

DEPARTMENT OF MATHEMATICS

NMKRV College

(Autonomous)

Jayanagar, Bangalore - 560011



**Syllabus for Bachelor of Science (B.Sc., Degree)
I, II, III & IV Semesters Mathematics Courses
(Under-Graduate (UG) Program with Mathematics as
one of the three Major subjects)**

**Framed according to the State Education Policy
(SEP-2024)**

EFFECTIVE FROM ACADEMIC YEAR – 2024-25

Support system for Students and Teachers learning FLOSS TOOLS:

As a national-level initiative towards learning FLOSSE (Free/Libre and Open-Source Software for Education) promotes the use of FLOSS tools in academia and research. The FOSSEE project is part of the National Mission on Education through Information and Communication Technology (ICT), Ministry of Education (MoE) and IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open-source softwares like scilab, wxmaxima, python, octave, geogebra and others.

Name of the Degree Program : Bachelor of Science-B. Sc., (with three Major)

Discipline/Subject : Mathematics

Starting Year of Implementation : 2024-25 (I to II Semesters)
2025-25 (III to IV Semester)

Scheme : SEP-2024-25

CURRICULUM STRUCTURE

| Semester | CourseNo. | Theory/Practical | Credits | Teaching hours/week | Paper Title | Marks | |
|----------|-----------|------------------|---------|---------------------|--|-------|------|
| | | | | | | S.A. | I.A. |
| I | MAT11T | Theory | 4 | 4 | Mathematics-I | 80 | 20 |
| | MAT11P | Practical | 2 | 3 | Theory based Practicals on Mathematics-I | 40 | 10 |
| II | MAT21T | Theory | 4 | 4 | Mathematics-II | 80 | 20 |
| | MAT21P | Practical | 2 | 3 | Theory based Practicals on Mathematics-II | 40 | 10 |
| III | MAT31T | Theory | 4 | 4 | Mathematics-III | 80 | 20 |
| | MAT31P | Practical | 2 | 3 | Theory based Practicals on Mathematics-III | 40 | 10 |
| IV | MAT41T | Theory | 4 | 4 | Mathematics-IV | 80 | 20 |
| | MAT41P | Practical | 2 | 3 | Theory based Practicals on Mathematics-IV | 40 | 10 |

**Abbreviation for MAT11T / MAT11P / MAT21T / MAT21P / MAT31T / MAT31P
MAT41T / MAT41P:**

MAT–Mathematics; T–Theory/P–Practical; I–First Semester; II–Second Semester;
III-Third Semester and IV-Semester.

I.A-Formative/Internal Assessment; **S.A.** - Summative Assessment.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 : Academic Excellence & Application

Graduates will acquire in-depth knowledge of physical sciences, mathematical reasoning, and computational methods, applying them to solve scientific and technological problems.

PEO2 : Research, Innovation & Problem-Solving

Graduates will analyze, model, and simulate physical and computational systems to develop innovative solutions.

PEO3 : Lifelong Learning & Professional Growth

Graduates will remain updated with advances in physics, mathematics, and computing for career growth and higher education.

PEO4 : Ethics, Technology & Social Responsibility

Graduates will use technology responsibly, uphold professional ethics, and promote sustainable and inclusive scientific practices.

PROGRAMME OUTCOMES (POs)

By the end of the program the students will be able to

| PO No. | Title | Description |
|---------------|---------------------------------------|--|
| PO1 | Knowledge & Conceptual Understanding | Apply fundamental concepts of physics, mathematics, and computer science to analyze and solve theoretical and practical problems. |
| PO2 | Problem Analysis | Identify, formulate, and analyze scientific problems using mathematical reasoning, experimental methods, and computational approaches. |
| PO3 | Experimentation & Data Interpretation | Design and conduct experiments, apply statistical tools, and interpret data to draw valid conclusions. |
| PO4 | Modern Tool Usage | Select and apply appropriate software, programming languages, and scientific equipment for research, analysis, and problem-solving. |
| PO5 | Research & Innovation | Develop research skills to investigate complex scientific issues, contribute to innovation, and adapt to emerging technologies. |

| | | |
|-------------|--------------------------------------|--|
| PO6 | Communication Skills | Communicate scientific ideas, experimental results, and technical information effectively in written, oral, and graphical forms. |
| PO7 | Ethics & Professional Responsibility | Demonstrate professional ethics, academic integrity, and responsibility in the application of science and technology. |
| PO8 | Environment & Sustainability | Understand the impact of scientific and technological solutions on the environment and promote sustainable development. |
| PO9 | Lifelong Learning | Recognize the need for and engage in independent, self-directed learning to keep pace with scientific advancements. |
| PO10 | Teamwork & Leadership | Function effectively in multidisciplinary teams, demonstrating leadership, collaboration, and adaptability. |

Pedagogy: Lectures by conventional method/MOOC / Desk Work / Book Chapter / Problem Solving / Seminars/ Assignment / Power Point presentation/Group discussion and other ICT

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- PSO1 :** Graduates will apply foundational knowledge of physics, mathematics, and computer science to solve domain-specific problems in theoretical and experimental contexts.
- PSO2 :** Graduates will design and conduct experiments, analyze data using statistical and computational tools, and interpret results to evaluate scientific hypotheses.
- PSO3 :** Graduates will demonstrate proficiency in using modern scientific software, simulation tools, and programming languages for modeling, simulation, and problem-solving in research and industry.
- PSO4 :** Graduates will formulate and execute innovative research projects, applying interdisciplinary knowledge to develop novel solutions for real-world scientific and technological challenges.
- PSO5 :** Graduates will effectively communicate scientific findings and demonstrate ethical behavior and responsibility in academic, research, and professional settings.
- PSO6 :** Graduates will collaborate in multidisciplinary teams, demonstrate leadership, and engage in lifelong learning to adapt to rapidly evolving scientific landscapes.

ASSESSMENT
First to Fourth Semester

Weightage for the Assessments (in percentage)

| Type of Course | Formative Assessment (I.A.) | Summative Assessment (S.A.) |
|----------------|-----------------------------|-----------------------------|
| Theory | 20% | 80 % |
| Practical | 20% | 80 % |

COURSE PATTERN & SCHEME EXAMINATION

| Sem. Name | Paper Code | Subjects | Instruction hrs / Week | Duration of Exam (hrs) | Marks | | | Credits |
|-----------|------------|---------------------------|------------------------|------------------------|-------|------|-------|---------|
| | | | | | IA | Exam | Total | |
| I | MAT11T | Mathematics-I | 4 | 3 | 20 | 80 | 100 | 4 |
| | MAT11P | Mathematics Practical-I | 3 | 3 | 10 | 40 | 50 | 2 |
| II | MAT21T | Mathematics-II | 4 | 3 | 20 | 80 | 100 | 4 |
| | MAT21P | Mathematics Practical-I | 3 | 3 | 10 | 40 | 50 | 2 |
| III | MAT31T | Mathematics-III | 4 | 3 | 20 | 80 | 100 | 3 |
| | MAT31P | Mathematics Practical-III | 3 | 3 | 10 | 40 | 50 | 2 |
| IV | MAT41T | Mathematics-IV | 4 | 3 | 20 | 80 | 100 | 3 |
| | MAT41P | Mathematics Practical-IV | 3 | 3 | 10 | 40 | 50 | 2 |

Abbreviation for MAT11T / MAT11P / MAT21T / MAT21P / MAT31T / MAT31P / MAT41T / MAT41P:

MAT–Mathematics; T–Theory/P–Practical; I–First Semester; II–Second Semester; III-Third Semester and IV-Semester.

I.A-Formative/Internal Assessment; **S.A.** - Summative Assessment.

FIRST SEMESTER

| MAT11T: MATHEMATICS-I | |
|---------------------------------------|---|
| Teaching Hours :4 Hours / week | Credits : 4 |
| Total Teaching Hours :56 Hours | Max. Marks : 100 (SA 80 + IA 20) |

COURSE OBJECTIVE:

The primary objective of teaching matrix theory in an UG syllabus is to equip students with the fundamental concepts and tools of matrices and their applications in various fields. Comprehend the fundamental concepts of Differential and Integral calculus. Also, Geometry in 3D involves understanding how to represent geometric objects like lines, planes, and curves using equations and how to solve geometric problems by translating them into algebraic equations.

COURSE OUTCOMES (COs):

| By the end of the program the students will be equipped with the following aspects: | |
|--|--|
| CO 1 | Understand the solving techniques of elementary transformations, find the Eigen values and Eigenvectors of a given matrix, verify and analyze the consequences of the Cayley – Hamilton theorem of a given matrix. |
| CO 2 | Explain the basic skills of differentiation, nth derivatives of standard functions, and apply the Leibnitz theorem to find the solutions to given problems. Also, solve problems on partial and total derivatives. Knowing the Jacobians and related properties. |
| CO 3 | Find the reduction formulae and apply Leibnitz Rule. Also, applying the methods of differentiation and integration to study the geometric properties of curves and surfaces. |
| CO 4 | Understand and recognize the concepts of analytical geometry in three dimensions and equations of the sphere, right circular cylinder and cone. |

