Telephone No. 2419677/2419361
Fax: 0821-2419363/2419301
e-mail : registrar@uni-mysore.ac.in
www.uni-mysore.ac.in

# UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21 Dated:10.10.2022

## Notification

**Sub:-** Syllabus and Examination Pattern of Mathematics (UG) (III & IV Semester) with effective from the Academic year 2022-23 as per NEP-2020.

**Ref:-**
1. Decision of Board of Studies in of Mathematics (UG) Meeting held on 30-05-2022.
2. Decision of the Faculty of Science & Technology Meeting held on 15-09-2022.
3. Decision of the Academic Council meeting held on 23-09-2022.

*****

The Board of Studies in Mathematics (UG) which met on 30-05-2022 has recommended & approved the syllabus and pattern of Examination of Mathematics Course (III & IV Semester) with effective from the Academic year 2022-23 as per NEP -2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 15-09-2022 and 23-09-2022 respectively has also approved the above said syllabus and hence it is hereby notified.

The syllabus and Examination pattern is annexed herewith and the contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

**Draft Approved by the Registrar**

**DeputyRegistrar(Academic)**
Deputy Registrar (Academic)
University of Mysore
Mysore-570 005

**To:-**

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Mathematics, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DoS in Earth Science, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council , Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
10. Office Copy.

NATIONAL EDUCATION POLICY 2020 INITIATIVES

B.A./B.Sc. (Hons) Mathematics,
B.A./B.Sc. with Mathematics as a Major/Minor Subject

# SYLLABUS FOR

# B.Sc. MATHEMATICS (SECOND YEAR)

## W.E.F. THE ACADEMIC YEAR 2022-23

## UNIVERSITY OF MYSORE
## MYSURU

# Preamble

The subject wise expert committee to draft model curriculum contents in Mathematics constituted by the Department of Higher Education, Government of Karnataka, Bangalore vide GO No. ED 260 UNE 2019 (PART-1) DATED 13.08.2021 is pleased to submit its partial report on the syllabus for the First Year (First & Second Semesters) B.A./B.Sc.(Basic/Honors) Mathematics and detailed Course Structure for B.A./B.Sc.(Honors) Mathematics and M.Sc. (One Year) Mathematics.

The committee discussed various models suggested by the Karnataka State Higher Education Council in its joint meetings with the Chairpersons of Board of Studies of all state universities in Karnataka and resolved to adopt Model IIA (*Model Program Structure for the Bachelor of Arts (Basic/Hons.)/ Bachelor of Science (Basic/Hons.*) for the subjects with practical's with Mathematics as Major/Minor.

To achieve the core objectives of the National Education Policy 2020 it is unanimously resolved to introduce computer based practical's for the Discipline Core (DSC) courses by using Free and Open Source Software's (FOSS) tools for implementation of theory based on DSC courses as it is also suggested by the LOCF committee that the papers may be taught using various Computer Algebra System (CAS) software's such as Mathematica, MATLAB, Maxima and R to strengthen the conceptual understanding and widen up the horizon of students' self-experience. In view of these observations the subject expert committee suggested the software's Phython /R / Msxima/ Scilab/ Maple/MatLab/Mathematica for hands on experience of implementation of mathematical concepts in computer based lab.

The expert committee suggests the implementation this curriculum structure in all the Departments of Mathematics in Universities/Colleges in Karnataka.

The subject expert committee designed the Course Learning Outcome (CO) to help the learners to understand the main objectives of studying the courses by

keeping in mind of the Programme outcomes (PO) of the graduate degree with honors in Mathematics or a graduate degree with Mathematics as a major subject.

As the Mathematics subject is a vast with several branches of specializations, it is difficult for every student to learn each branch of Mathematics, even though each paper has its own importance. Hence the subject expert committee suggests number of elective papers (for both Discipline electives and Open Electives) along with Discipline Core Courses. The BoS in Mathematics of universities may include additional electives based on the expertise of their staff and needs of the students'. A student can select elective paper as per her/his needs and interest.

The subject expert committee in Mathematics suggests that the concerned Department/Autonomous Colleges/Universities to encourage their faculty members to include necessary topics in addition to courses suggested by the expert committee.

