEX.
3. Have hands-on skills to type a document using LATEX software. Learn LATEX commands to create document and its type, sections; paper size, font type, size and styles; type mathematical and Greek symbols, mathematical equations and item listing.
4. **Problem Solving**- Questions related to the following problems will be solved and record of those will be maintained in the Practical Notebook:

**Linear Algebra;**

1. Practical problems to obtain basis by extending a given set of linearly independent set of vectors.
2. Practical problems to determine matrix representation of a linear transformation and to determine its rank and nullity.
3. Practical problems to determine Eigen Values & Eigen Vectors of a Linear Transformation.
4. Practical problems to find Dual of a Vector Space.
5. Practical problems to determine minimal polynomial of a linear transformation.
6. Practical problems to find orthogonal basis using Gram-Schmidt orthogonalisation process.
7. Practical problems to diagonalise symmetric matrices.
8. Practical problems to determine Jordan Canonical Form of a matrix.

**OR**

**PDE and Integral Transforms;**

1. Practical problems to reduce PDEs into canonical form and then solving those.
2. Practical problems of finding the characteristics of second order partial differential equations.
3. Practical problems to solve PDEs with Monge’s method.
4. Practical problems to solve wave equation (one and two dimensional).
5. Practical problems to solve Laplace equation.
6. Practical problems to solve heat equation.
7. Practical problems to solve differential equations by Laplace transform method.
8. Practical problems to solve differential equations by Fourier transform method.
9. **LATEX Practicals**- Following practicals of typing documents using LATEX software will be done and records of those will be maintained in the practical notebook and the candidates will be asked by the examiner to type a document using more than one of these listed commands at the time of Semester end practical examination:
10. Create a new file in the work directory with the name note1.tex and

to write a simple document in latex using following commands:

 \documentclass [a4paper, 12pt]{article}

 \begin{document}

 A paragraph of text

 \end{document}

1. Create a document to write code for a title page using

 \title{...}, \author{...}, \date{...}, \today{...}, \maketitle {...} commands and \emph{...}, \texbf{...}, \texit{...} etc. commands.

1. Create a document to write a code to using

 \section{...}, \subsection{...}, \subsubsection{...}, \paragraph{...},

 \subparagraph{…} commands and using environments to left justify, right justify, center and justify text.

1. Create a document to illustrate Latex commands for paper size, font size, font types and styles.
2. Create a document involving the mathematical equations.

Use of $...$ and $$...$$ symbols and use of Power and Indices( ^, \_ ), Fractions(\frac{numerator}{denominator}), Roots( \sqrt{...}, \sqrt[…]{...}), Sums (\sum\_{…}^{…}{…}), Product (\prod\_{…}^{…}{…}), Integral (\int\_a^b f(x) dx) within $...$ or $$...$$ symbols.

1. Use of commands for Greek letters and the commands \Re, \Im, \partial, \infty, \forall, \exists, \prime, \emptyset, \nabla, \surd,\parallel, \angle, \triangle, \backslash, \div, \vee, \wedge, \cap, \cup, \propto, \perp, \cong for Mathematical symbols and operations.
2. Use of \pm, \mp, \setminus, \cdot, \times,\ast, \hat, \bar,\dot, \ddot, \vec, \leq, \geq, \subset, \supset, \subseteq, \supseteq, \in, \neq,\equiv, \sim, \simeq, \approx commands for mathematical symbols and operators.
3. Create a document to produce equations using \begin{equation} … \end{equation} command and involving mathematical symbols, Greek letters and fractions.
4. Create a Latex document to illustrate the effect of enumerate listing and itemize listing.

**B-MAT 601: Real Analysis–II**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Learn basic theory of Riemann integration. Learn fundamental theorem and mean value theorem of integral calculus.
2. Understand improper integrals and to have knowledge to test their convergence. Understand integral as a function of a parameter. Apply this knowledge for problem solving.
3. Understand concepts of metric spaces, sub spaces and their properties. Learn open, closed and bounded sets, interior and limit points , Cauchy sequence and completeness.
4. Learn dense sets, compact and separable metric spaces and related results. Learn important theorems viz. Baire’s category theorem, Banach contraction principle, Bolzano−Weierstrass property, Heine−Borel theorem. Use this basic knowledge for life -long learning purposes.

**Unit-I:**

Riemann integral, Integrabililty of continuous and monotonic functions, The Fundamental theorem of integral calculus. Mean value theorems of integral calculus.

