# Dr. N.G.P.ARTS AND SCIENCE COLLEGE (Autonomous)

## REGULATIONS 2026-27 for Post Graduate Programme
## (Outcome Based Education model with Choice Based Credit System)

## M.Sc. Degree

(For the students admitted during the academic year 2026-27)

**Programme: M.Sc. Mathematics**

**Eligibility:**

A candidate who has passed the Degree Examination in B.Sc. (Mathematics) or B.Sc. (Mathematics with Computer Applications) of Bharathiar University and as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the **Master of Science in Mathematics** Degree Examination of this College after a course of study of two academic years

**Programme Educational Objectives:**

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To meet the demand for well trained Post Graduates in Mathematics with academic Excellence.
2. To demonstrate an understanding of the theoretical concepts and axiomatic underpinnings of Mathematics and an ability to construct proofs at the appropriate level.
3. To demonstrate competency in Mathematical modeling of complex phenomena, problem solving and decision making.
4. To demonstrate a level of proficiency in quantitative and computing skills sufficient to meet the growing demands of society upon modern education.

**PROGRAMME OUTCOMES:**

On the successful completion of the program, the following are the expectedoutcomes.

| PO Number | PO Statement |
|---|---|
| **PO1** | Students will have knowledge, understanding and Mathematical thinking of the basic and advanced concepts, techniques from different topics |
| **PO2** | They have a fundamental and advanced understanding of at least one Mathematical topic of their choice and able to solve problem related to the topic |
| **PO3** | They can be able to communicate clearly in writing and orallying the detailed technical arguments of complex Mathematical concepts |
| **PO4** | The students develop problem solving skill and apply them independently to problems in pure and applied Mathematics |
| **PO5** | They can develop the knowledge of formulating, analyzing and problem solving in core areas of the Mathematics including Analysis, Algebra and Statistics |

***PG Credit Distribution:***

| Part | Subjects | No. of Papers | Credit | Semester No. |
|---|---|---|---|---|
| III | Core | 16-18 | 13 x 04 = 52<br>02 x 03 = 06<br>01 x 05 = 05 | I - IV |
| | Elective | 04 | 04 x 04 = 16 | I - IV |
| | EDC | 01 | 01 x 03 = 03 | II |
| | Industrial Training | 01 | 01 x 02 = 02 | III |
| | Project Work | 01 | 01 x 08 = 08 | IV |
| **TOTAL CREDITS** | | | **92** | - |

## PG CURRICULUM

## M.Sc. MATHEMATICS - AY 2026-27

| Course Code | Course Category | Course Name | L | T | P | Instruction Week | Instruction Total | Exam (h) | Max Marks CIA | Max Marks ESE | Max Marks Total | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **First Semester** | | | | | | | | | | | | |
| 26MTP1CA | Core – I | Algebra | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP1CB | Core – II | Real Analysis | 4 | 2 | - | 6 | 72 | 3 | 25 | 75 | 100 | 4 |
| 26MTP1CC | Core – III | Ordinary Differential Equations | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP1CD | Core - IV | Numerical Analysis | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP1CE | Core - V | Operations Research | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP1DA | DSE -I | Mathematical Modeling | 4 | - | - | 4 | 48 | 3 | 25 | 75 | 100 | 4 |
| 26MTP1DB | | Commutative Algebra | | | | 4 | 48 | | | | | |
| 26MTP1DC | | Differential Geometry | | | | 4 | 48 | | | | | |
| **Total** | | | | | | 30 | 360 | | | | 600 | 24 |

| Course Code | Course Category | Course Name | L | T | P | Instruction | | Exam (h) | Max Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Week | Total | | CIA | ESE | Total | |
| **Second Semester** | | | | | | | | | | | | |
| 26MTP2CA | Core - VI | Complex Analysis | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP2CB | Core - VII | Advanced Analysis | 4 | 2 | - | 6 | 72 | 3 | 25 | 75 | 100 | 4 |
| 26MTP2CC | Core - VIII | Partial Differential Equations | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP2CD | Core - IX | Topology | 4 | 2 | - | 6 | 72 | 3 | 25 | 75 | 100 | 4 |
| 26DAP2EB | EDC | Foundations of Data Analytics | 3 | 1 | - | 4 | 48 | 3 | 25 | 75 | 100 | 3 |
| 26MTP2DA | DSE –II | Financial Mathematics | 4 | - | - | 4 | 48 | 3 | 25 | 75 | 100 | 4 |
| 26MTP2DB | | Information and coding theory | | | | 4 | 48 | | | | | |
| 26MTP2DC | | Stochastic Differential Equations | | | | 4 | 48 | | | | | |
| **Total** | | | | | | 30 | 360 | | | | 600 | 23 |