**Name of the Degree Program : B.A./B.Sc.**
**Discipline Course : Mathematics**
**Starting Year of Implementation : 2021-22**

**Programme Outcomes (PO): By the end of the program the students will be able to :**

| | |
|---|---|
| PO 1 | **Disciplinary Knowledge** : Bachelor degree in Mathematics is the culmination of in-depth knowledge of Algebra, Calculus, Geometry, differential equations and several other branches of pure and applied mathematics. This also leads to study the related areas such as computer science and other allied subjects |
| PO 2 | **Communication Skills**: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modeling and solving of real life problems. |
| PO 3 | **Critical thinking and analytical reasoning:** The students undergoing this programme acquire ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real life problems. |
| PO 4 | **Problem Solving** : The Mathematical knowledge gained by the students through this programme develop an ability to analyze the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development and also equip them with mathematical modelling ability, problem solving skills. |
| PO 5 | **Research related skills:** The completing this programme develop the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Mathematics. |
| PO 6 | **Information/digital Literacy**: The completion of this programme will enable the learner to use appropriate softwares to solve system of algebraic equation and differential equations. |
| PO 7 | **Self – directed learning**: The student completing this program will develop an ability of working independently and to make an in-depth study of various notions of Mathematics. |
| PO 8 | **Moral and ethical awareness/reasoning:** : The student completing this program will develop an ability to identify unethical behavior such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and Mathematical studies in particular. |
| PO 9 | **Lifelong learning**: This programme provides self directed learning and lifelong learning skills. This programme helps the learner to think independently and develop algorithms and computational skills for solving real word problems. |
| PO 10 | Ability to peruse advanced studies and research in pure and applied Mathematical sciences. |

# Assessment

## Weightage for the Assessments (in percentage)

| Type of Course | Formative Assessment/ I.A. | Summative Assessment (S.A.) |
|---|---|---|
| Theory | 40% | 60 % |
| Practical | 50% | 50 % |
| Projects | -- | -- |
| Experiential Learning (Internship etc.) | -- | -- |

## Contents of Courses for B.A./B.Sc. with Mathematics as Major Subject & B.A./B.Sc. (Hons) Mathematics
## Model IIA

| Semester | Course No. | Theory/ Practical | Credits | Paper Title | Marks | |
|---|---|---|---|---|---|---|
| | | | | | S.A. | I.A. |
| III | MATDSCT3.1 | Theory | 4 | Algebra - III and Differential Equations – I | 60 | 40 |
| | MATDSCP3.1 | Practical | 2 | Theory based Practical's on Algebra - III and Differential Equations – I | 25 | 25 |
| | MATOET3.1<br>MATOET3.2 | Theory<br>Theory | 3 | Discrete Mathematics – I<br>Mathematical Aptitude – III | 60 | 40 |
| IV | MATDSCT4.1 | Theory | 4 | Real Analysis - I and Differential Equations – II | 60 | 40 |
| | MATDSCP4.1 | Practical | 2 | Theory based Practical's on Real Analysis - I and Differential Equations – II | 25 | 25 |
| | MATOET4.1<br>MATOET4.2 | Theory<br>Theory | 3 | Basics of Number Theory<br>Mathematical Aptitude – IV | 60 | 40 |

1. Scheme of Admission: As per the University rules.
2. Eligibility: As prescribed by the University.
3. Scheme of Examination: Continuous assessment.

## THEORY EXAMINATION (For Discipline Specific Course(DSC) papers):

**(i) Internal Assessment**

*C1 Component* : 20 Marks. This will be based on test for 10 marks and seminar for 10 marks. This should be completed by the 8$^{th}$ week of the semester.
*C2 Component* : 20 Marks. This will be based on test for 10 marks and assignment for 10 marks. This should be completed by the 15$^{th}$ week of the semester.

(ii) *C3 component* **(Main Examination of 2 hours duration)** : 60 Marks. The pattern of the question paper will be as follows:
There will be 04 questions. All questions must be answered. All questions carry 15 marks.

**Question 1.** This question covers unit I of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-questions.

**Question 2.** This question covers unit II of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-questions.

**Question 3.** This question covers unit III of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-questions.

**Question 4.** This question covers unit IV of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-questions.

**PRACTICAL EXAMINATION (For Discipline Specific Course (DSC) papers):**

**(i) Internal Assessment: 25** (10 + 5 + 10)
This will be based on test (10 marks), Seminar/practical record maintenance (5 marks) and assignment (10 marks). This should be completed by the 15th week of the semester.

**(ii) Main Examination (3 hours duration)**: **25** (20 + 5)
There will be 3 questions each carrying equal marks. The student has to answer any 2 of the 3 questions (20 marks). Each student will be subjected to viva-voce examination, based on practical syllabus, for 5 marks.