| CONTENT | HOURS |
|---|-----------|
| UNIT-I: MATRICES | 14 |
| <p>Recapitulation of Symmetric and Skew Symmetric matrices, Elementary row and column transformations, Row reduced echelon form, Rank of a matrix, Normal form of a matrix, Inverse of a matrix by elementary operations.</p> <p>Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations, Solution of non-homogeneous system of linear equations. Eigen values and Eigen vectors of square matrices of order 2 and 3, Cayley-Hamilton theorem (with proof), Finding A^2, A^3, A^4 and inverse of matrices by Cayley-Hamilton theorem.</p> | |
| UNIT-II: DIFFERENTIAL CALCULUS-I | 14 |
| <p>Successive Differentiation: nth Derivatives of Standard functions e^{ax+b}, $(ax + b)^n$, $\log(ax + b)$, $\sin(ax + b)$, $\cos(ax + b)$, $e^{ax}\sin(bx + c)$, $e^{ax}\cos(bx + c)$, Leibnitz theorem (with proof) and examples based on Leibnitz theorem.</p> <p>Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives of higher order, Homogeneous functions-Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and problems.</p> | |
| UNIT-III: INTEGRAL CALCULUS | 14 |
| <p>Recapitulation of definite integrals and its properties.</p> <p>Reduction formulae- $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \cot^n x dx$, $\int \sin^m \cos^n x dx$, $\int_0^{\frac{\pi}{2}} \sin^n x dx$, $\int_0^{\frac{\pi}{2}} \cos^n x dx$, $\int_0^{\frac{\pi}{2}} \sin^m x dx \cos^n x dx$ and problems. Differentiation under integral sign by Leibnitz rule- problems. Computation of length of an arc, area of plane curves, surface area and volume of solids of revolution for standard curves in Cartesian and polar forms.</p> | |
| UNIT-IV: ANALYTICAL GEOMETRY | 14 |
| <p>Direction cosines and ratios, Equation of spheres in different forms (general, standard, central and diametric forms in both Cartesian and Vector forms), tangent plane to a sphere, derivation of condition for orthogonal of spheres and problems, standard equation of right circular cone and right circular cylinder (in both Cartesian and Vector forms) and problems, Derivations of paraboloid, ellipsoid, Hyperboloid of one and two sheets.</p> | |

TEXT/REFERENCE BOOKS:

1. Ranganath, G. K. *A Text Book of B.Sc Mathematics for 1st Semester Bangalore University* (First ed.). S Chand & Co Pvt Ltd.
2. Gururajachar, G. B. *A text book of mathematics for first semester B.Sc.* Academic Excellent Series Publications.
3. Herstein , I. N. *Topics in algebra* (2nd ed.). Wiley India Publications.
4. Narayan, S., & Mittal, P. K. *Differential calculus for B.A. and B.Sc. students* (1st ed.). Shyamlal Charitable Trust.
5. Bali, N. P. *Differential calculus* (Rev. ed.). Firewall Media Publications.
6. Narayan, S., & Mittal, P. K. *Integral calculus for B.A. and B.Sc. students* (1st ed.). S. Chand and Company Ltd.
7. Narayan, S., & Mittal, P. K. (2014). *Analytical solid geometry* (17th rev. ed.). S. Chand & Co. Pvt. Ltd.

WEB RESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO*

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

Legend:

3 – Strongly aligned 2 – Moderately aligned 1 – Slightly aligned – Not aligned

| | |
|---|--|
| MAT11P: THEORY BASED MATHEMATICS PRACTICAL - I | |
| Teaching Hours : 3 Hours / week | Credits : 2 |
| Total Teaching Hours :42 Hours | Max. Marks : 50 (SA 40 + IA 10) |

COURSE OBJECTIVES:

Mathematics-I with Python skill is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

| Course Outcomes | This practical course will enable the students to: |
|-----------------|--|
| CO1 | Understand the textbook companion activity aims to port solved examples from standard textbooks using Free/Libre and Open Source Software (FLOSS). |
| CO2 | Identify the given problem with the help of logic/aim/motivation to narrate the Matrix theory by using FLOSS. |
| CO3 | Apply fundamental differential and integral calculus concepts to solve problems, and their proficiency in using FLOSS for computation and visualization. |
| CO4 | Provide a huge database of Companions as a learning resource by adopting FLOSS for learning analytical geometry in 3D. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical-I)

Note-1:Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 12 programs must be done from the following list of **suggested programs**:

| SL.NO | SUGGESTED PROGRAMS |
|-------|---|
| 1. | Introduction to Python |
| 2. | Basics of software with simple examples. <ul style="list-style-type: none"> i. Compare two numbers using if statements ii. Sum of natural numbers using while loop iii. Finding the factors of a number using for loop iv. To check the given number is prime or not(use if.....else statement) v. Find the factorial of a number(use...if...if...else) vi. Simple programs to illustrate logical operators(and or not) |
| 3. | Computation of a rank of matrix by row reduced and normal forms |
| 4. | Solving the system of homogeneous and non-homogeneous linear equations |
| 5. | Computation of inverse of a matrix by using Cayley Hamilton theorem |
| 6. | Finding the n^{th} derivative of a function without Leibnitz theorem |
| 7. | Finding the n^{th} derivative of a function with Leibnitz theorem |
| 8. | Partial differentiation of some standard functions and Jacobian |
| 9. | Verification of Euler's theorems with examples |
| 10. | Program to find Jacobians |
| 11. | Program to find reduction formula with or without limits |
| 12. | Program to compute surface area of solids. |
| 13. | Program to compute Volume of solids of revolution |
| 14. | Program to find equation and plot sphere,cone,cylinder. |
| 15. | Program to find equation and plot paraboloid, ellipsoid and hyperboloid. |

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

WEB RESOURCES:

1. <http://www.univie.ac.at/future.media/moe/galerie.html>
2. <http://faculty.msmary.edu/heinold/python.html>
3. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
4. <https://www.vlab.co.in/>
5. <https://fossee.in/>
6. <http://www.python.org>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO *

| COs \ POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|---------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| CO1 | 3 | 2 | - | 3 | 2 | 1 | - | - | 3 | 1 | 3 | - | 3 | 2 | 1 | 1 |
| CO2 | 3 | 3 | - | 3 | 2 | 1 | - | - | 3 | - | 3 | - | 3 | 2 | - | 1 |
| CO3 | 3 | 3 | - | 3 | 2 | - | - | - | 3 | - | 3 | - | 3 | 2 | - | - |
| CO4 | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 |

Legend:

- 3 – Strongly aligned
- 2 – Moderately aligned
- 1 – Slightly aligned
- Not aligned

SECOND SEMESTER

| MAT21T : MATHEMATICS-II | |
|--------------------------------|----------------------------------|
| Teaching Hours :4 Hours / week | Credits :4 |
| Total Teaching Hour:56 Hours | Max. Marks : 100 (SA 80 + IA 20) |

COURSE OBJECTIVE:

The axioms of a group, exploring various examples of groups, to identify subgroups, understand their relationships to the parent group, and apply theorems like Lagrange's theorem and its consequences. The polar coordinates and plane curves help the students with the ability to represent and analyze curves using a different coordinate system. Also, the present content includes learning techniques for solving different types of differential equations, understanding their solutions, and applying them to real-world problems.

COURSE OUTCOMES (COs):

| By the end of the program the students will be equipped with the following aspects: | |
|---|--|
| CO 1 | Explain and appraise the beauty of the abstract nature of an elementary group theory, which is a solid foundation of theoretical mathematics. |
| CO 2 | Knowing and summarize the basic knowledge on the notions of Cartesian, parametric and polar forms, curvature of plane curve, center of curvature, asymptotes, singular points and double points. Also, tracing of Standard curves. |
| CO 3 | Illustrate and evaluate the fundamental concepts of Limits, Continuity and Differentiability. Also, solve the problems on Rolle's, Lagrange's mean value and Cauchy's mean value theorems. |
| CO 4 | Determine the method of solving problems on differential equations. Also, know how to apply differential equations in various fields. |

| CONTENT | HOUR |
|---|-------------|
| UNIT-I: ALGEBRA-II | 14 |
| Groups: Binary operation, algebraic structure-problems on finding identity and inverse. Definitions of a group with examples and properties. Abelian group – problems on finite and infinite groups. Subgroups, center of groups, order of an element of a group and its related theorems, cyclic groups and its related theorems, coset decompositions, Lagrange’s theorem and its consequences. | |
| UNIT-II: POLAR CO-ORDINATES | 14 |
| Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms. Curvature of plane curve-radius of curvature formula (in Cartesian ,parametric polar and pedal forms),Centre of curvature, asymptotes ,singular points and double points. | |
| UNIT-III: DIFFERENTIAL CALCULUS-II | 14 |
| Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle’s Theorem, Lagrange’s Mean Value theorem, Cauchy’s. Mean value theorem and examples. Taylor’s theorem & Maclaurin’s series of one variable, indeterminate forms and evaluation of limits using L’Hospital rule. | |
| Unit-IV: ORDINARY DIFFERENTIAL EQUATIONS-I | 14 |
| Recapitulation of differential equations of first order and first degree, Linear Differential equations and equations reducible to linear form (Bernoulli’s equation), Exact Differentialequations, Necessaryandsufficientconditionfortheequationstobeexact, Equationsreducibleto exact form.. Differential equations of the first order and higher degree: Equations solvable for p , x , y . Clairaut’s equation; general and singular solution. Orthogonal trajectories of Cartesian and polar curves. | |

TEXT/ REFERENCE BOOKS:

1. Ranganath, G. K. *A textbook of B.Sc mathematics for 2nd semester Bangalore University* (1st ed.). S. Chand & Company Pvt Ltd.
2. Gururajachar, G. B. *A text book of mathematics for second semester B.Sc. Academic Excellent Series Publications.*
3. Herstein, I. N. *Topics in algebra* (2nd ed.). Wiley India Publications.
4. Fraleigh, J. B. *A first course in abstract algebra* (7th ed.). Pearson Education Inc.
5. Bali, N. P. *Differential calculus* (Rev. ed.). Firewall Media Publications.

6. Narayan, S., & Mittal, P. K. *Differential calculus for B.A. and B.Sc students* (1st ed.). Shyamlal Charitable Trust.
7. Simmons, G. F., & Krantz, S. G. *Differential equations: Theory, techniques, and practice* (1st ed.). Tata McGraw Hill Education Pvt Ltd.
8. King, A. C., Billingham, J., & Otto, S. R. (Year). *Differential equations: Linear, nonlinear, ordinary, partial* (1st ed.). Cambridge University Press.