| Course Code | Course Category | Course Name | L | T | P | Instruction | | Exam (h) | Max Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Week | Total | | CIA | ESE | Total | |
| **Third Semester** | | | | | | | | | | | | |
| 26MTP3CA | Core – X | Functional Analysis | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP3CB | Core – XI | Classical Mechanics | 3 | 1 | - | 4 | 48 | 3 | 25 | 75 | 100 | 3 |
| 26MTP3CC | Core – XII | Advanced Statistics | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP3CD | Core –XIII | Advanced Graph Theory | 3 | 2 | - | 5 | 60 | 3 | 25 | 75 | 100 | 3 |
| 26MTP3CM | Core -XIV Practical | Computational Mathematics | 3 | - | 4 | 7 | 84 | 3 | 40 | 60 | 100 | 5 |
| 26MTP3CT | IT | Industrial Training | - | - | - | - | - | - | 40 | 60 | 100 | 2 |
| 26MTP3DA | DSE -III | Actuarial Mathematics | 4 | - | - | 4 | 48 | 3 | 25 | 75 | 100 | 4 |
| 26MTP3DB | | Algebraic Number Theory | | | | 4 | 48 | | | | | |
| 26MTP3DC | | Control Theory | | | | 4 | 48 | | | | | |
| **Total** | | | | | | 30 | 360 | | | | 700 | 25 |

| Course Code | Course Category | Course Name | L | T | P | Instruction | | Exam (h) | Max Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Week | Total | | CIA | ESE | Total | |
| **Fourth Semester** | | | | | | | | | | | | |
| 26MTP4CA | Core - XV | Mathematical Methods | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP4CB | Core - XVI | Fluid Dynamics | 4 | 1 | - | 5 | 60 | 3 | 25 | 75 | 100 | 4 |
| 26MTP4CV | Core-XVII | Project and Viva voce | - | - | 16 | 16 | 192 | 3 | 80 | 120 | 200 | 8 |
| 26MTP4DA | DSE -IV | Mathematical Econometrics | 4 | - | - | 4 | 48 | 3 | 25 | 75 | 100 | 4 |
| 26MTP4DB | | Lie Algebra | | | | 4 | 48 | | | | | |
| 26MTP4DC | | Finite Element Theory | | | | 4 | 48 | | | | | |
| | | **Total** | | | | 30 | 360 | | | | 500 | 20 |
| | | | | | | | | | | | | 92 |

BoS Chairman/HoD
Department of Mathematics
Dr. N. G. P. Arts and Science College
Coimbatore – [illegible]

## DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I to IV

**Semester I (Elective I) List of Elective Courses**

| S. No. | Course Code | Name of the Course |
|---|---|---|
| 1. | 26MTP1DA | Mathematical Modeling |
| 2. | 26MTP1DB | Commutative Algebra |
| 3. | 26MTP1DC | Differential Geometry |

**Semester II (Elective II) List of Elective Courses**

| S. No. | Course Code | Name of the Course |
|---|---|---|
| 1. | 26MTP2DA | Financial Mathematics |
| 2. | 26MTP2DB | Information and coding theory |
| 3. | 26MTP2DC | Stochastic Differential Equations |

**Semester III (Elective III) List of Elective Courses**

| S. No. | Course Code | Name of the Course |
|---|---|---|
| 1. | 26MTP3DA | Actuarial Mathematics |
| 2. | 26MTP3DB | Algebraic Number Theory |
| 3. | 26MTP3DC | Control Theory |

**Semester IV (Elective IV) List of Elective Courses**

| S. No. | Course Code | Name of the Course |
|---|---|---|
| 1. | 26MTP4DA | Mathematical Econometrics |
| 2. | 26MTP4DB | Lie Algebra |
| 3. | 26MTP4DC | Finite Element Theory |

## EXTRA CREDIT COURSES

**Self-study paper offered by the Mathematics Department**

| S. No. | Course Code | Course Title |
|---|---|---|
| 1. | 26MTPSSA | Research Methodology, IPR and Entrepreneurship |
| 2. | 26MTPSSB | Mathematics of Bioinformatics |

| Semester – I<br>CORE: ALGEBRA | | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Name | Category | L | T | P | Credits |
| I | 26MTP1CA | ALGEBRA | CORE | 48 | 12 | - | 4 |

| | |
|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• elementary group theory and how to solve contemporary problems<br>• elementary principles on certain algebraic structures<br>• Sylow's theorems that describe the structure of certain finite groups |
| **Prerequisite** | Knowledge on understanding of numbers, ratios, proportions, the order of operations, equality, algebraic symbolism, algebraic equations and functions. |

| Course Outcomes (Cos) | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | Explain external and internal direct products and concepts of group actions | K2 |
| CO2 | Apply polynomial division algorithm and evaluation homomorphisms in problem-solving | K3 |
| CO3 | Analyze irreducible polynomials and properties of algebraic extensions | K4 |
| CO4 | Evaluate field structures using automorphism groups and isomorphism properties | K5 |
| CO5 | Construct Galois groups and apply symmetric functions to solve advanced algebraic problems | K6 |

