GAUHATI UNIVERSITY

FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)(Major)

SUBJECT: MATHEMATICS
Syllabus: Version-I

Programme Code: MAT027

Programme name	Eligibility Criteria of the programme, if any	Semester	Course name	Course code	credits	Credit distribution of the course			Pre-requisite of the course (if any)	Internal marks	External Marks
						Lecture	Tutorial	Practical			
FYUGP in Mathematics	Nil	1	**Classical Algebra**	MAT0100104	4	4	0	0	Mathematics in 10+2 or equivalent standard	40	60
		2	**Calculus**	MAT0200104	4	4	0	0	Do	40	60
		3	**Ordinary Differential Equations**	MAT0300104	4	4	0	0	MAT020104	40	60
			Abstract Algebra	MAT0300204	4	4	0	0	Do	40	60
		4	**Real analysis**	MAT0400104	4	4	0	0	Mathematics in 10+2 or equivalent standard	40	60
			Complex Analysis-I (with practical)	MAT0400204	4	3	0	1	Mathematics in 10+2 or equivalent standard	Practical 25+Internal 30	45

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			Analytical Geometry	MAT0400304	4	4	0	0	Do	40	60
			Number Theory-I	MAT0400404	4	4	0	0	Do	40	60
		5	**Multivariate Calculus**	MAT0500104	4	4	0	0	MAT0200104	40	60
			Theory of Real Functions	MAT0500204	4	4	0	0	MAT0400104	40	60
			Numerical Analysis-I (with practical)	MAT0500304	4	3	0	1	Mathematics in 10+2 or equivalent standard	Practical 25+Internal 30	45
		6	**Linear Algebra**	MAT0600104	4	4	0	0	MAT0300204	40	60
			Partial Differential Equations (with practical)	MAT0600204	4	3	0	1	MAT0300104	Practical 25+Internal 30	45
			Metric Spaces	MAT0600304	4	4	0	0	MAT0400104	40	60
			Mechanics	MAT0600404	4	4	0	0	Mathematics in 10+2 or equivalent standard	40	60
Honours/ Honours with Research		7	**Algebra**	MAT0700104	4	4	0	0	MAT0500104	40	60
			Real Analysis and Lebesgue Measure	MAT0700204	4	4	0	0	MAT0400104 & MAT0500204	40	60
			Complex Analysis-II	MAT0700304	4	4	0	0	MAT0400204	40	60

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			Differential Equations	MAT0700404	4	4	0	0	MAT0300104 & MAT0600204	40	60
			Research Methodology	MAT0700504	4	4	0	0	Nil	40	60
Honours		8	**Topology**	MAT0800104	4	4	0	0	MAT0400104	40	60
			Number Theory-II	MAT0800204	4	4	0	0	MAT0400404	40	60
			Mechanics and Tensor Calculus	MAT0800304	4	4	0	0	MAT0600404	40	60
			Mathematical Methods	MAT0800404	4	4	0	0	MAT0500304	40	60
			Seminar/ Project	MAT0800504	4	4	0	0		40	60
Honours with Research		8	**Dissertation**	MAT0800116	16						
			Seminar/ Project	MAT0800204	4					40	60

Programme Specific Outcomes:

PSO1: Demonstrate mathematical ability effectively by oral, written, computational and graphical means.

PSO2: Measure the hypothesis, theories, techniques and proofs provisionally through analytic ability.

PSO3: Utilize mathematics to solve theoretical and applied/ real world problems by critical understanding, analysis and synthesis.
PS04: Develop a spirit of lifelong learning through continued education and research.

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SEMESTER-I

MAT0100104: Classical Algebra

Total Marks: 100 (External 60, Internal Assessment 40)
No. of Credits: 4
No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard

Course Outcomes:

The students who take this course will be able to:

CO1 Identify symmetric functions of the roots for cubic and biquadratic equations, solve cubic and biquadratic equations.

CO2 Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix and calculate the inverse and rank of a matrix.

CO3 Classify and compute the nature of the roots of a given polynomial equation by Descartes' rule

CO4 Express the basic concepts of exponential, logarithmic and hyperbolic functions of complex numbers.

CO5 Apply De Moivre's theorem in a number of applications to solve numerical problems.

UNIT 1: Polar representation of complex number, De Moivre's theorem (both integral and rational index), Roots of complex numbers, n^{th} roots of unity, Application of De Moivre's Theorem, Exponential and logarithmic functions of complex numbers, Hyperbolic functions.

[1] Chapter 2 (Sections 2.7-2.13, 2.16)

(No. of classes: 20, Marks: 20)

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UNIT 2: Algebraic equations: Deduction from Fundamental Theorem of Classical Algebra, Descartes' rule of signs, relation between roots and coefficients of a polynomial equation of degree n, symmetric functions of roots, Transformation of equations, Cardon's method of solution of a cubic equation, Euler's method of solution of a biquadratic equation.