## THEORY EXAMINATION (For Open Elective (OE) papers ):

**(i) Internal Assessment**

*C1 Component* : 20 Marks. This will be based on test for 10 marks and seminar for 10 marks. This should be completed by the 8$^{th}$ week of the semester.
*C2 Component* : 20 Marks. This will be based on test for 10 marks and assignment for 10 marks. This should be completed by the 15$^{th}$ week of the semester.

(ii) *C3 component* **(Main Examination of 2 hours duration)** : 60 Marks. The pattern of the question paper will be as follows:
There will be 03 questions. All questions must be answered. All questions carry 20 marks.

**Question 1.** This question covers unit I of the syllabus. There will be 6 sub- questions each carrying 5 marks. The student has to answer any four of the 6 sub-questions.

**Question 2.** This question covers unit II of the syllabus. There will be 6 sub- questions each carrying 5 marks. The student has to answer any four of the 6 sub-questions.

**Question 3.** This question covers unit III of the syllabus. There will be 6 sub- questions each carrying 5 marks. The student has to answer any four of the 6 sub-questions.

4. Minimum marks for Securing Credits: 30% in Theory Examination and 40% overall.
5. Minimum credits for getting B.Sc. Degree: As per NEP regulations.
6. Award of certificate/diploma/degree: As per NEP regulations.

## CURRICULUM STRUCTURE FOR UNDERGRADUATE DEGREE PROGRAM

**Name of the Degree Program : B.A. / B.Sc. (Honors)**

**Discipline/Subject : Mathematics**

**Starting Year of Implementation: 2021-22**

### PROGRAM ARTICULATION MATRIX

| Semester | Course No. | Programme Outcomes that the Course Addresses | Pre-Requisite Course(s) | Pedagogy* | Assessment** |
|---|---|---|---|---|---|
| I | MATDSCT1.1 | PO 1, PO 2, PO 3 | ---- | MOOC | CLASS TESTS |
| II | MATDSCT2.1 | PO 1, PO 2, PO 3, PO 8 | MATDSCT1.1 | PROBLEM SOLVING | |
| III | MATDSCT3.1 | PO 1, PO 4, PO7, PO 8 | ----- | SEMINAR | SEMINAR |
| IV | MATDSCT4.1 | PO 1, PO 4, PO7, PO 8 | MATDSCT3.1 | PROJECT BASED | QUIZ |
| V | MATDSCT5.1 | PO 1, PO 2, PO 3, PO 5 | ---- | LEARNING | ASSIGNMENT |
| V | MATDSCT5.2 | PO 3, PO 4, PO 7, PO10 | MATDSCT2.1 | ASSIGNMENTS | |
| VI | MATDSCT6.1 | PO 6, PO 7, PO 10. | MATDSCT5.2 | GROUP DISCUSSION | |
| VI | MATDSCT6.2 | PO 3, PO 4, PO 5, PO 8, PO 9, PO 10. | MATDSCT1.1 & MATDSCT2.1 | | |
| VII | MATDSCT7.1 | PO 3, PO 4, PO5, PO 7, PO 9. | MATDSCT1.1 & MATDSCT2.1 | | TERM END EXAM |
| VII | MATDSCT7.2 | PO 2, PO 4, PO 5, PO 10 | MATDSCT3.1 | | |
| VII | MATDSCT7.3 | PO 2, PO 4, PO 5, PO 10 | MATDSCT3.1 | | |
| VIII | MATDSCT8.1 | PO 2, PO 4, PO 5, PO 10 | MATDSCT5.1 | | |
| VIII | MATDSCT8.2 | PO 2, PO 4, PO 5, PO 10 | MATDSCT4.1 | | VIVA-VOCE |
| VIII | MATDSCT8.3 | PO 2, PO 4, PO 5, PO 10 | MATDSCT7.3 | | |

** Pedagogy for student engagement is predominantly Lecture. However, other pedagogies enhancing better student engagement to be recommended for each course. This list includes active learning/ course projects / Problem based or Project based Learning / Case Studies / Self Study like Seminar, Term Paper or MOOC.

*** Every Course needs to include assessment for higher order thinking skills (Applying/ / Evaluating / Creating). However, this column may contain alternate assessment methods that help formative assessment ( i.e. assessment for Learning).