**Unit-II:**

Improper integrals and their convergence, Comparison tests, Abel’s and Dirichlet’s tests, Frullani’s integral, Integral as a function of a parameter. Continuity, Differentiability and integrability of an integral of a function of a parameter.

**UNIT-III:**

Definition and examples of metric spaces, Subspace of a metric space. Open spheres and closed spheres, Neighbourhoods, Open sets, Interior, exterior and boundary points, Limit points and isolated points, Closed sets, Interior and closure of a set, Boundary of a set, Bounded sets, Distance between two sets, Diameter of a set.

**UNIT-IV:**

Convergent and Cauchy sequences, Completeness of metric spaces, Cantor’s intersection theorem. Dense sets and separable spaces, Nowhere dense sets and Baire’s category theorem, Continuous and uniformly continuous functions, Homeomorphism, Banach contraction principle.

**Recommended Text Books:**

1. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
2. R.R. Goldberg : Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
3. D. Somasundaram and B. Choudhary : A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
4. Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi
5. E. T. Copson (1988). *Metric Spaces*. Cambridge University Press.
6. P. R. Halmos (1974). *Naive Set Theory*. Springer.
7. P. K. Jain & Khalil Ahmad (2019). *Metric Spaces*. Narosa.
8. S. Kumaresan (2011). *Topology of Metric Spaces* (2nd edition). Narosa.
9. Satish Shirali&Harikishan L. Vasudeva (2006). *Metric Spaces*. Springer-Verlag.
10. MicheálO'Searcoid (2009). *Metric Spaces*. Springer-Verlag.
11. G. F. Simmons (2004). *Introduction to Topology and Modern Analysis*. McGraw-Hill.

**B-MAT 602: Complex Analysis**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Visualize complex numbers as points of $R^{2} $and stereographic projection of complex plane on the Riemann sphere. Know De Moivre’s Theorem and its Applications. Learn about trigonometric, circular and hyperbolic functions and their properties.
2. Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy−Riemann equations. Apply knowledge to solve related problems.
3. Learn complex integration and other related concepts. Know and understand Green’s theorem, Cauchy-Goursat theorem, Cauchy integral formula, Cauchy’s inequality, Derivative of analytic function.. Application of these results in problem solving.
4. Know and understand Liouville’s theorem, fundamental theorem of algebra, Maximum modulus theorem. Application of these results in problem solving. Understand sequences, series and their convergence. Learn about Taylor series, Laurent series. of analytic functions.

**Unit-I:**

Complex numbers and their representation, algebra of complex numbers; Complex plane, Open set, Domain and region in complex plane; Stereographic projection and Riemann sphere.

De Moivre’s Theorem and its Applications. Expansion of trigonometrical functions.

Direct circular and hyperbolic functions and their properties, Logarithm of a complex quantity, Summation of Trigonometric series.

**Unit-II:**

Complex functions and their limits including limit at infinity; Continuity and differentiability of a complex valued function. Analytic functions; Cauchy−Riemann equations, Harmonic functions, necessary and sufficient conditions for differentiability. Analyticity and zeros of exponential, trigonometric and logarithmic functions.

**Unit-III:**

Complex integration, Green’s theorem, Anti-derivative theorem, Cauchy−Goursat theorem, Cauchy integral formula, Cauchy’s inequality, Derivative of analytic function.

**Unit-IV:**

Liouville’s theorem, Fundamental theorem of algebra, Maximum modulus theorem and its consequences.

Sequences, series and their convergence, Taylor series and Laurent series of analytic functions.

**Recommended Text Books:**

1. Lars V. Ahlfors (2017). *Complex Analysis* (3rd edition). McGraw-Hill Education.
2. Joseph Bak & Donald J. Newman (2010). *Complex Analysis* (3rd edition). Springer.
3. James Ward Brown & Ruel V. Churchill (2009). *Complex Variables and Applications* (9th edition). McGraw-Hill Education.
4. John B. Conway (1973). *Functions of One Complex Variable*. Springer-Verlag.
5. E.T. Copson (1970). *Introduction to Theory of Functions of Complex Variable*. Oxford University Press.
6. Theodore W. Gamelin (2001). *Complex Analysis*. Springer-Verlag.
7. George Polya & Gordon Latta (1974). *Complex Variables*. Wiley.
8. H. A. Priestley (2003). *Introduction to Complex Analysis*. Oxford University Press.
9. E. C. Titchmarsh (1976). *Theory of Functions* (2nd edition). Oxford University Press.