| Mapping with Program Outcomes: | | | | | |
|---|---|---|---|---|---|
| Cos / POs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | S | M | S | S | S |
| CO2 | M | M | M | S | S |
| CO3 | M | S | M | S | M |
| CO4 | M | S | S | M | M |
| CO5 | S | S | S | M | S |

| 26MTP1CA | CORE: ALGEBRA |
|---|---|

## Syllabus

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **Direct Products**<br>External direct products - internal direct products. group action on a set - fixed sets and isotropy subgroups – orbits - application on G-sets to counting: p-groups - Sylow theorems. | 12 | Text Book |
| II | **Applications of the Sylow Theory and Rings of Polynomials**<br>Applications to p-groups and the class equation - further applications. Rings of polynomials: polynomials in an indeterminate - evaluation homomorphisms - division algorithm in $F[x]$ - irreducible polynomials – ideal structure in $F[x]$ - uniqueness of factorization in $F[x]$. | 11 | Text Book |
| III | **Introduction to Extension Fields**<br>Extension fields - algebraic and transcendental elements - irreducible polynomial for $\alpha$ over $F$ - simple extensions - Algebraic extensions: finite extensions – algebraically closed and algebraic closures. | 13 | Text Book |
| IV | **Automorphisms of Fields**<br>Basic isomorphism of algebraic field theory - automorphisms and fixed fields - Frobenius automorphism - isomorphism extension theorem: extension theorem - splitting fields. | 14 | Text Book |
| V | **Separable Extensions and Galois Theory**<br>Multiplicity of zeros of a polynomial - separable extensions- perfect fields - normal extensions - the main theorem - Galois group over finite fields - illustrations of Galois theory: symmetric functions. | 10 | Text Book & You Tube Videos |
| | **Total** | **60** | |

| | | |
|---|---|---|
| **Text book** | 1. | Fraleigh J.B, 2003,"A First Course in Abstract Algebra", Third Edition, Narosa Publishing House, New Delhi. |
| **Reference Books** | 1. | Herstein I.N, 2007, "Topics in Algebra", Second Edition, Narosa Publishing House, New Delhi. |
| | 2. | Artin M, 1991, "Algebra", Prentice-Hall of India, New Delhi. |
| | 3. | Hall HS and Knight SR, 2016,"Higher Algebra", Sixth Edition, Arihant Publications, New Delhi. |
| | 4. | Anderson M and Feil T, 2014, "A First Course in Abstract Algebra Rings, Groups, and Fields", Third Edition, Chapman and Hall/CRC, London. |

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| **Journal and Magazines** | https://www.sciencedirect.com/journal/journal-of-algebra |
| **E-Resources and Website** | https://www.uou.ac.in/lecturenotes/science/MSCMT-19/unit%201.pdf |

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|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar |

| | |
|---|---|
| **Focus of the Course** | Skill Development/Employability |

| Semester – I<br>CORE: REAL ANALYSIS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Name | Category | L | T | P | Credits |
| I | 26MTP1CB | REAL ANALYSIS | CORE | 48 | 24 | - | 4 |

| | |
|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• the concept of Riemann Stieltjes integral<br>• the inverse and Implicit function theorems<br>• integration of Differential forms. |
| **Prerequisite** | Knowledge on Mathematics |

| **Course Outcomes (Cos)** | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | Explain the definition, existence, and properties of the Riemann–Stieltjes integral | K2 |
| CO2 | Apply tests for uniform convergence in sequences and series of functions | K3 |
| CO3 | Analyze convergence and properties of special functions and complex fields | K4 |
| CO4 | Evaluate multivariable functions using differentiation and contraction principles | K5 |
| CO5 | Construct mathematical solutions using advanced integration techniques and differential forms | K6 |

| **Mapping with Program Outcomes:** | | | | | |
|---|---|---|---|---|---|
| **Cos / POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | S | S | S | S | S |
| CO2 | S | S | M | S | S |
| CO3 | S | S | S | S | S |
| CO4 | S | S | S | S | M |
| CO5 | S | S | S | M | S |

| 26MTP1CB | CORE: REAL ANALYSIS |
|---|---|

**Syllabus**

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **Riemann Stieltjes Integral**<br>Definition and existence of the integral – properties of the integral – integration and differentiation – integration of vector valued function – rectifiable curves. | 14 | Text Book |
| II | **Sequences and Series of Functions**<br>Uniform convergence and continuity – uniform convergence and integration - uniform convergence and differentiation – equicontinuous families of functions –Stone Weierstrass theorem | 15 | Text Book |
| III | **Some Special Functions**<br>Power Series - exponential and logarithmic functions - trigonometric functions – algebraic completeness of the complex field - Fourier series - gamma functions | 14 | Text Book |
| IV | **Functions of Several Variables**<br>Linear transformation – differentiation - contraction principle - inverse function theorem-the implicit function theorem. | 14 | Text Book |
| V | **Integration of Differential Forms**<br>Integration-primitive mappings - partitions of unity - change of variables - differential forms - simplexes and chains - Stokes' theorem. | 15 | Text Book |
| | **Total** | **72** | |