[1] Chapter 5; Theorem 5.1.1, Theorem 5.2.1, Section 5.3 - 5.6, 5.11,5.12.

(No. of classes: 20, Marks: 20)

UNIT 3: Matrix Algebra, Addition, Transposition, Symmetry, Multiplication of matrices and their properties, Matrix inversion and properties, Row Echelon form and Rank of a matrix, Reduced row Echelon form, Consistency of linear systems, Solutions of system of homogeneous linear equations with number of equations and unknowns up to four.

[2] Chapter 3 (Sections 3.2, 3.5, and 3.7) Chapter 2 (Sections 2.1 to 2.4)

(No. of classes: 20, Marks: 20)
Text Books:

1. Mappa, S.K., Higher Algebra (Classical), Revised 8th Edition, 2011, Levant Books.

2. Meyer, Carl D. (2000). Matrix Analysis and Applied Linear Algebra. Society for Industrial and Applied Mathematics (Siam).

Reference Books:

1. Dickson, Leonard Eugene (2009). First Course in The Theory of Equations. The Project Gutenberg eBook (http://www.gutenberg.org/ebooks/29785)

2. Gilbert, William J., & Vanstone, Scott A. (1993). Classical Algebra (3rd ed.). Waterloo Mathematics Foundation, Canada.

3. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser,2006.

SEMESTER-1
SEC0100103: C Programming
Total Marks: 75 (Theory 30, Practical 25, Internal-20)
No of Credit: 3(2+1)
No of Contact hours: 2 Lectures 1 Practical.

Course Objectives: This course introduces C programming in the idiom and context of mathematics and imparts a starting orientation using available mathematical libraries, and their applications.

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Course Learning Outcomes: After completion of this paper, student will be able to:

i) Understand and apply the programming concepts of C which is important to mathematical investigation and problem solving.

ii) Learn about structured data-types in C and learn about applications in factorization of an integer and understanding Cartesian geometry and Pythagorean triples.

iii) Use of containers and templates in various applications in algebra.

iv) Use mathematical libraries for computational objectives.

v) Represent the outputs of programs visually in terms of well formatted text and plots.

vi) In practical students learn about the roots of a quadratic equation, solution of an equation using N-R algorithm.

Unit 1: Variables, constants, variable declaration, initialization, basic data types, operators and expression (arithmetic, relational, logical, assignment, conditional, increment and decrement), hierarchy of operations for arithmetic operators, size of and comma operator, mixed mode operation and automatic (implicit) conversion, cast (explicit) conversion, library functions, structure of a C program, input/output functions and statements.

No of contact hours: 10

Unit 2: Control Statements: if-else statement (including nested if-else statement), switch statement. Loop control Structures (for and nested for, while and do-while). Break, continue, go to statements, exit function. **No of contact hours: 10**

Unit 3: Arrays and subscripted variables: One dimensional array declaration, accessing values in an array, initializing values in an array, sorting of numbers in an array, addition and multiplication of matrices with the help of array. **No of contact hours: 10**

Programmes for practical:
To find roots of a quadratic equation, value of a piecewise defined function (single variable), factorial of a given positive integer, Fibonacci numbers, square root of a number, cube root of a number, sum of different algebraic and trigonometric series, a given number to be prime or not, sum of the digits of any given

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positive integer, solution of an equation using N-R algorithm, reversing digits of an integer. Sorting of numbers in an array, to find addition, subtraction and multiplication of matrices.

[1] Chapters 3, 4, 5, 6, 7 and 9 **No of contact hours: 15**

Text Book:

1. T. Jeyapoovan, A First Course in Programming with C T. Jeyapoovan, Vikash Publishing House Pvt.Ltd.

Reference books:

1. E. Balaguruswamy, Programming with C, Schaum Series.
2. Y. Kanetkar, *Let us C*, B.P. Publication.

SEMESTER-II

MAT0200104: Calculus

Total Marks: 100 (External: 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard

Course Outcomes: The students who take this course will be able to:

CO1 Describe asymptotic behavior in terms of limits involving infinity.

CO2 Recognize function of two variables and operate the partial derivatives.

CO3 Express continuity and differentiability in terms of limits.

CO4 Calculate integrations which can be solved by reduction formula

CO5 Use the mean value theorems.

UNIT 1: Limits and continuity of a function including different approaches, Properties of continuous functions including Intermediate value theorem.

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[1] Chapter 1

(No. of classes: 15, Marks: 15)

UNIT 2: (a) Differentiability, Successive differentiation, Leibnitz theorem, Recursion formulae for higher derivatives.