**B-MAT 603: Linear Programming**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Familiarize with terminology of linear programming problems (LPP) and all other associated concepts. Analyze and solve linear programming problems of real life situations. Obtain solution of linear programming problems with graphical method.
2. Understand the theory of Simplex method to solve linear programming problems, basic feasible solution and criteria of optimality. Learn related problem solving.
3. Learn to apply knowledge of simplex algorithm in solving real life LPP by several methods.
4. Understand dual problems, duality theorem and to solve linear programming problems by making use of duality theorem. Use these tools for science and society.

**Unit-I:**

Linear Programming Problems, Definition, objective function, constraints, Canonical and Standard forms. Graphical Approach for solving some Linear Programs, limitations of graphical method. Convex and polyhedral sets, Extreme points, Basic solutions, Basic Feasible Solutions,

**Unit-II:**

Correspondence between basic feasible solutions and extreme points. Theory of simplex method, Concept of initial basic feasible solution, Optimality criterion, Improving a basic feasible solution, Unboundedness.

**Unit-III:**

Simplex algorithm and its tableau format; Artificial variables, Two-phase method, Big-*M* method. Relation between maximization and minimization problems, Solving numerical problems using simplex algorithm.

**Unit-IV:**

Formulation of the dual problem, Duality theorems, Unbounded and infeasible solutions in the primal, Solving the primal problem using duality theory.

**Recommended Text Books:**

1. Mokhtar S. Bazaraa, John J. Jarvis & Hanif D. Sherali (2010). *Linear Programming and Network Flows* (4th edition). John Wiley & Sons.
2. G. Hadley (2002). *Linear Programming*. Narosa Publishing House.
3. [Frederick S. Hillier](https://www.google.co.in/search?sa=X&hl=en&biw=1280&bih=642&tbm=bks&tbm=bks&q=inauthor:%22Frederick+S.+Hillier%22&ved=0ahUKEwiZ3M-YuuvfAhXPh3AKHTg9BZIQ9AgIXzAJ) &‎ [Gerald J. Lieberman](https://www.google.co.in/search?sa=X&hl=en&biw=1280&bih=642&tbm=bks&tbm=bks&q=inauthor:%22Gerald+J.+Lieberman%22&ved=0ahUKEwiZ3M-YuuvfAhXPh3AKHTg9BZIQ9AgIYDAJ) (2015). *Introduction to Operations Research* (10th edition). McGraw-Hill Education.
4. Hamdy A. Taha (2017). *Operations Research*: *An Introduction* (10th edition). Pearson.
5. Paul R. Thie & Gerard E. Keough (2014). *An Introduction to Linear Programming and Game Theory* (3rd edition). Wiley India Pvt. Ltd.

**B-MAT 604: Probability and Statistics**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Theory)** | **Teaching Hours per week** | **Internal Assessment Marks** | **External Theory Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2** | **2** | **10** | **40** | **50** | **3 Hours** |

**Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (COs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.**

**Course Outcomes:** This course will enable the students to:

1. Understand probability, distribution function, probability density functions and Joint probability distribution function and learn to use those for problem solving.
2. Learn about mathematical expectation, moments, moment generating function uniform, binomial, Bernoulli, geometric and Poisson distributions and their uses in problem solving.
3. Learn Uniform, Gamma, Exponential, Chi-square and Normal continuous distributions, bivariate distribution and marginal distribution.
4. Learn to find correlation coefficient, covariance, linear regression and to solve problems by method of least squares. Apply this knowledge and studied tools in investigation and solution of problems.

**Unit-I:**

Basic notions of probability, Conditional probability and independence, Baye’s theorem; Random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions; Joint Probability Distribution function, Joint Density function.

**Unit-II:**

Mathematical expectation, Moments, Moment generating function, Joint moment generating function, Characteristic function. Discrete distributions**:** Bernoulli, Binomial, Negative binomial, Geometric and Poisson.

**Unit-III:**

Continuous distributions**:** Uniform, Gamma, Exponential, Chi-square, Normal; Bivariate normal distribution, Marginal distributions.

**Unit-IV:**

The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Independent random variables, Linear regression for two variables, The method of least squares.

**Recommended Text Books:**

1. Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). *Introduction to Mathematical Statistics* (7th edition), Pearson Education.
2. Irwin Miller &Marylees Miller (2014). *John E. Freund’s Mathematical Statistics with*

*Applications* (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.