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|---|---|---|
| **Text book** | 1. | Walter Rudin, 1976, "Principles of Mathematical Analysis", Third Edition, McGraw Hill, New York. |
| **Reference Books** | 1. | Bartle R. G., 1976, "Elements of Real Analysis", Second Edition, John Wily and Sons, New York. |
| | 2. | Mainak Mukherjee, 2015, "A course in Real Analysis", Narosa publishing house, New Delhi. |
| | 3. | Tom M Apostol, 2002, "Mathematical Analysis", Narosa Publishing House Pvt Ltd., Second Edition, New Delhi. |
| | 4. | Somasundaram D and Choudhary B, 2015, "A first course in Mathematical Analysis", Narosa Publishing House, New Delhi. |

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| **Journal and Magazines** | https://www.worldscientific.com/worldscinet/bms) |
| **E-Resources and Website** | https://share.google/0nC77dzdfmkoyGlan<br>https://share.google/ZQ6nCJgw4uyE75xNH |

| | |
|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar |

| | |
|---|---|
| **Focus of the Course** | Skill Development/ Employability |

| Semester – I<br>CORE: ORDINARY DIFFERENTIAL EQUATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Name | Category | L | T | P | Credits |
| I | 26MTP1CC | ORDINARY DIFFERENTIAL EQUATIONS | CORE | 48 | 12 | - | 4 |

| | |
|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• the first order and second order ordinary differential equations<br>• the usages of power series method to solve differential equations<br>• the homogenous and non-homogenous order ordinary differential equations |
| **Prerequisite** | Knowledge on Differential Equations |

| **Course Outcomes (Cos)** | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | Define Legendre and Bessel equations | K2 |
| CO2 | Solve systems using matrix methods and fundamental matrices | K3 |
| CO3 | Construct and solve non-homogeneous models representing engineering and physical systems | K6 |
| CO4 | Inspect the existence and uniqueness of solutions | K4 |
| CO5 | Analyze the solution using oscillatory theorems | K5 |

| **Mapping with Program Outcomes:** | | | | | |
|---|---|---|---|---|---|
| **Cos / POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | S | S | M | S | S |
| CO2 | M | S | S | M | M |
| CO3 | S | S | M | S | M |
| CO4 | M | M | S | M | M |
| CO5 | S | S | M | S | S |

| 26MTP1CC | CORE: ORDINARY DIFFERENTIAL EQUATIONS |
|---|---|

**Syllabus**

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **Solutions in power series**<br>Introduction - second order linear equations with ordinary points - Legendre equation and Legendre polynomials - second order equation with regular singular point - properties of Bessel functions. | 12 | Text Book |
| II | **System of Linear differential equations**<br>System of first order equations - model for ARMS competition between two nations - existence and uniqueness theorem - fundamental matrix. | 11 | Text Book & NPTEL |
| III | **Non-homogeneous linear system**<br>Non-homogeneous linear systems - linear system with constant coefficients - linear systems with periodic coefficients. | 10 | Text Book |
| IV | **Existence and uniqueness of solutions**<br>Preliminaries - successive approximations - Picard's theorem- some examples - continuation and dependence on initial conditions - existence of solutions in the large - existence and uniqueness of solutions of system. | 13 | Text Book |
| V | **Oscillations of second order equations**<br>Fundamental results - Sturm's comparison theorem - elementary linear oscillations - comparison theorem of Hille - Winter - oscillations of $x'' + a(t)x = 0$. | 14 | Text Book & You Tube Videos |
| | **Total** | **60** | |

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|---|---|---|
| **Text book** | 1. | Deo S.G, Lakshmikandham V and Raghavendra V, 2007, "Text book of Ordinary Differential Equations", Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi. |
| **Reference Books** | 1. | Reid W.T, 1971, "Ordinary Differential Equations", John Wiley & sons, New York. |
| | 2. | Coddington E.A and Levinson N, 2006, "Theory of Ordinary Differential Equations", Tata McGraw-Hill Publishing Company Limited, New Delhi. |
| | 3. | Tesch I.G., 2012, "Ordinary Differential Equations and Dynamics Systems", American Mathematical Society, Providence. |
| | 4. | Coddington E A, 2006, "An introduction to Ordinary Differential Equations", PHI Private Limited, New Delhi. |