# Credit Distribution for B.A./B.Sc.(Honors) with Mathematics as Major in the 3rd Year

## *(For Model IIA)*

| Subject | Semester | Major/ Minor in the 3rd Year | Credits | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Discipline Specific Core (DSC) | Open Elective (OE) | Discipline Specific Elective (DSE) | AECC & Languages | Skill Enhancement Courses (SEC) | Total Credits |
| Mathematics | I - IV | Major | 4 Courses (4+2)x 4=24 | 4 Courses 3 x 4 = 12 | --- | (4+4=8) Courses 8x(3+1)= 32 | 2 Courses 2x(1+1)= 4 | 72 |
| Other Subject | | Minor | 24 | -- | -- | -- | -- | 24 |
| | | | | | | | | **96** |
| Mathematics | V & VI | Major | 4 Courses 4x(3+2)=20 | ----- | 2 Courses 2 x 3 = 06 | --- | 2 Courses 2 x 2 = 4 | 30 |
| Other Subject | | Minor | 10 | -- | -- | -- | -- | 10 |
| | | | | (96+40)**=136** | | | | |
| Mathematics | VII & VIII | Major | 2 Courses 2x(3+2)=10 3 Courses 3 x 4 = 12 1 Course 1 x 3 = 3 Total=25 | ----- | 2 Courses 2 x 3 = 6 Res.Meth 1 x 3 = 3 2 Courses 2 x 3 = 6 Total= 15 | ---- | ----- | 40 |
| Total No. of Courses | | | 14 | 04 | 07 | 08 | 04 | |
| | | | | | | | | 136+40**=176** |

## Syllabus for B.A./B.Sc. with Mathematics as Major Subject & B.A./B.Sc. (Hons) Mathematics

### SEMESTER – III

| MATDSCT 3.1: Algebra - III and Differential Equations – I | |
|---|---|
| **Teaching Hours : 4 Hours/Week** | **Credits: 4** |
| **Total Teaching Hours: 56 Hours** | **Max. Marks: 100 (S.A.-60 + I.A. – 40)** |

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

- enhance learning in Algebra and Differential Equations.
- apply the concepts of algebra in practical problems.
- solve various differential equations of practical interest.

**UNIT I: Group Theory – I (14 hrs)**

Definition and examples of groups – Some general properties of Groups, Subgroups, Group of permutations – Cyclic permutations – Even and odd permutations. Order of an element of a group – Cyclic groups problems and theorems.

**UNIT II: Group Theory – II (14 hrs)**

Cosets, Index of a group, Lagrange's theorem, consequences, Normal Subgroups, Quotient groups – Homomorphism. – Kernel of homomorphism – Isomorphism - Automorphism – Fundamental theorem of homomorphism, Cayley's theorem.

**UNIT III: Differential Equations – I (14 hrs)**

Recapitulation of Definition, examples of differential equations, Formation of differential equations by elimination of arbitrary constants, Differential equations of first order – Separation of variables, Reducible to separation of variables, Homogeneous differential equations, Reducible to homogeneous, Exact differential equations, Reducible to exact, Integrating factors found by inspection and the determination of integrating factors, Linear differential equations, Bernoulli's differential equations.

**UNIT IV: Differential Equations – II (14 hrs)**

Equations of First order and higher degree – Solvable for p, Solvable for x, Solvable y, Clairaut's equations – Singular and General solutions.

Ordinary Linear differential equations with constant coefficients – Complementary function – particular integral – Inverse differential operators. Simultaneous differential equations (two variables with constant coefficients)

**Books for References:**


1. Daniel A Murray – Introductory Course to Differential equations
2. Earl David Rainville and Philip Edward Bedient – A short course in Differential equations, Prentice Hall College Div; 6th edition.
3. I N Herstien – Topics in Algebra.
4. Joseph Gallian – Contemporary Abstract Algebra, Narosa Publishing House, New Delhi, Fourth Edition.
5. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
6. J B Fraleigh – A first course in Abstract Algebra.
7. Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
8. Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.
9. R Balakrishan and N.Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
10. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.
11. F Ayres, Schaum's outline of theory and problems of Differential Equations, 1st ed. USA McGraw-Hill, 2010.
12. S Narayanan and T K Manicavachogam Pillay, Differential Equations .: S V Publishers Private Ltd., 1981.
13. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt. Ltd.
14. G F Simmons, Differential equation with Applications and historical notes, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.

| MATDSCP 3.1: Practical's on Algebra - III and Differential Equations – I | |
|---|---|
| **Practical Hours : 4 Hours/Week** | **Credits: 2** |
| **Total Practical Hours: 56 Hours** | **Max. Marks: 50 (S.A.-25 + I.A. – 25)** |

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

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on algebra and differential equations studied in **MATDSCT 3.1** by usingFOSS software's.
- Acquire knowledge of applications of algebra and differential equations through FOSS

**Practical/Lab Work to be performed in Computer Lab (FOSS)**

**Suggested Software's**: Maxima/Scilab /Python/R.

Introduction to the software and commands related to the topic.