WEB RESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO *

| Cos/POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 2 | - | - | - | - | - | - | 2 | 1 | 3 | - | - | - | - | - |
| CO2 | 3 | 2 | - | - | - | - | - | - | 2 | - | 3 | - | - | - | - | - |
| CO3 | 3 | 3 | - | - | - | - | - | - | 2 | - | 3 | - | - | - | - | - |
| CO4 | 3 | 3 | 2 | 2 | 2 | - | - | 1 | 2 | 1 | 3 | 3 | 2 | 2 | - | 1 |

Legend:

- 3 – Strongly aligned
- 2 – Moderately aligned
- 1 – Slightly aligned
- Not aligned

| MAT21P: THEORY BASED MATHEMATICS PRACTICAL - II | |
|--|---------------------------------------|
| Teaching Hours : 3 Hours / week | Credits :2 |
| Total Teaching Hours :42 Hours | Max. Marks: 50 (SA 40 + IA 20) |

COURSE OBJECTIVES:

Mathematics-II with Python skill is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

| Course Outcomes | This practical course will enable the students to: |
|------------------------|---|
| CO1 | Apply and illustrate the fundamental concepts of group theory and their proficiency in using FLOSS tools for problem solving and visualization. |
| CO2 | Apply fundamental differential and integral calculus concepts to solve problems, and their proficiency in using FLOSS for computation and visualization. |
| CO3 | Solve and describe the problems of Limits, Continuity, and Differentiability. Also, analyze the Rolle's, Lagrange's mean value and Cauchy's mean value theorems. Further, identify the nature of Indeterminate forms. |
| CO4 | Provide a huge database of companions as a learning resource by adopting FLOSS for learning and solve the problems of differential equations. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical-II)

Note-1:Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 12 programs must be done from the following list of **suggested programs**:

| SL.NO | SUGGESTED PROGRAMS |
|-------|---|
| 1. | Verify whether given operator is binary or not and to find identity and inverse element of a group. |
| 2. | To construct the Cayley's table and test abelian for a given finite set. |
| 3. | Program to find all possible cosets of the given finite group. |
| 4. | Program to find generators and corresponding possible subgroups of a cyclic group. |
| 5. | Finding the angle between the radius vector and tangent. |
| 6. | Finding the angle between two curves. |
| 7. | Finding the radius of curvature of the given curve. |
| 8. | Plotting of standard Cartesian, polar and parametric curves |
| 9. | Program to find limit and continuity of functions |
| 10. | Program to verify Rolle's, Lagrange's and Cauchy's mean value theorem |
| 11. | Program to find Maclaurin's expansion. |
| 12. | Program to find limits by L'Hospital's rule. |
| 13. | Solution of Linear and exact differential equation. |
| 14. | Solving non-linear differential equations for p,x and y |
| 15. | Finding the general and singular solutions of Clairaut's equation. |

WEB RESOURCES:

1. <http://www.univie.ac.at/future.media/moe/galerie.html>
2. <http://faculty.msmary.edu/heinold/python.html>
3. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
4. <https://www.vlab.co.in/>
5. <https://fossee.in/>
6. <http://www.python.org>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO*

| COs \ POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 3 | - | 3 | 2 | 1 | - | - | 2 | 1 | 3 | - | 3 | 2 | 1 | 1 |
| CO2 | 3 | 3 | - | 3 | 2 | - | - | - | 3 | - | 3 | - | 3 | 2 | - | 1 |

| COs \ POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO3 | 3 | 3 | - | 2 | 2 | - | - | - | 2 | - | 3 | - | 2 | 1 | - | - |
| CO4 | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 |

Legend:

- 3 – Strongly aligned
- 2 – Moderately aligned
- 1 – Slightly aligned
- Not aligned

THIRD SEMESTER

| MAT31T: MATHEMATICS-III | |
|--------------------------------|-------------------------------|
| Teaching Hours :4 Hours / week | Credits :3 |
| Total Teaching Hours :56 Hours | Max.Marks:100 (SA 80 + IA 20) |

COURSE OBJECTIVE:

The vector algebra emphasizes rigorous proofs and logical reasoning, helping students develop critical thinking and problem-solving abilities.

Beta and gamma functions is to generalize the factorial function to complex numbers and provide a powerful tool for solving problems in various fields of mathematics, physics, and statistics. The fundamental properties of the sequence and series are leads to exploring their properties, and mastering techniques for analyzing their convergence and divergence.

COURSE OUTCOMES (COs):

| By the end of the program the students will be equipped with the following aspects: | |
|---|--|
| CO 1 | A deeper understanding of core vector algebra concepts, mastering techniques for handling more complex functions, and applying these concepts to solve problems in scalar and vector fields. |
| CO 2 | Beta and gamma functions provide a framework for understanding and manipulating mathematical expressions, particularly in the realm of integrals and their applications to diverse fields. |
| CO 3 | Learn the fundamental concept of convergence and divergence of a sequence of real numbers along with nature of sequences such as limits of sequence, monotonic sequence and others. |
| CO 4 | Apply and evaluate the comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy root test and Alternate series-Leibnitz test. |

| CONTENT | HOUR |
|--|-----------|
| UNIT-I: VECTOR ALGEBRA | 14 |
| <p>Multiple product – scalar triple product, vector triple product, geometrical interpretation, related problems, vector function of a scalar variable – interpretation as a space curve.</p> <p>Scalar Field: Gradient of a scalar field, geometrical meaning, directional derivative, unit normal to the surfaces - tangent plane and normal to the surface.</p> <p>Vector Field: Divergence and curl of a vector field, solenoidal and irrotational fields, Laplacian of a scalar field, Vector identities.</p> | |
| UNIT-II: IMPROPER INTEGRAL AND BETA-GAMMA FUNCTIONS | 14 |
| <p>Improper Integral-Improper integrals of the first, second and third kind with examples. Improper integral has the limit of the proper integral.</p> <p>Beta-Gamma Functions-Definitions, Properties and examples, relations between beta and gamma functions, standard theorems, applications of evaluations of definite integrals, duplication formula and applications.</p> | |
| UNIT-III: SEQUENCES OF REAL NUMBERS | 14 |
| <p>Definition and examples of sequences, Bounded sequences, and its properties (some theorems), Limit of a sequence, Nature of sequences, Algebra of limits of sequence, Monotonic sequences (theorems and problems), Behavior of standard sequences. Cauchy's general principle for convergence of a sequence</p> | |
| UNIT-IV: SERIES OF REAL NUMBERS | 14 |
| <p>Series of real numbers (Infinite series), Definition and examples of Convergence, Divergence, Oscillatory series, Geometric, p-series, Comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy root test, Alternate series-Leibnitz test. Absolute convergence and conditional convergence of a series. Summation of series: Binomial, exponential and logarithmic.</p> | |

TEXT/ REFERENCE BOOKS

1. Ranganath, G. K. *A textbook of B.Sc mathematics for 3rd semester Bangalore University* (2nd rev. ed.). S. Chand & Company Pvt Ltd.
2. Gururajachar, G. B. *A text book of mathematics for third semester B.Sc.* Academic Excellent Series Publications.
3. Young, E. C. *Vector and tensor analysis* (2nd ed.). CRC Press.

4. Ansari, A. A., Denis, R. Y., Dubey, S. K. D., & Gupta, U. K. *A text book of advance calculus, vectors and numerical analysis* (1st ed.). Mangalam Publishers.
5. Narayan, S., & Mittal, P. K. *Integral calculus for B.A. and B.Sc. students* (1st ed.). S. Chand and Company Ltd.
6. Gupta, S. L., & Nisharam. *Fundamentals of real analysis* (4th ed.). Vikas Publishing House.
7. Goldberg, R. R. *Methods of real analysis* (1st Indian ed.). Oxford and IBH Publishing Co.
8. Rudin, W. *Principles of mathematical analysis* (3rd ed.). McGraw Hill Education Pvt Ltd.

WEB RESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO*

| COs \ POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 3 | - | 2 | 2 | - | - | - | 2 | 1 | 3 | - | 2 | 2 | - | 1 |
| CO2 | 3 | 2 | - | 2 | 2 | - | - | - | 2 | - | 3 | - | 2 | 2 | - | - |
| CO3 | 3 | 2 | - | 1 | 1 | - | - | - | 2 | - | 3 | - | 1 | - | - | - |
| CO4 | 3 | 3 | - | 1 | 2 | - | - | - | 2 | - | 3 | - | 1 | - | - | - |

Legend:

- 3 – Strongly aligned
- 2 – Moderately aligned
- 1 – Slightly aligned
- Not aligned

| MAT31P: THEORY BASED MATHEMATICS PRACTICAL-III | |
|---|--|
| Teaching Hours :3 Hours / week | Credits : 2 |
| Total Teaching Hours :42 Hours | Max. Marks : 50 (SA 40 + IA 20) |

COURSE OBJECTIVES:

Mathematics-III with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

| Course Outcomes | This practical course will enable the students to: |
|------------------------|---|
| CO1 | Understand and Analyze the Gradient and Laplacian of a scalar field, Divergence and Curl of a vector field. Also, estimate the solenoidal and irrotational of a vector field by using the FLOSS packages. |
| CO2 | Solve and analyze the problem on Beta and Gamma functions via FLOSS packages. |
| CO3 | Solve and analyze the problem of convergence and divergence of a sequence of real numbers via FLOSS packages. |
| CO4 | Solve and analyze the problem of convergence and divergence of a series of real numbers along with the comparison test, D’Alembert’s Ratio test, Raabe’s test, Cauchy root test and Alternate series-Leibnitz test via FLOSS tools. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical-III)