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| **Journal and Magazines** | https://www.worldscientific.com/worldscinet/bms |
| **E-Resources and Website** | https://www.sciencedirect.com/topics/mathematics/system-of-ordinary-differential-equations |

| | |
|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar |
| **Focus of the Course** | Skill Development/ Employability |

| Semester – I<br>CORE : NUMERICAL ANALYSIS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Semester** | **Course Code** | **Course Name** | **Category** | **L** | **T** | **P** | **Credits** |
| I | 26MTP1CD | NUMERICAL ANALYSIS | CORE | 48 | 12 | - | 4 |

| | |
|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• the method of solving nonlinear equations<br>• analyze the solution of ordinary differential equations<br>• analyze the convergence of various methods. |
| **Prerequisite** | Knowledge on basic Mathematics |

| **Course Outcomes (Cos)** | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | Apply the numerical method to solve nonlinear equations | K3 |
| CO2 | Categorize the system of equations and solve by appropriate method | K4 |
| CO3 | Examine the solution got by applying various of numerical differentiation and integration methods | K4 |
| CO4 | Evaluate ordinary differential equations using Taylor's series | K5 |
| CO5 | Solve one and two dimensional partial differential equations. | K6 |

| **Mapping with Program Outcomes:** | | | | | |
|---|---|---|---|---|---|
| **Cos / POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | S | S | M | S | M |
| CO2 | M | S | S | M | S |
| CO3 | M | S | S | M | M |
| CO4 | S | M | M | S | S |
| CO5 | M | S | S | M | S |

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| 26MTP1CD | CORE: NUMERICAL ANALYSIS |
|---|---|

Syllabus

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **Nonlinear Equations**<br>Interval halving (Bisection) - linear interpolation methods - Newton's method -fixed-point iteration: $x = g(x)$ method - multiple roots - nonlinear systems. | 12 | Text Book |
| II | **Solving System of Equations**<br>Matrices and vectors - elimination methods - the inverse of a matrix and matrix pathology - iterative methods - parallel processing. | 12 | Text Book |
| III | **Numerical Differentiation and Integration**<br>Numerical integration - Trapezoidal Rule - Simpson's rules - Fourier series and Fourier transforms - adaptive integration - Gaussian quadrature - multiple integrals. | 12 | Text Book |
| IV | **Numerical Solution of Ordinary Differential Equations**<br>Taylor-Series Method - Euler method and its modifications - Runge-Kutta methods - multistep methods - higher-order equations and systems - Boundary-value Problems. | 11 | Text Book |
| V | **Numerical Solutions of Partial-Differential Equations**<br>Elliptic equations: Iterative methods - Poisson's equation – derivative boundary conditions - Parabolic equations: Solving heat equation by explicit method – Crank-Nicolson method - hyperbolic equations: solving vibrating string problem. | 13 | Text Book |
| | **Total** | 60 | |

| | | |
|---|---|---|
| **Text book** | 1. | Gerald C. F. and Wheatley P. O., 1999, "Applied Numerical Analysis", 7th Edition, Pearson Education, New York. |
| **Reference Books** | 1. | Smith. G. D., 1985, "Numerical Solution of Partial Differential Equations – Finite Difference Methods", Oxford University Press, Oxford. |
| | 2. | Jain M. K., Iyengar S. R. K. and Jain R. K., 1993, "Numerical Methods for Scientific and Engineering Computation", 3rd Edition, Wiley Eastern Ltd, Noida. |
| | 3. | Marghitu D. B. and Dupac M., 2012, "Advanced Dynamics: Analytical and Numerical Calculations with MATLAB", Springer, New York. |
| | 4. | Samuel Conte D. and Boor C. D., 1983, "Elementary Numerical Analysis", McGraw- Hill International Edition, New Delhi. |

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|---|---|
| **Journal and Magazines** | https://www.sciencedirect.com/journal/applied-numerical-mathematics, |
| **E-Resources and Website** | https://www.math.wsu.edu/math/kcooper/M448/resources.php, https://nptel.ac.in |

| | |
|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar |

| | |
|---|---|
| **Focus of the Course** | Skill Development/Employability |

| Semester – I<br>CORE : OPERATIONS RESEARCH | | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Name | Category | L | T | P | Credits |
| I | 26MTP1CE | OPERATIONS RESEARCH | CORE | 48 | 12 | - | 4 |

| | |
|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• the dynamic, integer and Nonlinear Programing<br>• concept of queueing and inventory<br>• how to solve the queueing models. |
| **Prerequisite** | Knowledge on Management |

| Course Outcomes (Cos) | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | Evaluate the efficiency and limitations of integer programming algorithms | K5 |
| CO2 | Explain the recursive nature and principles of dynamic programming | K2 |
| CO3 | Design inventory management models for real-world supply chain scenarios | K6 |
| CO4 | Analyze the behavior of various queueing models | K4 |
| CO5 | Apply unconstrained and constrained optimization techniques to solve nonlinear problems | K3 |