(b) Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n\,dx$, $\int \sin^n x \cos^m x\,dx$.

[2] Chapter 5(for part (a))

[3] Chapter 4 (4.1-4.6) (only for part (b))

(No. of classes: 15, Marks: 15)

UNIT 3: Rolle's theorem, Lagrange's mean value theorem with geometrical interpretations and simple applications, Maclaurin and Taylor polynomials and their sigma notations. Taylor's formula with remainder, Introduction to Maclaurin and Taylor series.

[1] Chapter 9 (Sections 9.8 and 9.9 (without 'convergence' part))

[2] Chapter 6

(No. of classes: 15, Marks: 15)

UNIT 4: Functions of two or more variables, Partial differentiation up to second order, Euler's theorem on homogeneous functions

[1] Chapter 13 (Sections 13.1 and 13.3)

[2] Chapter 10(10.81)

(No. of classes: 15, Marks: 15)

Text books:

[1] Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). Calculus (10th ed.). John Wiley & Sons Singapore Pte. Ltd. Reprint (2016) by Wiley India Pvt. Ltd. Delhi

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[2] Shanti Narayan and P.K. Mittal, Differential Calculus, S. Chand, 2005

[3] Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand, 2007.

Reference book:

[1] Thomas, Jr. George B., Weir, Maurice D., & Hass, Joel (2014). Thomas' Calculus (13th ed). Pearson Education, Delhi. Indian Reprint 2017.

SEMESTER-2
SEC02006803: LaTeX

Total marks: 75 (Theory 45, Practical 30)

No of Credit: 3 (2+1)

Contact hour class: 2 Lectures, 1 Practical

Course Objectives: The purpose of this course is to acquaint students with the latest type setting skills, which shall enable them to prepare high quality typesetting, beamer presentation.

Course Learning Outcomes: After studying this course, the student will be able to:

i) Create and typeset a LaTeX document.

ii) Typeset a mathematical document using LaTeX.

iii) Learn about pictures and graphics in LaTeX.

iv) Create beamer presentations.

Unit 1: Elements of LaTeX; Hands-on-training of LaTeX **No of contact hours: 10**

Unit-2: Graphics in LaTeX; PS Tricks **No of contact hours: 10**

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Unit-3: Beamer presentation **No of contact hours: 10**

[1] Chapter 9, [1,2] Chapter 10, [3] Chapter 11.

Practical: At least six practicals should be done by each student. The teacher can assign practical from the exercises from [1] No of contact hours: 15

Text Book:

1. Martin J. Erickson and Donald Bindner, A Student's Guide to the Study, Practice, and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011.

Reference Book:

1. L. Lamport, LATEX: A Document Preparation System, User's Guide and Reference Manual. Addison- Wesley, New York, second edition, 1994.

SEMESTER-III

MAT0300104: Ordinary Differential Equations

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: MAT0200104

Course Outcomes:

CO1 Identify 1st order ordinary differential equations like exact first order differential equations, Bernoulli equations and rules of finding integrating factors of exact equations.

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CO2 Recognize the second order differential equations like homogenous equations with constant coefficients equations, non-homogenous equations and Cauchy-Euler equations

CO3 Solve first order and second order differential equations

CO4 Calculate Wronskian and show its properties.

CO5 Use the method of undetermined coefficients, variation of parameters.

UNIT 1: **First Order Ordinary Differential Equations**

Classification of differential equations; their origin and application. Solutions. First order exact differential equation. Integrating factors, Rules to find an integrating factor.

[1] Chapter 1(Sections 1.1and 1.2) Chapter 2 (Sections 2.1, 2.2 and 2.4)

Linear equations and Bernoulli equations. Basic theory of higher order linear differential equations. Solving differential equation by reducing its order. Wronskian and its properties.

[1] Chapter 2 (Section 2.3), Chapter 4 (Sections 4.1 and 4.6)

(No. of classes: 30, Marks: 30)

UNIT 2: Second Order Linear Differential Equations

Linear homogenous equations with constant coefficients. Linear non- homogenous equations; the method of undetermined coefficients, the method of Variation of Parameters. The Cauchy-Euler equations.

[1] Chapter 4 (Sections 4.2, 4.3, 4.4 and 4.5)

(No. of classes: 30, Marks: 30)

Text Book:

[1] Ross, Shepley L. (1984). Differential Equations (3rd Ed.), John Wiley & Sons,Inc.

Reference Book:

1.Kreyszig, Erwin (2011). Advanced Engineering Mathematics(10th ed.).John Wiley & Sons, Inc. Wiley India Edition 2015.