1. Generate Cayley's table.
2. Verifying whether given operator is binary or not.
3. Finding identity and inverse elements of a group.
4. Finding left and right cosets of a group.
5. Solving Differential equation using Maxima and plotting the solution.

## Open Elective Course

**(For Students of all Streams)**

| MATOET 3.1: Discrete Mathematics | |
|---|---|
| **Teaching Hours : 3 Hours/Week** | **Credits: 3** |
| **Totat Teaching Hours: 42 Hours** | **Max. Marks: 100**<br>**(S.A.- 60 + I.A. – 40)** |

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

- know the concept of set theory.
- know graph theory which helps in decision making in various capacities in organization.
- Enhance the knowledge towards Electronics and computer science.

**Unit I:**

**Basics of Set Theory (14 hrs)**

Notation, Inclusion and Equality of sets, The power set, Operation on sets, Venn diagram, Set identities, Ordered pairs and Cartesian products.

Relations and ordering – Properties of binary relation in a set, Relation matrix and Graph of a relation. Equivalence relations, Compatibility relations, composition of Binary relation.

**Unit II:**

**Graph Theory (14 hrs)**

Basic definitions, Paths and Connectedness, Matrix representation of Graphs, Trees.

**Unit III:**

**Mathematical Logic (14 hrs)**

Statements and Notation, Connectives, Negation, Conjunction, Disjunction,, Statement formulas and Truth tables, Conditional and Bi-conditional, Tautologies, Equivalence of formulas, Tautological Implications.

References:


1) Discrete Mathematical Stuctures with Application to computer science by J. P. Tremblay, R. Manohar 3rd Edition – Tata McGraw Hill.

2) Discrete Mathematical Structures by B. Kolman, R. C. Busby and S. Rose, 3rd edition.

3) Introduction to discrete mathematics by C. L. Liu, McGraw Hill, 2nd edition, 1985.

4) Discrete Mathematics by S. A. Witala, McGraw Hill, 1987.

## Open Elective

**(For Students of all Streams)**

| MATOET 3.2: Mathematical Aptitude-III | |
|---|---|
| **Teaching Hours : 3 Hours/Week** | **Credits: 3** |
| **Totat Teaching Hours: 42 Hours** | **Max. Marks: 100**<br>**(S.A.- 60 + I.A. – 40)** |

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

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

**Unit I:** Algebraic Expressions, Polynomials, Fundamental operations on Algebraic expressions, Factorisation, Linear equations and problems based on Ages, Quadratic equations. **(14 hrs)**

**Unit II:**

**Mensuration**

Area, Volume and Surface area (Cylinder, Cone, Sphere). **(14 hrs)**

**Unit III:**

**Verbal Reasoning**

Direction Test, Relation Test, Venn Diagram Analysis Test, Seating puzzles. **(14 hrs)**

Reference Books:


1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogita prakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

## SEMESTER – IV

| MATDSCT 4.1: Real Analysis – I and Differential Equations – II | |
|---|---|
| **Teaching Hours : 4 Hours/Week** | **Credits: 4** |
| **Totat Teaching Hours: 56 Hours** | **Max. Marks: 100 (S.A.-60 + I.A. – 40)** |

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

- enhance learning in Analysis and Differential Equations.
- apply the concepts of analysis in practical problems.
- solve various differential equations of practical interest.

**UNIT I: Sequences (14 hrs)**

Sequence of real numbers – Bounded and unbounded sequences – Infimum and supremum of a sequence – Limit of a sequence – Sum, product and quotient of limits – Standard theorems on limits – Convergent , divergent and oscillatory sequences – Discuss the convergence of $x^n, n^{\frac{1}{n}}, \left(1+\frac{1}{n}\right)^n$ and standard problems – Monotonic sequences and their properties – Cauchy's general principle of convergence.

**UNIT II: Infinite Series (14 hrs)**

Infinite series of real numbers – Convergence and Divergence - Oscillation of series – Properties of convergence – Series of positive terms – Geometric series – p – series – Comparison tests – D'Alembert's ratio test – Raabe's test – Cauchy's root test – Leibnitz's test for alternating series.