| Mapping with Program Outcomes: | | | | | |
|---|---|---|---|---|---|
| Cos / POs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | S | M | S | M | M |
| CO2 | M | S | M | M | S |
| CO3 | S | M | M | S | M |
| CO4 | M | S | S | M | S |
| CO5 | S | M | M | M | S |

| 26MTP1CE | CORE: OPERATIONS RESEARCH |
|---|---|

## Syllabus

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **Integer Linear Programming**<br>Introduction - Applications – Integer Programming Algorithms: Branch and Bound Algorithm – Cutting Plane Algorithm. | 12 | Text Book |
| II | **Deterministic Dynamic Programming**<br>Recursive Nature of Dynamic Programming Computations – Forward and Backward Recursion – Selected DP Applications – Problem of Dimensionality. | 12 | Text Book |
| III | **Inventory Modeling**<br>Inventory problem: A supply chain perspective – Role of Demand in the Development of Inventory Models – Static Economic order Quantity Models – Dynamic EOQ Models – Sticky Issues in Inventory Modeling. | 12 | Text Book |
| IV | **Queuing Systems**<br>Elements of a Queueing Model – Role of Exponential Distribution – Pure Birth and Death models – General Poisson Queuing Model - Specialised Poisson Queues – (M/G/1): (GD/∞/∞) - Pollaczek - Khintchine Formula – Other Queuing Models – Queuing Decision Models. | 12 | Text Book |
| V | **Nonlinear Programming Algorithms**<br>Unconstrained Algorithms – Constrained Algorithms: Separable Programming – Quadratic Programming – Chance-Constrained Programming – Linear Combinations Method – SUMT Algorithm. | 12 | Text Book |
| | **Total** | 60 | |

| | | |
|---|---|---|
| **Text book** | 1. | Hamdy A. Taha,"Operations Research – An Inroduction", Tenth edition, Pearson India Education Services Pvt. Ltd, Uttar Pradesh, India. |
| **Reference Books** | 1. | Frederick S. Hillier and Gerald J. Lieberman, 2010,"Introduction to Operations Research ", Nineth Edition, McGraw-Hill Companies, New Delhi. |
| | 2. | Kandiswarup, Gupta P.K and Man Mohan, 1998,"Operations Research", S. Chand & Sons Education Publications, New Delhi. |
| | 3. | Ravindran, Phillips D.T and Solberg J.J, 2005, "Operations Research-Principles and Practice", John Wiley & Sons, New Jersey. |
| | 4. | Er Prem Kumar Gupta and Dr. D. S. Hira , "Introduction to Operations Research", Revised Edition, S. Chand & Company Pvt Ltd., New Delhi. |

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| **Journal and Magazines** | https://www.worldscientific.com/worldscinet/bms |
| **E-Resources and Website** | https://nptel.ac.in |

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|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar |

| | |
|---|---|
| **Focus of the Course** | Skill Development/ Employability |

| Semester – I<br>DSE: MATHEMATICAL MODELING | | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Name | Category | L | T | P | Credits |
| I | 26MTP1DA | MATHEMATICAL MODELING | DSE | 48 | - | - | 4 |

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|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• the deterministic states and analysis of models<br>• the stochastic analysis of models<br>• various evolution of models |
| **Prerequisite** | Knowledge on calculus, linear algebra and differential equations |

| Course Outcomes (Cos) | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | discuss the Deterministic analysis of observations. | K2 |
| CO2 | Apply Chebyshev error criteria and construct optimal linear and nonlinear models | K3 |
| CO3 | Analyze the concept of dimensional analysis and similarity in different complexity | K5 |
| CO4 | Apply the concept of probability density function to define stochastic states. | K4 |
| CO5 | Develop hybrid models combining deterministic and stochastic changes for real-world systems | K6 |

| Mapping with Program Outcomes: | | | | | |
|---|---|---|---|---|---|
| Cos / POs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | S | S | S | M | M |
| CO2 | S | M | S | M | M |
| CO3 | M | S | M | S | M |
| CO4 | M | M | S | S | M |
| CO5 | M | S | M | S | S |

| 26MTP1DA | DSE: MATHEMATICAL MODELING |
|---|---|

**Syllabus**

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **Deterministic Analysis of Observations**<br>Data transformations: Linear models – Model development: Polynomial models – Model Evaluation: Population modeling – The Advantage of Modeling: Global warming modeling. | 10 | Text Book |
| II | **Stochastic Analysis of Observations**<br>Model Errors – The Chebyshev Error – Optimal Linear models – Optimal Quadratic models – Optimal Power and Exponential models. | 10 | Text Book |
| III | **Deterministic States**<br>Dimensional Analysis and Similarity - Applications of Low-Complexity – Applications of Medium Complexity – Time measurement – Applications of High Complexity: Lift. | 10 | Text Book & You Tube Videos |
| IV | **Stochastic States**<br>Probability Density Functions – Models for Probability Density Functions – Data Analysis – Real Distribution. | 9 | Text Book |
| V | **Deterministic and Stochastic Changes**<br>Linear Changes - Linear Changes with Delays - Linear Stochastic Changes - Diffusion - Brownian Motion Model. | 9 | Text Book & Reference Book |
| | **Total** | 48 | |