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MAT0300204: Abstract Algebra

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard

Course Outcomes:

CO1	Recognize the mathematical objects called group, ring and fields.
CO2	Associate the fundamental concepts of groups and symmetries of geometrical objects.
CO3	Explain the significance of the notion of Permutation groups, cosets, cyclic groups, normal subgroups, factor groups.
CO4	Analyse consequences of Lagrange's theorem and Fermat's Little theorem.
CO5	Describe structure preserving mappings between groups and their consequences.
CO6	Describe the fundamental concepts in ring theory such as of the subrings, integral domains, ideals, factor rings and fields.

Unit 1: Definition and examples of groups, Elementary properties of groups, Symmetries of a square, Dihedral groups, order of a group, Order of an element in a group, Subgroups, Subgroup Tests, Subgroup generated by an element of a group, Centre of a group, Centralizer of an element in a group, Cyclic groups, Properties of cyclic groups, Fundamental theorem of cyclic groups.

[1] Chapter 1 to Chapter 4.

(No. of classes: 15, Marks: 15)

Unit 2: Permutations, Permutation group, Properties of permutations, Even and odd permutations, Alternating groups, Cosets, Properties of cosets, Lagrange's Theorem, Fermat's Little Theorem, Normal subgroups, Factor groups.

[1] Chapter 5 (up to theorem 5.7), Chapter 7 (up to theorem 7.2), Chapter 9 (up to theorem 9.2)

(No. of classes: 15, Marks: 15)

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Unit 3: Isomorphism of groups, Cayley's Theorem, Properties of isomorphism, Group homomorphism, Kernal of a group homomorphism, Properties of group homomorphism, First isomorphism Theorem of groups.

[1] Chapter 6 (up to theorem 6.3), Chapter 10 (up to theorem 10.4).

(No. of classes: 15, Marks: 15)

Unit 4: Rings, Examples of rings, Properties of rings, Subrings, Zero-Divisors in a ring, Integral domains, Fields, Characteristic of a ring, Ideals, Ideal Test, Factor rings, Prime ideals and maximal ideals of a ring.

[1] Chapter 12 to Chapter 14.

(No. of classes: 15, Marks: 15)

Text Books:

1. Gallian Joseph A., *Contemporary Abstract Algebra* (8th Edition) , Cengage Learning India Private limited, Delhi, Fourth impression, 2015.

Online link: https://ict.iitk.ac.in/wp-content/uploads/CS203-Mathematics-for-Computer-Science-III-Gallian.pdf

Reference Books:

1. David S. Dummit and Richard M. Foote, *Abstract Algebra* (2nd Edition) , John Wiley and Sons (Asia) Pvt. Ltd. , Singapore, 2003.

2. John B. Fraleigh, *A First course in Abstract Algebra*, 7th Edition, Pearson, 2002.

3. G. Santhanam. *Algebra,* Narosa Publishing House, 2017.

SEMESTER-3

SEC0316303: Computer Algebra Systems and Related Software

Total marks:75 (External 45, Practical 30)

No of Credits 3(2+1)

No of contact classes: (2: Lectures, 1 Practical)

No of noncontact classes: 0

Course Objectives: This course aims at familiarizing students with the usage of mathematical software (Mathematica/MATLAB/Maxima/Maple) and the statistical software **R**. The basic emphasis is on plotting and working with matrices using CAS. Data entry and summary commands will be studied in **R**. Graphical

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representation of data shall also be explored.

Course Outcomes: This course will enable the students to:

(i) Use of software; Mathematica/MATLAB/Maxima/Maple, etc. as a calculator, for plotting functions and animations.

(ii) Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigen vectors.

(iii) Understand the use of the statistical software **R** as calculator and learn to read and get data into **R.**

(iv) Apply **R** in summary calculation, pictorial representation of data and exploring relationship between data.

(v) Analyze, test, and interpret technical arguments on the basis of geometry

Unit 1: Introduction to CAS and Applications:

Computer Algebra System (CAS), Use of a CAS as a calculator, Computing and plotting functions in 2D, plotting functions of two variables using Plot 3 D and Contour Plot, plotting para metric curves surfaces, customizing plots, animating plots, producing tables of values, working with piecewise defined functions, Combining graphics.

[1] Chapter 12 (Sections 12.1 to 12.5)

[2] Chapter1, and Chapter 3 (Sections 3.1to 3.6, and 3.8) Chapter 6(Sections 6.2 and 6.3) **(No. of classes: 15)**

Unit 2: Working with Matrices:

Simple programming in a CAS, working with matrices, addition, subtraction, multiplication of matrices, Minors and cofactors, working with 3x3 matrices, Solving system of linear equations of three variables.

[2] Chapter7(Sections7.1to7.8) **(No. of classes: 15)**

Practical:

Six practicals should be done by each student. The teacher can assign practical from the exercises from [1,2].