Note-1:Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 12 programs must be done from the following list of **suggested programs**:

| SL.NO | SUGGESTED PROGRAMS |
|-------|---|
| 1. | Program to find Gradient of a scalar field. |
| 2. | Program to find Divergence of a vector field. |
| 3. | Program to find Curl of a vector field. |
| 4. | Program to find Laplacian of a scalar field. |
| 5. | Program to verify whether the given vector field is solenoidal or not. |
| 6. | Program to verify whether the given vector field is irrotational or not. |
| 7. | Program to evaluate of the integrals using gamma function |
| 8. | Program to evaluate of the integrals using beta function |
| 9. | Program to find the limit of a sequence. |
| 10. | Program to verify the convergence of a sequence. |
| 11. | Program to check whether the sequences is monotonically increasing or decreasing. |
| 12. | Program to check whether the sequences is bounded or not |
| 13. | Program to test the convergence of series using partial sums. |
| 14. | Program to test the convergence of series by using comparison test |
| 15. | Program to test the convergence of series by using D'Alembert's ratio Test |
| 16. | Program to test the convergence of series by using Raabe's Test |
| 17. | Program to test the convergence of alternating series using the Leibnitz's theorem. |

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

WEB RESOURCES:

1. <http://www.univie.ac.at/future.media/moe/galerie.html>
2. <http://faculty.msmmary.edu/heinold/python.html>
3. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
4. <https://www.vlab.co.in/>
5. <https://fossee.in/>
6. <http://www.python.org>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO *

| COs \ POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 3 | 2 | 3 | 2 | 2 | - | - | 2 | 1 | 3 | 2 | 3 | 2 | - | 1 |
| CO2 | 3 | 3 | 2 | 3 | 2 | 2 | - | - | 2 | - | 3 | - | 3 | - | - | - |
| CO3 | 2 | 3 | 3 | 2 | 2 | - | - | - | 2 | - | 3 | 2 | 3 | - | - | - |
| CO4 | 2 | 3 | 3 | 3 | 2 | - | - | - | 2 | - | 3 | 2 | 3 | - | - | - |

Legend:

- 3 – Strongly aligned
- 2 – Moderately aligned
- 1 – Slightly aligned
- Not aligned

FOURTH SEMESTER

| MAT41T: MATHEMATICS-IV | |
|---------------------------------------|---|
| Teaching Hours :4 Hours / week | Credits :4 |
| Total Teaching Hours :56 Hours | Max. Marks : 100 (SA 80 + IA 20) |

COURSE OBJECTIVE:

The main learning objectives of Normality, Quotient group, homomorphism and isomorphism of a group and its applications are explored. To understand, apply, and analyze the Laplace transform and its inverse. The Fourier series and Fourier transforms, applying them to solve problems, and appreciating their applications in various fields. Also, to equip students with the tools and techniques to solve and analyze differential equations that involves second and higher-order derivatives.

COURSE OUTCOMES (COs):

| By the end of the program the students will be equipped with the following aspects: | |
|--|---|
| CO 1 | Understand the concepts of Normality, Quotient group, Homomorphism group, Isomorphism group and learn the nature of kernel and image of Homomorphism groups. |
| CO 2 | Identify the Laplace transform, understand its properties, and determine the Laplace transforms of standard functions. |
| CO 3 | Learn to represent periodic functions using Fourier series, understand the concept of convergence, Fourier Coefficients and Half range sine and cosine series. Also, knowing the basic properties of Fourier transform. |
| CO 4 | The ordinary differential equation (second and higher order) is to equip students with the knowledge and skills to analyze, solve, and model various phenomena using different types of equations. |

| CONTENT | HOOR |
|--|-----------|
| UNIT I - GROUP-II | 14 |
| Normal subgroups-Examples and problems, Quotient group, Homomorphism of groups, Kernel and Image of a homomorphism, Normality of the kernel, Fundamental theorem of homomorphism and its related problems. | |
| UNIT II - LAPLACE TRANSFORM | 14 |
| Definition and basic properties Laplace transform of some common functions and Standard results, Inverse Laplace transforms. Laplace transform of periodic functions- Laplace transforms of derivatives and the integral of functions, Laplace transforms of Heaviside function convolution theorem (without proof) and related problems, solution of second order differential equations | |
| UNIT III- FOURIER SERIES AND FOURIER TRANSFORM | 14 |
| Periodic functions. Fourier Coefficients. Fourier series of functions with period $2L$. Fourier series of even and odd functions. Half range sine and cosine series. Fourier transform, Finite Fourier sine and cosinetransform. | |
| UNIT IV- ORDINARY DIFFERENTIAL EQUATIONS-II | 14 |
| Linear differential equations of n^{th} order with constant coefficients. Particular Integrals when the RHS is of the form e^{ax} , $\sin(ax+b)$, $\cos(ax+b)$, x^n , $e^{ax}V$, where V is a function of x . Cauchy-Euler equations ,Solving second order ODE by changing independent variable, by changing dependent variable and Method of variation of parameters. Applications of second order differential equations | |

TEXT/REFERENCE BOOKS

1. Ranganath, G. K. *A textbook of B.Sc mathematics for 4th semester Bangalore University* (2nd rev. ed.). S. Chand & Company Pvt Ltd.
2. Gururajachar, G. B. *A text book of mathematics for fourth semester B.Sc.* (2nd ed.). Academic Excellent Series Publications.
3. Herstein, I. N. *Topics in algebra* (2nd ed.). Wiley India Publications.
4. Fraleigh, J. B. *A first course in abstract algebra* (7th ed.). Pearson Education Inc.
5. Simmons, G. F., & Krantz, S. G. *Differential equations: Theory, techniques, and practice* (1st ed.). Tata McGraw Hill Education Pvt Ltd. LT
6. Simmons, G. F. (Year). *Differential equations with applications and historical notes* (26th reprint ed.). McGraw Hill (India) Private Limited.

7. Rudin, W. *Real and complex analysis* (3rd ed.). Tata McGraw Hill Education Pvt Ltd. Coddington, E. A., & Levinson, N. *Theory of ordinary differential equations* (1st ed.). Tata McGraw Hill Education Pvt Ltd.
8. Rao, S. B., & Anuradha, H. R. *Differential equations* (1st ed.). Universities Press (India) Private Limited.
9. King, A. C., Billingham, J., & Otto, S. R. (Year). *Differential equations: Linear, nonlinear, ordinary, partial* (1st ed.). Cambridge University Press.

WEB RESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO *

| COs \ POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 2 | - | 1 | 2 | 1 | - | - | 2 | 1 | 3 | - | 1 | 2 | 1 | 1 |
| CO2 | 3 | 3 | - | 2 | 2 | 1 | - | - | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 1 | - | - | 2 | 1 | 3 | 3 | 3 | 2 | 1 | 1 |
| CO4 | 3 | 3 | 2 | 2 | 3 | 1 | - | - | 2 | 1 | 3 | 3 | 2 | 3 | 1 | 1 |

Legend:

- 3 – Strongly aligned
- 2 – Moderately aligned
- 1 – Slightly aligned
- Not aligned

MAT41P: THEORY BASED MATHEMATICS PRACTICAL-IV**Teaching Hours :3 Hours / week****Credits :2****Total Teaching Hours :56 Hours****Max. Marks: 50 (SA 40 + IA 20)****COURSE OBJECTIVES:**

Mathematics-IV with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

| Course Outcomes | This practical course will enable the students to: |
|------------------------|--|
| CO1 | Provide a huge database of companions as a learning resource by adopting FLOSS for learning algebraic structures through groups such as normality, homomorphism and isomorphism of a group. |
| CO2 | To analyze and solve the problems of Laplace transform and it's inverse of some standard functions. Also, to solve first and second order ordinary differential equation with constant coefficients using Laplace transforms via FLOSS. |
| CO3 | Ability to formulate, analyze and solve the problems of Fourier series, half range Fourier sine and cosine series of some standard functions. Also, understand the nature of Fourier sine and cosine transforms by using FLOSS packages. |
| CO4 | Able to find the complete solution of a differential equation with constant coefficients by variation of parameters and described by second order linear differential equations with constant coefficients by adopting FLOSS tools. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS) tool for computer programs (i. e., Theory Based Practical-IV)

Note-1: Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 15 programs must be done from the following list of **suggested programs**:

| SL.NO | SUGGESTED PROGRAMS |
|-------|--|
| 1. | Program to verify the Normality of a given subgroup. |
| 2. | Program to verify the given function is homomorphism or not. |
| 3. | Program to verify the given function is isomorphism or not. |
| 4. | Program to find the Laplace transform of some Standard functions. |
| 5. | Program to find an inverse Laplace transform of some Standard functions. |
| 6. | Program to solve first order ordinary linear differential equation with constant coefficients using Laplace transform. |
| 7. | Program to solve second order ordinary linear differential equation with constant coefficients using Laplace transform. |
| 8. | Program to find the Fourier series of some functions with period $2L$. |
| 9. | Program to find half range Fourier sine series of some functions. |
| 10. | Program to find half range Fourier cosine series of some functions. |
| 11. | Program to find the Fourier sine Transform |
| 12. | Program to find the Fourier cosine Transform |
| 13. | Program to find the complimentary function of linear homogeneous differential equations with constant coefficients. |
| 14. | Program to find the particular integral of linear homogeneous differential equations with constant coefficients. |
| 15. | Program to find the solution of second order ordinary linear differential equations with variable coefficients by the method of changing independent variable. |
| 16. | Program to find solution of second order ordinary linear differential equations with variable coefficients by the method of changing dependent variable. |

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

WEB RESOURCES:

1. <http://www.univie.ac.at/future.media/moe/galerie.html>
2. <http://faculty.msmar.edu/heinold/python.html>
3. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
4. <https://www.vlab.co.in/>
5. <https://fossee.in/>

6. <http://www.python.org>

COURSE ARTICULATION MATRIX MAPPING OF CO-PO-PSO *

| CO \ PO/PSO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|-------------|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| CO1 | 3 | 2 | - | 3 | 2 | 1 | - | - | 2 | 1 | 3 | 1 | 3 | 2 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 3 | 2 | 1 | - | - | 2 | 1 | 3 | 3 | 3 | 2 | 1 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 1 | - | - | 2 | 1 | 3 | 3 | 3 | 3 | 1 | 1 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 1 | - | - | 2 | 1 | 3 | 3 | 3 | 3 | 1 | 1 |

Legend:

- 3 – Strongly aligned
- 2 – Moderately aligned
- 1 – Slightly aligned
- Not aligned

Pedagogy: Lectures by conventional method, use of ICT and conducting competitions like Quiz, Seminars, Desk Work, Book Chapter, Problem Solving, Power Point Presentation, etc.