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|---|---|---|
| **Text book** | 1. | Stefen Heinz, 2011,"Mathematical Modeling", Springer-Verlag, New York. |
| **Reference Books** | 1. | Kapur J.N., 1998, "Mathematical Modeling", New Age International (P) Limited, New Delhi. |
| | 2. | Crossand and Moscrcadini A.O, 1976,"The Art of Mathematical Modeling", Ellis Harwood and John Wiley, New York . |
| | 3. | Sarah. P. Otto and Troy Day, 2000, "A Biologist guide to Mathematical Modeling in Ecology and Evolution", Princeton University Press, Princeton. |
| | 4. | Frank. R.Glordance, Maurice D. Weir and William P.Fox, 2003, "A First course in Mathematical Modeling", Thomson Learning, London.. |

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| **Journal and Magazines** | https://www.sciencedirect.com/journal/applied-mathematical-modelling |
| **E-Resources and Website** | https://en.wikipedia.org/wiki/Mathematical_model#:~:text=A%20mathematical% |

| | |
|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar |

| | |
|---|---|
| **Focus of the Course** | Skill Development/ Employability |

| Semester – I<br>DSE: COMMUTATIVE ALGEBRA | | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Name | Category | L | T | P | Credits |
| I | 26MTP1DB | COMMUTATIVE ALGEBRA | DSE | 48 | - | - | 4 |

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|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• the concepts of ideals and modules through examples<br>• the properties to decompose the Noetherian and Artin rings<br>• the importance of dimension theory of rings and modules |
| **Prerequisite** | Knowledge on Modern Algebra |

| Course Outcomes (Cos) | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | Apply operations on ideals and submodules to solve algebraic problems | K3 |
| CO2 | Evaluate the uniqueness and structure of primary decompositions | K2 |
| CO3 | Evaluate the behavior of ideals under integral extensions | K5 |
| CO4 | analyze the importance of discrete valuation of rings and dedekind domains | K4 |
| CO5 | Construct advanced algebraic models using completion techniques and dimension theory | K6 |

| Mapping with Program Outcomes: | | | | | |
|---|---|---|---|---|---|
| Cos / POs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | S | S | S | S | S |
| CO2 | S | M | S | S | S |
| CO3 | S | S | M | S | S |
| CO4 | S | S | S | S | S |
| CO5 | S | S | M | S | S |

| 26MTP1DB | DSE: COMMUTATIVE ALGEBRA |
|---|---|

## Syllabus

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **Rings and Ideals**<br>Rings and ring homomorphisms - ideals - quotient rings - zero divisors, nilpotent elements, units - prime ideal and maximal ideals - nilradical and Jacobson radical - operations on ideals - extension and contraction.<br>Modules: modules and module homomorphisms – submodulus and quotient modulus - operations on submodules - finitely generated modulus. | 09 | Text Book |
| II | **Rings, modules of fractions and primary decomposition**<br>Local properties - extended and contracted ideals in rings of fractions - primary decomposition. | 09 | Reference Book |
| III | **Integral dependence and valuations**<br>Integral dependence - the going up theorem -Integrally closed integral domains - the going down theorem - valuation rings - Chain conditions. | 09 | Text Book |
| IV | **Noetherian rings, artin rings, Discrete valuation rings and Dedekind domains**<br>Primary decomposition in Noetherian rings - artin rings - structure theorem for artin rings - discrete valuation rings - dedekind domains - fractional ideals. | 09 | Text Book /NPTEL |
| V | **Completions and Dimension Theory**<br>Topologies and completions - filtrations - graded rings and modules - the associated graded ring - Hilbert functions - dimension theory of Noetherian local rings - regular local rings - transcendental dimension. | 12 | Text Book /You Tube Videos |
| | **Total** | **48** | |

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|---|---|---|
| **Text book** | 1. | Atiyah-Macdonald, 1994, "Commutative Algebra", Westview Press, London. |
| **Reference Books** | 1. | Zariski and Samuel, 1991, "Commutative Algebra I, II", Springer, New York. |
| | 2. | Eisenbud, 1995, "Commutative Algebra with a View Towards Algebraic Geometry", Springer, New York. |
| | 3. | Bourbaki, 1989, "Commutative Algebra", Springer, New York. |
| | 4. | Herstein I N, 2000, "Topics in Algebra", Second Edition, John Wiley and Sons, New Jersey. |