(No. of classes: 15)

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Text Book:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Torrence, Bruce F., & Torrence, Eve A. (2009). *The Student's Introduction to Mathematica*: *A Handbook for Precalculus, Calculus and Linear Algebra* (2nd ed.). Cambridge University Press

SEMESTER-IV

MAT0400104: Real analysis

Total Marks: 100 (External60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard

Course Outcomes:

CO1 Identify the properties of the real line *R*, including completeness and Archimedean properties.

CO2 Define sequences in terms of functions from *N* to a subset of *R*.

CO3 Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.

CO4 Distinguish alternating series and infer absolute convergence of an infinite series of real numbers.

CO5 Apply limit comparison tests for convergence, the ratio, root, Raabe's, integral tests for convergence of an infinite series of real numbers.

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UNIT 1: Algebraic and order properties of R, absolute value and real line, bounded sets, supremum and infimum, completeness property of R, the Archimedean property, the density theorem, intervals, Nested interval theorem, uncountability of R.

[1] Chapter 2

(No of classes: 15, Marks: 15)

UNIT 2: Real sequences, limit of a sequence, convergent sequence, bounded sequence, limit theorems, monotone sequences, monotone convergence theorem, subsequences, monotone subsequence theorem, Bolzano Weierstrass theorem for sequences, Cauchy sequences, Cauchy's convergence criterion, properties of divergence sequences.

[1] Chapter 3

(No of classes: 20, Marks: 20)

UNIT 3: Infinite series, convergence and divergence of infinite series, Cauchy criterion, Tests for convergence: comparison test, limit comparison test, ratio test, root test, integral test, Raabes's test, Absolute convergence, rearrangement theorem, alternating series, Leibniz test, conditional (non-absolute) convergence.

[1] Chapter 3: Section: 3.7, Chapter 9: Sections: 9.1-9.3.

(No of classes: 25, Marks: 25)

Text Book:

1. R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons, 2002.

Reference Books:

1. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, *An Introduction to Analysis,* Jones &Bartlett, Second Edition, 2010.
2. A. Kumar and S. Kumaresan, *Basic Course in Real Analysis*, CRC Press, 2014.
3. K.A. Ross, *Elementary Analysis*: *The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

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SEMESTER-IV

MAT0400204: Complex Analysis-I (with practical)

Total Marks: 100

(External:45, Practical 25, InternalAssessment:30)

No. of Credits: 4 (Theory 3, Practical 1)

No. of Contact classes: 75 (45+30×1)

No. of Non-Contact classes: 0

Prerequisites: Knowledge on

- complex number system as the extension of real number system
- Algebra of complex numbers.
- Properties of complex number.
- Modulus, argument and geometrical representation of complex numbers

Course Outcomes:

CO1 List some elementary functions and evaluate the contour integrals.

CO2 State Cauchy−Goursat theorem and the Cauchy integral formula

CO3 Discuss the differentiability of complex functions

CO4 Explain the concept of Cauchy-Riemann equations.

CO5 Apply Cauchy-Riemann equations, Cauchy−Goursat theorem and the Cauchy integral formula.

UNIT1: Functions of complex variable, mappings, limits, theorems on limits, limits involving point at infinity, continuity. Derivatives, rules for differentiation, Cauchy-Riemann equations, sufficient conditions for differentiability, polar co-ordinates.

[1]: Chapter 2(Section 13, 14, 15,16,17, 18,19,20, 21,22,23,24)

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(No. of classes: 10, Marks: 15)

UNIT 2: Analytic functions, examples of analytic functions, harmonic function. The exponential function, Logarithmic function, examples, branches and derivatives of logarithms, some identities involving logarithms, the power function. Trigonometric function, zeros and singularities of trigonometric functions derivatives of functions, definite integrals of functions.

[1]:Chapter2(Sections25, 26,27),Chapter3(Sections30, 31,32,33,34, 35,36,37,38),Chapter4(Section41,42)

(No. of classes: 15, Marks: 10)

UNIT 3: Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, antiderivatives, proof of antiderivative theorem.

[1]: Chapter 4 (Section43, 44, 45,47, 48, 49)

(No. of classes: 10, Marks: 10)

UNIT4: Cauchy-Goursattheorem, simply connected domains, multiply connected domains, Cauchyintegralformula, extension of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.

[1]:Chapter4(Sections50, 52,53,54, 55, 58)

(No. of classes: 10, Marks: 10)

LAB WORK TOBEPERFORMEDONACOMPUTER

(MODELINGOFTHEFOLLOWINGPROBLEMSUSINGMATLAB/MATHEMATICA/MAPLEetc.)