Formative Assessment:

| Types of Course | Internal Assessment (I.A.) |
|-----------------|----------------------------------|
| Theory | C1: Mid semester exam 10 Marks |
| | C2: Assignments / tests 10 Marks |
| | Total 20 Marks |
| Practical's | C1: Pre-Practicals 10 Marks |

FORMAT OF QUESTION PAPER OF THEORY EXAMS

| Section. | Topic | No. of sub divisions | | Marks for each sub divisions | Maximum marks for the question |
|--------------------|--------------|----------------------|----------------|------------------------------|--------------------------------|
| | | To be Set | To be answered | | |
| A | UNIT-I | 3 | 10 | 2 | 20 |
| | UNIT-II | 3 | | | |
| | UNIT-III | 3 | | | |
| | UNIT-IV | 3 | | | |
| | TOTAL | 12 | | | |
| B | UNIT-I | 5 | 3 | 5 | 15 |
| C | UNIT-II | 5 | 3 | 5 | 15 |
| D | UNIT-III | 5 | 3 | 5 | 15 |
| E | UNIT-IV | 5 | 3 | 5 | 15 |
| GRAND TOTAL | | | | | 80 |

FORMAT OF QUESTION PAPER OF MATHEMATICS PRACTICAL

| Duration of Exam: 3 Hours | | | Maximum Marks : 40 | | |
|--|----------|------------------|---------------------------|--------------------------|-----------------|
| LAB RECORD : 5-MARKS VIVA: 5-MARKS QUESTION BANK: 6-MARKS | | | | | |
| Write the python code and solve manually one question from each unit | | | | | |
| Unit | Topic | No. of questions | To be answered | Marks for each questions | Maximum marks |
| 1 | UNIT-I | 1 | 1 | 6 | 6 |
| 2 | UNIT-II | 1 | 1 | 6 | 6 |
| 3 | UNIT-III | 1 | 1 | 6 | 6 |
| 4 | UNIT-IV | 1 | 1 | 6 | 6 |
| TOTAL | | | | | 24 |
| GRAND TOTAL | | | | | 24+16=40 |

DEPARTMENT OF MATHEMATICS

NMKRV College

(Autonomous)

Jayanagar, Bangalore - 560011



**Syllabus for Bachelor of Science (B.Sc., Degree)
V & VI Semesters Mathematics Courses
(Under-Graduate (UG) Program with Mathematics as one
of the two Major subjects)**

**Framed according to the National Education Policy
(NEP-2021)**

EFFECTIVE FROM ACADEMIC YEAR – 2023-24

Support system for Students and Teachers learning FLOSS TOOLS:

As a national-level initiative towards learning FLOSSE (Free/Libre and Open-Source Software for Education) promotes the use of FLOSS tools in academia and research. The FOSSEE project is part of the National Mission on Education through Information and Communication Technology (ICT), Ministry of Education (MoE) and IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open-source softwares like scilab, wxmaxima, python, octave, geogebra and others.

| | |
|--|---|
| Name of the Degree Program | : Bachelor of Science-B. Sc., (with two Major) |
| Discipline/Subject | : Mathematics |
| Starting Year of Implementation | : 2021-22 (I to II Semesters) 2022-23 (III to IV Semester) 2023-24 (V to VI Semester) |
| Scheme | : NEP-2021-22 |

CURRICULUM STRUCTURE

| Semester | Course No. | Theory/Practical | Credits | Paper Title | Marks in percentage | |
|-----------------|-------------------|-------------------------|----------------|---|----------------------------|-------------|
| | | | | | S.A. | I.A. |
| V | DSMAT51 | Theory | 4 | Real Analysis-II and Complex Analysis | 60 | 40 |
| | DSMAT51P | Practical | 2 | Theory based Practical's on Real Analysis-II and Complex Analysis | 25 | 25 |
| | DSMAT52 | Theory | 4 | Vector calculus and Analytical geometry | 60 | 40 |
| | DSMAT52P | Practical | 2 | Theory based Practical's on Vector calculus and Analytical geometry | 25 | 25 |
| | DSMAT61 | Theory | 4 | Linear Algebra and Calculus of Variation | 60 | 40 |

| | | | | | | |
|----|----------|-----------|---|--|----|----|
| VI | DSMAT61P | Practical | 2 | Theory based Practical's on Linear Algebra and Calculus of Variation | 25 | 25 |
| | DSMAT62 | Theory | 4 | Numerical Analysis | 60 | 40 |
| | DSMAT62P | Practical | 2 | Theory based Practical's on Numerical Analysis | 25 | 25 |
| | INTMAT | | 2 | Internship [Institutes/Industries] | | |

**Abbreviation for DSMAT51, DSMAT51P, DSMAT52, DSMAT52P ,DSMAT61, DSMAT61P, DSMAT62,DSMAT62P,INTMAT: MAT–Mathematics; P–Practical; III–Third Semester; IV–Fourth Semester; INT-intenship
I.A-Formative/Internal Assessment; S.A. - Summative Assessment.**

ASSESSMENT
Fifth and Sixth Semester

Weightage for the Assessments (in percentage)

| Type of Course | Formative Assessment (I.A.) | Summative Assessment (S.A.) |
|----------------|-----------------------------|-----------------------------|
| Theory | 40% | 60 % |
| Practical | 25% | 25 % |

COURSE PATTERN & SCHEME EXAMINATION

| Sem Name | Paper Code | Subjects | Instruc tion hrs / Week | Durati on of Exam (hrs) | Marks | | | Credits |
|-------------|------------|---------------------------------------|----------------------------------|----------------------------------|-------|------|-----------|---------|
| | | | | | IA | Exam | Tota l | |
| V | DSMAT51 | Real Analysis-II and Complex Analysis | 4 | 3 | 40 | 60 | 100 | 4 |
| | DSMAT51P | Theory based Practical's | 4 | 3 | 25 | 25 | 50 | 2 |

| | | | | | | | | |
|----|----------|--|---|---|----|----|-----|---|
| | | on Real Analysis-II and Complex Analysis | | | | | | |
| | DSMAT52 | Vector calculus and Analytical geometry | 4 | 3 | 40 | 60 | 100 | 4 |
| | DSMAT52P | Theory based Practical's on Vector calculus and Analytical geometry | 4 | 3 | 25 | 25 | 50 | 2 |
| VI | DSMAT61 | Linear Algebra and Calculus of Variation | 4 | 3 | 40 | 60 | 100 | 4 |
| | DSMAT61P | Theory based Practical's on Linear Algebra and Calculus of Variation | 4 | 3 | 25 | 25 | 50 | 2 |
| | DSMAT62 | Numerical Analysis | 4 | 3 | 40 | 60 | 100 | 4 |
| | DSMAT62P | Theory based Practical's on Numerical Analysis | 4 | 3 | 25 | 25 | 50 | 2 |

Abbreviation for DSMAT51, DSMAT51P, DSMAT52, DSMAT52P ,DSMAT61, DSMAT61P, DSMAT62,DSMAT62P,INTMAT: MAT–Mathematics; P–Practical; III–Third Semester; IV–Fourth Semester; I.A-Formative/Internal Assessment; S.A. - Summative Assessment.

FIFTH SEMESTER PAPER V

| | |
|--|---|
| DSMAT51: REAL ANALYSIS-II and COMPLEX ANALYSIS | |
| Teaching Hours :4 Hours / week | Credits : 4 |
| Total Teaching Hours :60 Hours | Max. Marks : 100 (SA 60 + IA 40) |

COURSE OBJECTIVE:

This course aims to provide students with a comprehensive understanding of improper integrals and Beta-Gamma functions, their properties, and applications. It introduces complex numbers, analytic functions, and complex integration theorems. Additionally, students will explore conformal and bilinear transformations, learning to analyze and solve problems involving complex mappings. The course develops strong analytical and problem-solving skills essential for advanced mathematics and related fields.