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| **Journal and Magazines** | https://www.worldscientific.com/worldscinet/bms |
| **E-Resources and Website** | https://nptel.ac.in |

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|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar |

| | |
|---|---|
| **Focus of the Course** | Skill Development/Employability |

| Semester – I<br>DSE: DIFFERENTIAL GEOMETRY | | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Name | Category | L | T | P | Credits |
| I | 26MTP1DC | DIFFERENTIAL GEOMETRY | DSE | 48 | - | - | 4 |

| | |
|---|---|
| **Preamble** | This course has been designed for students to learn and understand<br>• The fundamental concepts of differential geometry of surfaces<br>• It provides knowledge on intrinsic and extrinsic properties, geodesics, curvature, and special types of surfaces.<br>• To develop analytical skills to study and apply geometric properties of surfaces. |
| **Prerequisite** | Basic knowledge of calculus, vector algebra, and three-dimensional coordinate geometry |

| Course Outcomes (Cos) | | |
|---|---|---|
| **CO Number** | **Course Outcomes (COs) Statement** | **Bloom's Taxonomy Knowledge Level** |
| CO1 | Construct and study surfaces of revolution and helicoids | K3 |
| CO2 | Derive and apply canonical geodesic equations in surface geometry | K3 |
| CO3 | Analyze geodesic curvature, apply the Gauss–Bonnet theorem, and evaluate Gaussian curvature, surfaces of constant curvature, conformal mapping and geodesic mapping | K4 |
| CO4 | Evaluate the geometric significance of the Dupin indicatrix | K5 |
| CO5 | Design and model developable surfaces for applications in geometry and engineering | K6 |

| Mapping with Program Outcomes: | | | | | |
|---|---|---|---|---|---|
| **Cos / POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | S | S | S | S | S |
| CO2 | S | M | S | S | M |
| CO3 | S | S | M | M | S |
| CO4 | M | S | S | S | M |
| CO5 | S | M | S | M | S |

| 26MTP1DC | DSE: DIFFERENTIAL GEOMETRY |
|---|---|

## Syllabus

| Unit | Content | Hrs | Resources |
|---|---|---|---|
| I | **The First Fundamentals Form and Local Intrinsic Properties of a Surface**<br>Introduction – Definition of a surface – Nature of points on a surface – Representation of a surface – Curves on surface – Tangent plane and surface normal – The general surface of revolution - Helicoids - metric on a surface –The first fundamental form - Direction coefficients on a surface - Orthogonal Trajectories – Double family of curves - Isometric correspondence - Intrinsic properties. | 10 | Text Book |
| II | **Geodesics on a Surface**<br>Introduction - Geodesics and their differential equations - Canonical geodesics equations - Geodesics on surfaces of revolution - Normal property of geodesics – Differential equations of geodesics using normal property – Existence theorems – Geodesics parallels – Geodesic polar coordinates. | 10 | Text Book |
| III | **Geodesic curvature**<br>Geodesics curvature - Gauss–Bonnet theorem - Gaussian Curvature – Surface of constant curvature – Conformal mapping – Geodesic mapping. | 9 | Text Book |
| IV | **Second Fundamental Form and Local Non-intrinsic Properties of a surface**<br>Introduction – The second fundamental form - Classification of points on a surface - Principle curvatures – Line of curvature – The Dupin indicatrix. | 10 | Text Book |
| V | **Developable Surfaces**<br>Developable surfaces - developable associated with space curves and curves on surfaces - minimal surfaces – Ruled surfaces – Three fundamental forms. | 9 | Text Book |
| | **Total** | **48** | |

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|---|---|---|
| **Text book** | 1. | Somasundaram D, 2014, "Differential Geometry A first course", Narosa Publishing House, New Delhi. |
| **Reference Books** | 1. | Struik D.J, 1961, "Lectures on Classical Differential Geometry", 2nd Edition, Dover Publications, New York. |
| | 2. | Venkatachalam, S.G, 2012, "Differential Geometry", Margham publications, Chennai. |
| | 3. | Spivak M, 1999, "A Comprehensive Introduction to Differential Geometry", 3rd Edition, Peris, Houston. |
| | 4. | Barrett Neill, 2006, "Elementary Differential Geometry", Revised 2nd Edition, Academic Press, New York. |

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| **Journal and Magazines** | https://www.sciencedirect.com/journal/differential-geometry-and-its-applications |
| **E-Resources and Website** | https://learn.mit.edu/c/unit/ocw?resource=4396<br>https://www.youtube.com/watch?v=ByZ9AFXsWRc |

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|---|---|
| **Learning Method** | Chalk and Talk/Assignment/Seminar/ Group Discussion |

| | |
|---|---|
| **Focus of the Course** | Skill Development/ Employability |

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APPROVED

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