1. Declaring a complex number and graphical representation. e.g. $Z_1=3+4i, Z_2= 4-7i$

2. Program to discuss the algebra of complex numbers,e.g.,

$Z_1=3+4i, Z_2=4-7i$,thenfind$Z_1+Z_2, Z_1-Z_2, Z_1*Z_2andZ_1/ Z_2$

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3. To find conjugate, modulus and phase angle of an array of complex numbers.

e.g.Z= [2+ 3i,4-2i, 6+11i,2-5i]

4. To compute the integral over a straight line path between the two specified end points.

e. g., $\oint \text{Sin} z dz$, along the contour C which is a straight line pathfrom-1+ ito2 -i.

5. To perform contour integration.,e.g.,

(i) $\oint (z^2-2z+1)dz$ along the Contour C given by $x=y^2+1; -2\leq y\leq 2$.

(ii) $\oint (z^3+2z^2+1)dz$ along the contour C given by$x^2+y^2=1$,which can be parameterized by

$x = \cos(t)$, $y= \sin(t)$for $0\leq y\leq 2\pi$.

6. To plot the complex functions and analyze the graph.e.g.,

$f(z)=z, iz, z^2, z^3, e^zand(z^4-1)^{1/4}$,etc

(No. of practical classes: 30, Marks: 25)

Text Book:

1. James Ward Brown and Ruel V. Churchill ,Complex Variables and Applications (NinthEdition),McGraw-Hill Indian Edition, 2021.

ReferenceBook:

1. Joseph Bak and Donald J. Newman,*Complex analysis* (2ndEdition),Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.

2. M.R. Spiegel, *Complex Variables*. Schaum's Outlines series, McGraw Hill Education, 2017

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SEMESTER-IV

MAT0400304: Analytical Geometry

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard

Course Outcomes:

CO1 Define Vector Algebra and represent the use of geometric view of vectors in Coordinate Geometry.

CO2 Recognize three dimensional surfaces represented by equations of the second degree

CO3 Change the coordinate systems

CO4 Explain pair of straight lines, conic sections and related properties

CO5 Express systems of coordinates which are very useful to define the position of a point in space

UNIT 1: Transformation of coordinates, invariants under orthogonal transformations, pair of straight lines.

[1] Chapter 1 (Section 1.3), Chapter 2, Chapter 3

(No. of classes: 15, Marks: 15)

UNIT 2: Parabola, parametric coordinates, tangent and normal, ellipse and its conjugate diameters with properties, hyperbola and its asymptotes, General conics: tangent, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, reduction to standard forms, central conics, equation of the axes, and length of the axes, polar equation of a conic, tangent and normal, and properties.

[1] Chapters 4, 5, 6, 7, 9 (upto Section 9.43)

(No. of classes: 15, Marks: 15)

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UNIT 3: Quadric surfaces:Sphere, Cylinder and Cone. Cylindrical and spherical polar coordinates.

[1] Chapter 6 (Section 6.1 – 6.3), Chapter 12

(No. of classes: 15, Marks: 15)

UNIT 4: Rectangular coordinates in 3-space, Vector viewed geometrically, Vectors in coordinates system, Vectors determined by length and angle, Dot product, Cross product and their geometrical properties, Triple product, Parametric equations of lines in 2-space and 3-space.

[2] Chapter 11 (Section 11.1 - 11.5)

(No. of classes: 15, Marks: 15)

Text Books:

1. R.M. Khan, Analytical Geometry of two and three dimensions and Vector Analysis. New Central Book Agency, 2012.

2. Anton, Howard, Bivens, Irl, & Davis, Stephen (2013), Calculus (10th ed.). John Wiley & Sons, Singapore Reprint (2016) by Wiley India Pvt. Ltd., Delhi.

Reference Book:

1. R.J.T. Bell, Coordinate Solid Geometry, Macmillan, 1983.

2. E.H. Askwith, The Analytical Geometry of the Conic Sections, Nabu Press (27 February 2012)

3. B. Das, Analytical Geometry and Vector Analysis, Orient Book Company, Kolkata -700007

SEMESTER-IV

MAT0400404: Number Theory-I

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

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Prerequisites: Mathematics in 10+2 or equivalent standard

Course Outcomes:

CO1	State Fermat's theorem and Wilson's theorem and use them to solve problems
CO2	Explain division algorithm, Euclid's algorithms , greatest common divisor, the concepts of congruences, linear congruences
CO3	Explore the Chinese Remainder theorem to solve simultaneous linear congruences.
CO4	Apply mathematical ideas and concepts within the context of number theory.
CO5	Summarize number theoretic techniques to a mathematical audience.