COURSE OUTCOMES (COS):

| By the end of the program the students will be equipped with the following aspects: | |
|--|--|
| CO 1 | Understand and evaluate different types of improper integrals including the first, second, and third kinds, and apply Beta and Gamma functions to evaluate definite integrals using standard properties and formulas such as duplication and their interrelations. |
| CO 2 | Analyze and construct analytic functions using Cauchy-Riemann equations , determine harmonic functions, and apply the Milne-Thomson method for constructing analytic functions from real or imaginary parts. |
| CO 3 | Apply and interpret complex integration techniques including Cauchy's Integral Theorem, Cauchy's Integral Formula, and Liouville's Theorem , and solve problems involving conformal and bilinear transformations , including the analysis of invariant points and transformation of geometric figures. |
| CO 4 | Demonstrate and analyze the effect of elementary transformations (translation, rotation, magnification, inversion) and bilinear transformations on the complex plane, including the determination of cross-ratios, invariant points, and geometric images under these transformations. |

| CONTENT | HOURS |
|---|-----------|
| UNIT-I: IMPROPER INTEGRAL AND BETA-GAMMA FUNCTIONS | 15 |
| <p>Improper Integral-Improper integrals of the first, second and third kind with examples. Improper integral has the limit of the proper integral.</p> <p>Beta-Gamma Functions-Definitions, Properties and examples, relations between beta and gamma functions, standard theorems, applications of evaluations of definite integrals, duplication formula and applications.</p> | |
| UNIT-II: COMPLEX NUMBERS AND FUNCTIONS OF COMPLEX VARIABLES: | 15 |
| <p>Complex numbers -Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula- $e^{ix} = \cos x + i \sin x$. Functions of a complex variable-limit, continuity and differentiability of a complex function. Analytic function, Cauchy-Riemann equations in Cartesian and Polar forms-Sufficiency conditions for analyticity (Cartesian form only)-Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given-Milne Thomson method.</p> | |
| UNIT-III: COMPLEX INTEGRATION: | 15 |
| <p>Complex integration – properties - problems. Cauchy's Integral theorem proof using Green's theorem- direct consequences. Cauchy's Integral formula - Cauchy's generalized formula for the derivatives and applications for evaluation of simple line integrals - Cauchy's inequality – Liouville's theorem. Fundamental theorem of algebra.</p> | |
| UNIT-IV: TRANSFORMATIONS | 15 |
| <p>Conformal transformation – some elementary transformations namely translation, rotation, magnification and inversion - examples. The bilinear transformation - cross ratio - invariant points of a bilinear transformation - properties</p> <p>(i) Bilinear transformation sets up a one to one correspondence between the extended z-plane and the extended w-plane.</p> <p>(ii) Preservation of cross ratio under a bilinear transformation.</p> <p>(iii) A bilinear transformation transforms circles onto circles or straight lines. Problems on finding a bilinear transformation, and finding images under a bilinear transformation and invariant points of a bilinear transformation. Discussion of transformations $w = z^2$, $w = \sin z$, $w = \frac{1}{z}$, $w = e^z$.</p> | |

TEXT/ REFERENCE BOOKS

1. Ranganath, G. K. (n.d.). *A textbook of B.Sc mathematics for 6th semester Bangalore University* (2nd rev. ed.). S. Chand & Company Pvt. Ltd.
2. Gururajachar, G. B. (n.d.). *A text book of mathematics for 6th semester B.Sc.* (2nd ed.). Academic Excellent Series Publications.
3. Ansari, A. A., Denis, R. Y., Dubey, S. K. D., & Gupta, U. K. (n.d.). *A text book of complex variables and calculus of variation* (1st ed.). Mangalam Publishers.
4. Jeffrey, A. (2005). *Complex analysis and applications* (2nd ed.). McGraw-Hill Education Pvt. Ltd.
5. Greene, R. E., & Krantz, S. G. (2006). *Function theory of one complex variable* (3rd ed.). Mangalam Publishers.
6. Ahlfors, L. V. (1979). *Complex analysis* (3rd ed.). McGraw-Hill Education Pvt Ltd.

WEB RESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

| | |
|---|--|
| DSMAT51P: THEORY BASED PRACTICALS ON REAL ANALYSIS-II and COMPLEX ANALYSIS | |
| Teaching Hours :3 Hours / week | Credits : 2 |
| Total Teaching Hours :42 Hours | Max. Marks : 50 (SA 25 + IA 25) |

COURSE OBJECTIVES:

Mathematics-DSMAT51P with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

| Course Outcomes | This practical course will enable the students to: |
|------------------------|--|
| CO 1 | Apply Gamma and Beta functions to evaluate definite integrals arising in engineering and applied mathematics. |
| CO 2 | Analyze the analyticity of complex functions using Cauchy–Riemann equations in Cartesian and Polar forms. |
| CO 3 | Construct analytic functions using the Milne–Thomson method and determine whether functions are harmonic in Cartesian and Polar coordinates. |
| CO 4 | Evaluate complex transformations and integrals, and apply bilinear transformation concepts to solve advanced problems in complex analysis. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical)

Note-1:Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 12 programs must be done from the following list of **suggested programs**:

| SL.NO | SUGGESTED PROGRAMS |
|-------|---|
| 1. | Program to evaluate the integrals using gamma function |
| 2. | Program to evaluate the integrals using beta function |
| 3. | Program on verification of Cauchy – Riemann equations (Cartesian form) or test for analyticity. |
| 4. | Program on verification of Cauchy – Riemann equations (Polar form) or test for analyticity. |
| 5. | Program to construct analytic functions (through Milne–Thompson method) (real part is given) |
| 6. | Program to construct analytic functions (through Milne–Thompson method) (imaginary part is given) |
| 7. | Program to check whether a function is harmonic or not (in cartesian form) |
| 8. | Program to check whether a function is harmonic or not (Polar form) |
| 9. | Program to check whether a function forms orthogonal system or not |
| 10. | Program to find Cross ratio of points and related aspects. |
| 11. | Program to find fixed points of bilinear transformations. |
| 12. | Program on complex integration. |

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

WEB RESOURCES:

1. <http://www.univie.ac.at/future.media/moe/galerie.html>
2. <http://faculty.msmary.edu/heinold/python.html>
3. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
4. <https://www.vlab.co.in/>
5. <https://fossee.in/>
6. <http://www.python.org>

FIFTH SEMESTER- PAPER VI

| DSMAT52: VECTOR CALCULUS AND ANALYTICAL GEOMETRY | |
|---|---|
| Teaching Hours :4 Hours / week | Credits : 4 |
| Total Teaching Hours :60 Hours | Max. Marks : 100 (SA 60 + IA 40) |

COURSE OBJECTIVE:

This course aims to develop a comprehensive understanding of the geometry of space curves, vector differential calculus, and vector integration. Students will explore key concepts such as curvature, torsion, and Serret-Frenet formulas, alongside orthogonal curvilinear coordinates. Emphasis is placed on vector fields, their derivatives, and integral theorems including Green's, Gauss', and Stokes' theorems. Additionally, the course covers analytical geometry of planes, lines, and spheres, focusing on distances, angles, and intersections. Through theoretical derivations and problem-solving, learners will build strong analytical and spatial reasoning skills essential for advanced mathematics and applied sciences.

COURSE OUTCOMES (COS):

| By the end of the program the students will be equipped with the following aspects: | |
|--|--|
| CO 1 | Understand and apply the fundamental concepts of space curves, including curvature, torsion, and the Serret-Frenet formulas, to solve related geometric problems. |
| CO 2 | Analyze scalar and vector fields using vector differential calculus, interpreting gradient, divergence, curl, and their physical significance. |
| CO 3 | Demonstrate proficiency in vector integration techniques and apply major integral theorems (Green's, Gauss', and Stokes') to evaluate line, surface, and volume integrals. |
| CO 4 | Apply principles of analytical geometry to determine distances, angles, and intersections involving planes, lines, and spheres in three-dimensional space. |

| CONTENT | HOURS |
|---|--------------|
| UNIT-I: GEOMETRY OF SPACE CURVES | 15 |
| Multiple product – scalar triple product, vector triple product, geometrical interpretation, related problems, vector function of a scalar variable – interpretation as a space curve, derivative, tangent, normal and binormal vectors to a space curve, Curvature and Torsion of a space curve- definitions, derivation and problems, Serret-Frenet formula. Orthogonal curvilinear coordinates- relations between base vectors and normal vectors, reciprocity of these vectors, arc, area and volume element, specialization of Cartesian, cylindrical and spherical coordinates. | |
| UNIT-II: VECTOR DIFFERENTIAL CALCULUS | 15 |
| Gradient of a scalar field, geometrical meaning – directional derivative – maximum directional derivative – angle between two surfaces. Vector field – divergence and curl of a vector field – solenoidal and irrotational - scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties, Harmonic functions, problems. | |
| UNIT-III: VECTOR INTEGRATION | 15 |
| Vector Integration – Definition and basic properties, vector line integral, surface integral and volume integral; Green’s theorem in the plane – Proof and related problems, Direct consequences of the theorem; Gauss’ Divergence theorem – Proof and related problems, Direct consequences of the theorem; Stokes’ theorem–Proof and related problems, Direct consequences of the theorem. | |
| UNIT-IV: ANALYTICAL GEOMETRY | 15 |
| Planes: Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes. Straight lines: Equations of straight lines, Distance of a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane. Spheres: Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal. | |

TEXT/REFERENCE BOOKS:

1. Ranganath, G. K. (Year). *A textbook of B.Sc mathematics for 6th semester Bangalore University* (2nd rev. ed.). S. Chand & Company Pvt Ltd.

2. Gururajachar, G. B. (n.d.). *A text book of mathematics for 6th semester B.Sc.* (2nd ed.). Academic Excellent Series Publications.
3. Young, E. C. (n.d.). *Vector and tensor analysis* (2nd ed.). CRC Press. Narayan, S., & Mittal,
4. P. K. (2014). *Analytical solid geometry* (17th rev. ed.). S. Chand & Co. Pvt. Ltd.
5. Young, E. C. (n.d.). *Vector and tensor analysis* (2nd ed.). CRC Press.
6. Ansari, A. A., Denis, R. Y., Dubey, S. K. D., & Gupta, U. K. (n.d.). *A text book of advance calculus, vectors and numerical analysis* (1st ed.). Mangalam Publishers.

WEBRESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

| | |
|--|--|
| DSMAT52P : THEORY BASED PRACTICALS ON VECTOR CALCULUS AND ANALYTICAL GEOMETRY | |
|--|--|

| | |
|---------------------------------------|--|
| Teaching Hours :3 Hours / week | Credits : 2 |
| Total Teaching Hours :42 Hours | Max. Marks : 50 (SA 25 + IA 25) |

COURSE OBJECTIVES:

Mathematics-DSMAT52P with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

| Course Outcomes | This practical course will enable the students to: |
|-----------------|---|
| CO 1 | Apply vector operations and differentiation techniques to compute scalar and vector products, gradients, divergence, curl, and Laplacians using programming tools. |
| CO 2 | Analyze scalar and vector fields using vector differential calculus, interpreting gradient, divergence, curl, and their physical significance. |
| CO 3 | Evaluate vector integrals and apply fundamental theorems such as Green's, Stokes', and Gauss' divergence theorem to solve mathematical problems computationally. |
| CO 4 | Construct and plot 3D geometric surfaces such as spheres, cones, and cylinders, and compute distances and relationships between geometric entities using programming. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical)

Note-1:Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer

Program / Python code and output. The minimum 12 programs must be done from the following list of **suggested programs**:

| SL.NO. | SUGGESTED PROGRAMS |
|--------|--|
| 1. | Program on multiple product of vectors–Scalar and Cross product. |
| 2. | Program on vector differentiation and finding unit tangent. |
| 3. | Program to find the gradient and Laplacian of a scalar function. |
| 4. | Program to find divergence and curl of a vector function. |
| 5. | Program to demonstrate the physical interpretation of gradient, divergence and curl. |
| 6. | Program to evaluate a vector line integral. |
| 7. | Program to evaluate a surface integral. |
| 8. | Program to evaluate a volume integral. |
| 9. | Evaluate the problem using Green’s theorem. |
| 10. | Evaluate the problem using Stoke’s theorem. |
| 11. | Evaluate the problem using Gauss divergence’s theorem. |
| 12. | Program to find equation and plot sphere, cone and cylinder |
| 13. | Program to find distance between a straight line and a plane. |
| 14. | Program to construct and plot some standard surfaces. |

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

WEB RESOURCES:

1. <http://www.univie.ac.at/future.media/moe/galerie.html>
2. <http://faculty.msmary.edu/heinold/python.html>
3. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
4. <https://www.vlab.co.in/>
5. <https://fossee.in/>
6. <http://www.python.org>

SIXTH SEMESTER -PAPER VII

| DSMAT61: LINEARALGEBRA AND CALCULUS OF VARIATION | |
|---|---|
| Teaching Hours :4 Hours / week | Credits : 4 |
| Total Teaching Hours :60 Hours | Max. Marks : 100 (SA 60 + IA 40) |

COURSE OBJECTIVE:

Understand the definitions and examples of rings, integral domains, and fields. Identify properties and substructures such as subrings and subfields. Learn necessary and sufficient conditions for subrings. Explore ideals, including principal, prime, and maximal ideals, and their operations. Study quotient rings and ring homomorphisms, culminating with the fundamental theorem of homomorphism.

COURSE OUTCOMES (COs):

| By the end of the program the students will be equipped with the following aspects: | |
|--|---|
| CO 1 | Understand and apply fundamental concepts of rings, integral domains, fields, and their substructures, including ideals and ring homomorphisms. |
| CO 2 | Analyze vector spaces and subspaces, and solve problems involving linear independence, basis, and dimension. |
| CO 3 | Define and work with linear transformations, including their matrix representations, change of basis, and apply the Rank-Nullity theorem. |
| CO 4 | Formulate and solve variational problems using Euler's equation and apply these methods to classical problems in calculus of variations. |

| CONTENT | HOURS |
|--|-----------|
| UNIT-I: RINGS, INTEGRAL DOMAINS, FIELDS | 15 |
| Definition and examples of rings, properties of rings , subrings, necessary and sufficient condition for a subring, integral domain and field, subfield. Ideals, ideal generated by a subset of a ring. Quotient(Factor) ring. Operation on ideals, principal , prime and maximal ideal. Ring Homomorphism. Fundamental theorem of Homomorphism. | |
| UNIT-II: VECTOR SPACES | 15 |
| Vector spaces - Definition, examples and properties; - Examples, criterion for a sub- set to be a subspace and some properties; Linear Combination - Linear span, Linear dependence and Linear independence,- Co-ordinates, ordered basis-basic properties and related problems. | |
| UNIT-III: LINEAR TRANSFORMATIONS | 15 |
| Linear transformation - Definition, examples, equivalent criteria, some basic properties and matrix representation and change of basis and effect on associated matrix, similar matrices; Rank - Nullity theorem - Null space, Range space, proof of rank nullity Theorem and related problems. | |
| UNIT-IV: CALCULUS OF VARIATION | 15 |
| Calculus of Variation - Variation of a function– variation of the corresponding functional – extremal of a functional – variational problem $f = f(x, y, y')$ – Euler’s equation and its particular forms – Examples – standard problems on geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem – Isoperimetric problems. | |

TEXT/ REFERENCE BOOKS

1. Ranganath, G. K. (n.d.). *A textbook of B.Sc mathematics for 6th semester: Bangalore University* (2nd rev. ed.). S. Chand & Company Pvt. Ltd.
2. Gururajachar, G. B. (n.d.). *A text book of mathematics for 6th semester B.Sc.* (2nd ed.). Academic Excellent Series Publications.
3. Gardner, B. J., & Wiegandt, R. (2004). *Radical theory of rings* (1st ed.). CRC Press.
4. Bali, P. K. (2011). *Linear algebra* (Golden Series). Golden Publications (Golden Books Centre).
5. Lipschutz, S., & Lipson, M. (2019). *Linear algebra* (7th ed.). McGraw-Hill Education.

6. Ansari, A. A., Denis, R. Y., Dubey, S. K. D., & Gupta, U. K. (n.d.). *A text book of complex variables and calculus of variation* (1st ed.). Mangalam Publishers.

WEB RESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

**DSMAT61P: THEORY BASED PRACTICALS ON LINEAR ALGEBRA AND
CALCULUS OF VARIATION**

| | |
|---------------------------------------|--|
| Teaching Hours :3 Hours / week | Credits : 2 |
| Total Teaching Hours :42 Hours | Max. Marks : 50 (SA 25 + IA 25) |

COURSE OBJECTIVES:

Mathematics-DSMAT61P with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

| Course Outcomes | This practical course will enable the students to: |
|------------------------|---|
| CO 1 | Analyze the structure of algebraic systems such as rings, integral domains, and fields, and demonstrate ring homomorphisms through computational tools. |
| CO 2 | Apply concepts of vector spaces to test linear dependence, find linear combinations, and determine basis and dimension of subspaces. |
| CO 3 | Examine linear transformations and determine their matrix representations; apply Rank–Nullity Theorem to analyze transformation properties. |
| CO 4 | Solve advanced problems involving Euler’s differential equations and variational calculus using appropriate mathematical techniques and programming. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS) tool for computer programs (i. e., Theory Based Practical)

Note-1: Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 12 programs must be done from the

following list of **suggested programs**:

| SL.NO. | SUGGESTED PROGRAMS |
|---------------|--|
| 1. | Program on Commutative ring and Ring with unity. |
| 2. | Program on Integral domain and field. |
| 3. | Program on Homomorphism of rings. |
| 4. | Program on linear combination of vectors. |
| 5. | Program to verify linear dependence and independence. |
| 6. | Program to find basis and dimension of the subspaces. |
| 7. | Program to verify if a function is linear transformation or not. |
| 8. | Program to find the matrix of linear transformation. |
| 9. | Program on Rank–nullity theorem. |
| 10. | Program on different forms of Euler’s equation. |
| 11. | Programs on Variational problems. |

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

WEB RESOURCES:

7. <http://www.univie.ac.at/future.media/moe/galerie.html>
8. <http://faculty.msmary.edu/heinold/python.html>
9. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
10. <https://www.vlab.co.in/>
11. <https://fossee.in/>
12. <http://www.python.org>

SIXTH SEMESTER- PAPER VIII

| DSMAT62: NUMERICAL ANALYSIS | |
|---------------------------------------|---|
| Teaching Hours :4 Hours / week | Credits : 4 |
| Total Teaching Hours :60 Hours | Max. Marks : 100 (SA 60 + IA 40) |

COURSE OBJECTIVE:

This course aims to equip students with foundational and advanced numerical methods for solving mathematical problems. It covers polynomial interpolation techniques, error analysis, and methods to solve algebraic and transcendental equations. Students will learn direct and iterative methods for solving systems of linear equations and compute eigenvalues using the power method. The course also introduces numerical differentiation and integration using standard formulas and rules. Emphasis is placed on understanding the derivations, implementing the methods, and solving real-world problems, fostering analytical thinking and computational proficiency in numerical mathematics.

| By the end of the program the students will be equipped with the following aspects: | |
|--|--|
| CO 1 | Apply finite difference operators and interpolation techniques such as Newton-Gregory, Gauss, Lagrange, and Newton's divided difference methods to construct and analyze interpolation polynomials. |
| CO 2 | Analyze and solve algebraic and transcendental equations using numerical methods like Bisection, Regula-Falsi, Newton-Raphson, Secant, and iterative techniques, including error estimation. |
| CO 3 | Solve systems of linear equations using direct and iterative methods, including Gauss elimination, Gauss-Jordan, LU decomposition, Gauss-Seidel, and Jacobi methods; compute eigenvalues using the power method. |
| CO 4 | Compute numerical derivatives and integrals using Newton-Gregory formulas, Trapezoidal rule, Simpson's rules, and implement initial value problem solvers like Euler's and Runge-Kutta methods. |

| CONTENT | HOURS |
|---|--------------|
| UNIT – I: POLYNOMIAL INTERPOLATIONS | 15 |
| Finite differences. Forward, backward and central differences and shift operators: definitions, properties and problems; Polynomial interpolation - Newton-Gregory forward and backward interpolation formulas, Gauss's Forward and backward interpolation formulas, Lagrange interpolation polynomial, Newton's divided differences and Newton's general interpolation formula (Discussion on setting up the polynomials, differences between them and problems on their applications). | |
| UNIT– II: ALGEBRAIC AND TRANSCENDENTAL EQUATIONS | 15 |
| Errors - Significant digits, absolute, relative, percentage errors, rounding off and truncation errors (meanings and related problems), general error formula (derivation of formula and problems based on it), error in series approximation: Taylor series approximations (problems only), Solutions to algebraic and transcendental equations -Bisection method, Regula-Falsi method, iterative method Newton-Raphson method and secant method (Plain discussion of the rational behind techniques and problems on their application) . | |
| UNIT – III: SYSTEM OF LINEAR ALGEBRAIC EQUATIONS | 15 |
| Direct Methods – Iterative methods Tringularization method-LUD, Gauss-Jacobi method, Gauss- Seidal method , Gauss elimination method, Gauss-Jordan elimination method, Computation of largest Eigen value of a square matrix by power method. | |
| UNIT-IV: NUMERICAL DIFFERENTIATION AN INTEGRATION | 15 |
| Formula for derivatives (till second order) based on Newton-Gregory forward and backward interpolations (Derivations and problems based on them). Numerical Integration - General quadrature formula, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule and Weddell's rule (derivations for only general quadrature formula, trapezoidal rule and Simpson's 1/3 rd rule and problems on the applications of all formulas), Euler's method Modified Euler's method , Runge Kutta 2 nd and 4 th method. | |