**UNIT III: Linear differential equations (14 hrs)**

Cauchy – Euler differential equations, Solution of ordinary second order linear differential equations with variable coefficients by various methods such as:

(i) When a part of complementary function is given.
(i) Changing the independent variable.
(ii) Changing the dependent variable.
(iii) By method of variation of parameters.
(iv) Exact method.

Total differential equations - Necessary and sufficient condition for the equation Pdx + Qdy + Rdz = 0 to be exact (proof only for the necessary part) – Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

**UNIT IV: Partial differential equations (14 hrs)**

Basic concepts – Formation of a partial differential equations by elimination of arbitrary constants and functions – Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form $Pp + Qq = R$ , Standard types of first order non-linear partial differential equations – Charpit's method – Homogenous linear equations with constant coefficient – Rules for finding the complementary function – Rules for finding the particular integral, Method of separation of variables (product method).

**Books for References:**


1. G. Stephonson – An introduction to Partial Differential Equations.
2. B. S. Grewal – Higher Engineering Mathematics
3. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt. Ltd.
4. E D Reinville and P E Bedient – A Short Course in Differential Equations
5. D A Murray – Introductory Course in Differential Equations.
6. G P Simmons – Differential Equations
7. F. Ayres – Differential Equations (Schaum Series)
8. Martin Brown – Application of Differential Equations.
9. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.
10. S C Malik –Real Analysis
11. Leadership project – Bombay university- Text book of mathematical analysis
12. S S Bali – Real analysis.
13. Richard R Goldberg, Methods of Real Analysis, Indian ed.

## PRACTICAL

| MATDSCP 4.1: On Number Theory and Calculus – II | |
|---|---|
| **Practical Hours : 4 Hours/Week** | **Credits: 2** |
| **Total Practical Hours: 56 Hours** | **Max. Marks: 50**<br>**(S.A.-25 + I.A. – 25)** |

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

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on real analysis and differential equations by using FOSS software's.
- Acquire knowledge of applications of real analysis and differential equations through FOSS

**Practical/Lab Work to be performed in Computer Lab**

**Suggested Software's**: Maxima/Scilab//Python/R.

1. Test for convergence, divergence and oscillation sequences.
2. Test for convergence, divergence and oscillation series.
3. Test the convergence of the series using D'Alembert's ratio test and Raabe's test.
4. Programs on Linear differential equations with variable coefficients.
5. Programs on Partial differential equations.

## *Open Elective*

(For Students of all Streams)

| **MATOET 4.1: Basics of Number Theory** | |
|---|---|
| **Teaching Hours : 3 Hours/Week** | **Credits: 3** |
| **Total Teaching Hours: 42 Hours** | **Max. Marks: 100**<br>**(S.A.- 60 + I.A. – 40)** |

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

- Know the expansion of sum of two numbers with positive integral powers.
- General method of proving the statement.
- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruences and its applications.

**Unit I:**

Binomial Theorem, Mathematical Induction. **(14 hrs)**

**Unit II:**

**Number System (14 hrs)**

Test for Divisibility, Number of divisors and Sum of divisors of a number, Greatest Common Divisor (GCD), Least Common Multiplie (LCM), Relation between GCD and LCM, Representation of a GCD as a linear combination of given two numbers.

**Unit III:**

**Congruence (14 hrs)**

Basic properties of congruence, Binary and Decimal representations of integers, Linear Congruences and the Chinese Remainder Theorem.

References:


1) An Introduction to the Theory of Numbers by Ivan Niven, Herbert S. Zuckerman, Hugh L. Montgomery.

2) Elementary Number Theory by David M. Burton.

## Open Elective

**(For Students of all Streams)**

| MATOET 4.2: Mathematical Aptitude – IV | |
|---|---|
| **Teaching Hours : 3 Hours/Week** | **Credits: 3** |
| **Totat Teaching Hours: 42 Hours** | **Max. Marks: 100**<br>**(S.A.- 60 + I.A. – 40)** |

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

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

**Unit I:** Data interpretation, Data sufficiency. **(14 hrs)**

**Unit II:** Surds & Indices, Logarithm and its properties. **(14 hrs)**

**Unit III:**
**Non-verbal Reasoning**
Series Test, Analogy, Classification, Cube and Dice, Analytical Reasoning. **(14 hrs)**

Reference Books:


1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
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