UNIT 1: Well-Ordering Principle of integers, Archimedian property, First principle of finite induction, Second principle of finite induction, The division algorithm of integers, The greatest common divisor, The Euclidean algorithm, The Diophantine equation $ax + by = c$, Fundamental Theorem of Arithmetic, The sieve of Eratosthenes, The Goldbach Conjecture.

[1] Chapter 1 (Sections 1.1), Chapter2 (sections 2.2 -- 2.5), Chapter3.

(No of classes:20, Marks:20)

UNIT 2: Congruence modulo of a fixed positive integer, Basic properties of congruences, Binary and decimal representation of integers, Linear congruences, Chinese Remainder Theorem, Fermat's Little Theorem, pseudoprimes, Wilson's Theorem.

[1] Chapter 4 (Sections 4.2-4.4) Chapter5 (Sections: 5.2, 5.3).

(No of classes: 20, Marks: 20)

UNIT 3: Number Theoretic Functions: The sum and number of divisors of a positive integer, Multiplicative functions, Mobius function, The Mobius inversion Formula, The greatest integer function, Euler's Phi-Function, Euler's Theorem, Properties of Euler's Phi function.

[1] Chapter 6 (Sections 6.1-6.3), Chapter 7 (Sections 7..2 to 7.4) .

(No of classes:20, Marks: 20)

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Text Books:

1. David M. Burton, *Elementary Number Theory*, 7th Edition, McGraw Hill Education (India) private limited. 2012.

Reference Books:

1. G.A. Jones and J. Mary Jones, *Elementary Number Theory*. Undergraduate Mathematics Series (SUMS) , 2005.
2. Neville Robinns, *Beginning Number Theory*. 2nd Ed., Narosa Publishing House Pvt. Ltd. Delhi-2007
3. K.C. Chowdhury, *A First Course in Number Theory*, Asian Books Publications- 2012.

SEMESTER-V

MAT0500104: Multivariate Calculus

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

(Use of Scientific calculator is allowed)

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Knowledge on the following topics:

- Functions of single variable, limit, continuity, differentiability and extrema of single variable functions.
- Knowledge of Integration
- Vector valued functions, dot and cross product of vectors.

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Course Outcomes:

CO1 Identify the conceptual variations when advancing in calculus from one variable to multivariable discussion.

CO2 Describe themaximizationandminimizationofmultivariablefunctionssubjecttothegivenconstraintsonvariables.

CO3 Explain about the inter-relationship amongst the line integral, double and triple integral formulations.

CO4 Assess Green's, Stokes' and Gauss divergence theorems

UNIT 1: Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Higher order partial derivative, Chain rule, Directional derivatives, The gradient, Maximal property of the gradient.

[1]Chapter11 [(Sections11.1, 11.2, 11.3,11.5, Section 11.6 (upto page 592)]

(No. of classes: 15, Marks: 15)

UNIT 2: Extrema of functions of two variables, Method of Lagrange multipliers, Constrained optimization problems; Definition of vector field, Divergence and curl.

[1]Chapter 11[Section11.7(uptopage605),Section11.8(pages610-614)],Chapter13(Section13.1)

(No. of classes: 15, Marks: 15)

UNIT 3: Double integration over rectangular and nonrectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals.

[1]Chapter 12(Sections12.1-12.4)

(No. of classes: 15, Marks: 15)

UNIT4: Line integrals, Applications of line integrals**:** Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral; Surface integrals, Stokes' theorem, The Gauss divergence theorem.

[1] Chapter 13 [(Sections 13.2, 13.3), Section 13.4 (pages 712 to 716), Section 13.5 (pages 723to 726) Section 13.6 (pages 733 to 737), Section 13.7 (pages 742

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to 745)]

(No. of classes: 15, Marks: 15)

Textbook:

[1] Strauss, Monty J., Bradley, Gerald L.,& Smith, Karl J.(2007). *Calculus* (3rd ed.). Dorling Kindersley (India)Pvt. Ltd. (Pearson Education). Delhi. IndianReprint2011

Reference Books:

1. Marsden, J.E., Tromba, A., & Weinstein,A.(2004).*Basic Multivariable Calculus*. Springer (SIE). First Indian Reprint.
2. G.B.Thomas and R.L.Finney,Calculus,9thEd.,Pearson Education,Delhi,2005.
3. James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA,2001.

SEMESTER-V

MAT0500204: Theory of Real Functions

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: MAT0400104

Course Outcomes:

CO1	Describe the concept of limit of a function.
CO2	Define differentiability using limits, leading to a better understanding for applications.
CO3	Explain the continuity and uniform continuity of functions defined on intervals.
CO4	Analyze geometrical properties of continuous functions on closed and bounded intervals.