1. Jim Pitman (1993). *Probability*, Springer-Verlag.
2. Sheldon M. Ross (2014). *Introduction to Probability Models* (11th edition). Elsevier.
3. A. M. Yaglom and I. M. Yaglom (1983). *Probability and Information*. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

**B-MAT 605: PRACTICAL -VI**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Programme** | **Course Credit (Practical)** | **Practical Hours per week** | **Internal Assessment Marks** | **External Examination Marks** | **Maximum Marks** | **End Term Examination Time** |
| **B.Sc.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |
| **B.A.** | **2**  | **4** | **10** | **40** | **50** | **3 Hours** |

**Note:** This course has two components, Problem Solving and Practical using LATEX software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (a) and two questions from the part (b) by taking course outcomes (COs) into consideration. The examinee will be required to solve one problem from the part (a) and to execute one program successfully from the part (b). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

**Course Outcomes:** This course will enable the students to:

1. Attain skills to solve practical Linear Programming Problems using graphical method, simplex method and other methods.

OR

1. Attain skills to measure a dispersion, find correlation coefficient, regression line and to fit a curve through given data points.
2. Learn tools for solving practical transportation problems using Vogel’s method, (**u v**) method and matrix method.

OR

1. Apply knowledge to solve practical problems related to Binomial, Normal and Poisson distributions.
2. Attain skills to type a document which includes mathematical symbols, expressions, equations, tables and matrices by making use of LATEX software.
3. Have hands-on experience to type a document in LATEX which illustrates abstract, citation, footnotes, hyperlinks and bibliography.
4. **Linear Programming Problem Solving**- Questions related to the following problems will be solved using scientific calculator and record of those will be maintained in the Practical Notebook:
5. To solve a Linear Programming Problem by Simplex method with unique solution or with unbounded solution.
6. To solve a Linear Programming Problem by Two Phase method.
7. To solve a Linear Programming Problem by Big M- Method.
8. To solve a Linear Programming Problem using duality.
9. To obtain an optimal solution by Dual Simplex Method.
10. To determine optimal solution of a transportation problem using Vogel’s method.
11. Determine optimal solution of transportation problem using (**u v**) method.
12. Determine an initial basic feasible solution of transportation problem by matrix method.

OR

1. **Problem Solving of Statistics and Probability-** Questions related to the following problems will be solved using scientific calculator and record of those will be maintained in the Practical Notebook:
2. Practical problems based on measures of dispersion (variance, standard deviation and coefficient of variation).
3. Tocompute Karl Pearson’s coefficient of correlation for given bivariate frequency distribution.
4. To obtain the regression lines for given data.
5. Practical problems based on Binomial distribution.
6. Practical problems based on Poisson distribution.
7. Practical problems based on Normal distribution.
8. To fit a straight line for the given data on pairs of observations.
9. Practical problem solving related to expectation of random variables.
10. **LATEX Practicals**- Following practicals of typing documents using LATEX software will be done and records of those will be maintained in the practical notebook and the candidates will be asked by the examiner to type a document using more than one of these listed commands at the time of Semester end practical examination:
11. Create a document with mixed math and text note. Type some mathematical expressions related to limit, continuity, derivative and differential equations using suitable environment for mathematics formulas and also \begin{eqnarray} ...\end{eqnarray} and \begin{equation} ...

\end {equation} environment.

1. Create a document to typeset arithmetic operations, subscripts, superscripts, accents, operators, binomial coefficients, congruences, delimiters and integrals.
2. Create a document to produce tables using commands:

\begin{tabular}{…}

 l for a column of left-aligned text ,

 r for a column of right-aligned text,

 c for a column of centre-aligned text,

 | for a vertical line

and following \begin command, table data is written by using following symbols;

 & is placed between columns,

 \\ is placed at the end of a row (to start a new one),

 \hline inserts a horizontal line.

 \cline{1-2} inserts a partial horizontal line between column 1 and

column 2,

the command \end{tabular} finishes the table.

1. Create a document including figures by using following commands:

\usepackage{graphicx} (graphic package is used for figures)

\begin{figure}[h!]

\centering

\includegraphics[width=1\textwidth]{ImageFilename}

\caption{My test image}

\label{…}

\end{figure}

1. Create a document using matrix using the following commands:

\usepackage {amsmath}

 \begin{matrix}

 …

 \end{matrix}

 \begin{pmatrix}

 …

 \end{pmatrix}

 \begin{bmatrix}

 …

 \end{bmatrix}

 \begin{vmatrix}

 …

 \end{vmatrix}

1. Create a document illustrating use of \begin{abstract} ...\end{abstract}, \begin{theorem} ... \end{theorem}, and \begin{definition} ... \end{definition} formats.
2. Create a document illustrating references, citations, footnotes and hyperlinks.
3. Create a document to generate bibliography.