TEXT/REFERENCEBOOKS:

1. Ranganath, G. K. (n.d.). *A textbook of B.Sc Mathematics for 6th semester Bangalore University* (2nd rev. ed.). S. Chand & Company Pvt. Ltd.
2. Gururajachar, G. B. (n.d.). *A text book of mathematics for 6th semester B.Sc.* (2nd ed.). Academic Excellent Series Publications.
3. Gerald, C. F., & Wheatley, P. O. (n.d.). *Applied numerical analysis* (7th ed.). Pearson Education Inc.
4. Chapra, S. C. (n.d.). *Applied numerical methods with MATLAB for engineers and scientists* (3rd ed.). Tata McGraw-Hill Education Private Limited.
5. Moin, P. (n.d.). *Fundamentals of engineering numerical analysis* (2nd ed.). Cambridge University Press Pvt. Ltd.
6. Jain, M. K., Iyengar, S. R. K., & Jain, R. K. (n.d.). *Numerical methods: For scientific and engineering computation* (6th ed.). New Age International Pvt. Ltd.
7. Jain, M. K., Iyengar, S. R. K., & Jain, R. K. (n.d.). *Numerical methods: Problems and solutions* (2nd ed.). New Age International Pvt. Ltd.
8. Sastry, S. S. (n.d.). *Introductory methods of numerical analysis* (5th ed.). PHI Learning Pvt. Ltd.
9. Chapra, S. C., & Canale, R. P. (n.d.). *Numerical methods for engineers* (6th ed.). Tata McGraw Hill Education Private Limited.

WEBRESOURCES:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <https://ndl.iitkgp.ac.in/>
5. <http://cec.nic.in/cec/>
6. <https://www.doabooks.org/>

| DSMAT62P: THEORY BASED PRACTICALS ON NUMERICAL ANALYSIS | |
|--|--|
| Teaching Hours :3 Hours / week | Credits : 2 |
| Total Teaching Hours :42 Hours | Max. Marks : 50 (SA 25 + IA 25) |

COURSE OBJECTIVES:

Mathematics-DSMAT62P with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

| Course Outcomes | This practical course will enable the students to: |
|------------------------|--|
| CO 1 | Apply root-finding algorithms such as Bisection, Regula-Falsi, Newton-Raphson, and Secant methods to solve nonlinear equations efficiently. |
| CO 2 | Solve systems of linear algebraic equations using direct and iterative methods including Gauss-elimination, Gauss-Jordan, Gauss-Jacobi, and Gauss-Seidel techniques. |
| CO 3 | Evaluate definite integrals numerically through techniques like Simpson's 1/3 and 3/8 rules, Trapezoidal rule, and Weddle's rule for accurate approximation. |
| CO 4 | Employ interpolation methods such as Newton-Gregory and Lagrange for differentiation and estimation of missing values in data sets, enhancing computational analysis skills. |

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical)

Note-1: Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 12 programs must be done from the following list of **suggested programs**:

| SL.NO. | SUGGESTED PROGRAMS |
|--------|--|
| 1. | Program to find root of an equation using bisection and Regula-Falsi methods. |
| 2. | Program to find root of an equation using Newton-Raphson and Secant methods. |
| 3. | Program to solve system of algebraic equations using Gauss-elimination method. |
| 4. | Program to solve system of algebraic equations using Gauss-Jordan method. |
| 5. | Program to solve system of algebraic equation using Gauss-Jacobimethod. |
| 6. | Program to solve system of algebraic equation using Gauss-Seidelmethod. |
| 7. | Program to evaluate integral using Simpson's 1/3 and 3/8 rules. |
| 8. | Program to evaluate integral using Trapezoidal and Weddle rules |
| 9. | Program to find the sums of powers of successive natural numbers Using Newton – Gregory technique. |
| 10. | Program to find differentiation at specified point using Newton-Gregory interpolation method. |
| 11. | Program to find the missing value of table using Lagrange method. |

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

WEB RESOURCES:

1. <http://www.univie.ac.at/future.media/moe/galerie.html>
2. <http://faculty.msmmary.edu/heinold/python.html>
3. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>
4. <https://www.vlab.co.in/>
5. <https://fossee.in/>
6. <http://www.python.org>

Pedagogy: Lectures by conventional method, use of ICT and conducting competitions like Quiz, Seminars, Desk Work, Book Chapter, Problem Solving, Power Point Presentation, etc.

Formative Assessment:

| Types of Course | Internal Assessment (I.A.) |
|-----------------|--|
| Theory | C1: Mid semester exam : 15 Marks |
| | C2: Assignments / tests/ Attendance : 25 Marks |
| | Total 40 Marks |
| Practical's | C1: Pre-Practicals 10 Marks |

FORMAT OF QUESTION PAPER OF THEORY EXAMS

| Section. | Topic | No. of sub divisions | | Marks for each sub divisions | Maximum marks for the question |
|--------------------|--------------|----------------------|----------------|------------------------------|--------------------------------|
| | | To be Set | To be answered | | |
| A | UNIT-I | 2 | | 2 | 12 |
| | UNIT-II | 2 | | | |
| | UNIT-III | 2 | | | |
| | UNIT-IV | 2 | | | |
| | TOTAL | 8 | | | |
| B | UNIT-I | 5 | 3 | 4 | 12 |
| C | UNIT-II | 5 | 3 | 4 | 12 |
| D | UNIT-III | 5 | 3 | 4 | 12 |
| E | UNIT-IV | 5 | 3 | 4 | 12 |
| GRAND TOTAL | | | | | 60 |

FORMAT OF QUESTION PAPER OF MATHEMATICS PRACTICAL

| Duration of Exam: 3 Hours | | | Maximum Marks : 25 | | |
|---|----------|------------------|---------------------------|--------------------------|----------------|
| LAB RECORD : 5-MARKS VIVA: 4-MARKS | | | | | |
| Write the python code and solve manually one question from each unit | | | | | |
| Unit | Topic | No. of questions | To be answered | Marks for Each questions | Maximum marks |
| 1 | UNIT-I | 1 | 1 | 4 | 4 |
| 2 | UNIT-II | 1 | 1 | 4 | 4 |
| 3 | UNIT-III | 1 | 1 | 4 | 4 |
| 4 | UNIT-IV | 1 | 1 | 4 | 4 |
| TOTAL | | | | | 16 |
| GRAND TOTAL | | | | | 16+9=25 |

| | |
|---------------------------------------|--|
| INTMA61 : INTERSHIP | |
| Teaching Hours: 0 Hours/Week | Credits:2 |
| Total Teaching Hours: 60 Hours | Max. Marks: 50(S.A.-30 +I.A.20) |

Course Description:

This course provide the students an opportunity to gain work experience in the relevant institution / industry, connected to their subject of study. The experience gained in the workplace will give the students a competitive edge in their career.

Course Objectives: This course will enable the students to

1. get exposed the work ethics of the field of their professional interest
2. gain practical experience on the field of their interest
3. choose their career through practical experience

UNIT-I-INTERNSHIP

Skill Focused : Skill development, Employability

The students of B.Sc have to undertake a mandatory internship in Mathematics for a period of not less than 30 working days at any of the following: reputed research centers, banking sectors, recognized educational institutions or any other industry internship approved by the Head of the Department.

The internship is to be undertaken at the end of fifth semester (during third year vacation). The report submission and the presentation on the report will be held during the sixth semester and the credits will appear in the mark sheet of sixth semester.

The students will have to give an internship proposal with the following details: Organization where the student proposes to do the internship, reasons for the choice, nature of internship, period on internship, relevant permission letters, if available, name of the mentor in the organization, email, telephone and mobile numbers of the person in the organization with whom NMKRV College for Women could communicate matters related to internship.

The HOD will assign faculty members from the department as mentors at least two weeks before the end of fifth semester. The students will have to be in touch with the mentors during the

internship period either through personal meetings, over the phone or through email. At the place of internship, students are advised to be in constant touch with their mentors in the organization. At the end of the required period of internship, the candidates will submit a report in a specified format adhering to department guidelines. The report should be submitted within first 20 days of the reopening of the University for the sixth semester.

The department must hold a presentation by the students during the End-Semester-Examination. During the presentation the guide or a nominee of the guide should be present and be one of the evaluators. Students should preferably be encouraged to make a presentation of their report. A minimum of 10 minutes should be given for each of the presenters. The maximum limit is left to the discretion of the evaluation committee. Students will get 2 credits on successful completion of internship. If a student fails to comply with the aforementioned guidelines, the student has to repeat the internship.

Course Learning Outcomes: On completion of this course, students are able to:

- 1.** be competent in the field of their professional interest.
- 2.** strengthen/upgrade the knowledge base required for handling problems during work