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CO5 Apply mean value theorems and Taylor's theorem

UNIT 1: Cluster point or limit point of a set, limits of a function (ε-δ approach), sequential criterion for limits, divergence criteria, limit theorems, one sided limits, infinite limits and limits at infinity.

[1] Chapter 4

(No. of classes: 15, Marks: 15)

UNIT 2: Continuous functions, sequential criterion for continuity and discontinuity, algebra of continuous functions, continuous functions on intervals, maximum-minimum theorem, intermediate value theorem, location of roots theorem, preservation of intervals theorem, uniform continuity, uniform continuity theorem, monotone and inverse functions.

[1] Chapter 5 (5.1 to 5.6)

(No. of classes: 20, Marks: 20)

UNIT 3: Differentiability of a function at a point and in an interval, Caratheodory's theorem, chain rule, derivative of inverse function, Rolle's theorem, mean value theorem, Darboux's theorem, Cauchy mean value theorem, Taylor's theorem and applications to inequalities, Taylor's series expansions of exponential and trigonometric functions, ln(1+x), 1/(ax+b) and $(1+x)^n$.

[1] Chapter 6, and Taylor series as in Section 6.4.

(No. of classes: 25, Marks: 25)

Text Book:

1. R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons, 2002.

Reference Books:

1. Ajit Kumar and S. Kumaresan, *A Basic Course in Real Analysis*, CRC Press, Indian Ed. 2014.
2. K.A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer, 2004.
3. Mattuck, *Introduction to Analysis*, Prentice Hall, 1999.
4. S.R.Ghorpade and B.V.Limaye, *A Course in Calculus and Real Analysis*, Springer, 2006.

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SEMESTER-V

MAT0500304: Numerical Analysis (with practical)

Total Marks: 100

(External 45, Practical 25, Internal Assessment:30)

No. of Credits: 4 (Theory 3, Practical 1)

(Use of Scientific calculator is allowed)

No. of Contact classes: 75 (45+30×1)

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard, Knowledge on computer software and programming

Course Outcomes:

CO1 Apply numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, upto a certain given level of precision.

CO2 Compute the values for a tabulated function at points not in the table using interpolation techniques.

CO3 Measure a definite integral that cannot be done analytically

CO4 Estimate numerical differentiation of functional values

CO5 Solve differential equations that cannot be solved by analytical methods

UNIT1: Gaussian elimination method (withrowpivoting),Gauss-Jordan method; Iterative methods**:** Jacobi method, Gauss-Seidel method; Interpolation**:** Lagrange form, Newton form, Finite difference operators, Gregory-Newton forward and backward difference interpolations, Piecewise polynomial interpolation (Linear and Quadratic).

[1] Chapter3(Sections3.1, and3.2),Chapter6(Sections6.1and6.2)Chapter8(Section8.1, Section8.3 (8.3.1,and8.3.2)

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[2] Chapter3(Sections3.2, and3.4)Chapter4(Section4.2)Chapter4(Sections4.3,and4.4)[1]Chapter18(Sections18.1to18.3)

[3] **(No. of classes: 20, Marks: 25)**

UNIT 2: Numerical differentiation**:** First and second order derivatives; Numerical integration**:** Trapezoid rule, Simpson's rule; Extrapolation methods**:** Richardson extrapolation, Romberg integration; Ordinary differential equation**:** Euler's method, Modified Euler's methods **(**Heun and Mid-point).

[2] Chapter 11 [Sections 11.1(11.1.1,11.1.2,11.1.4), and11.2(11.2.1,11.2.2,11.2.4)]

[1] Chapter22 (Sections22.1, and 22.2,22.3)

(No. of classes: 25, Marks: 20)

***Practical /Lab work to be performed on a compute*r:**

Use of computeraided software (CAS),for example *Matlab/Mathematica/Maple*etc., for developing the following numerical programs:

(i) Lagrange's interpolation method

(ii) Newton's interpolation method

(iii) To calculate forward and backward differences

(iv) Trapezoidal rule

(v) Simpson's rule

Note: For any of the CAS *Matlab/Mathematic a/Maple* etc., Data types-simple data types, floating data types,characterdatatypes,arithmeticoperatorsandoperatorprecedence,variablesandconstantdeclarations,expressions,input/output, relational operators, logical operators and logical expressions, control statements and loop statements, arrays should be introduced to the students.

(No. of practical classes: 30, Marks: 25)

Text Books:

[1] Chapra, Steven C.(2018).*Applied Numerical Methods with* MATLAB *for Engineers and* Scientists(4th ed.) Mc Graw-Hill Education.

[2] Fausett ,LaureneV. (2009). *Applied Numerical Analysis Using* MATLAB.Pearson.India

Scanned with OKEN Scanner

[3] Jain,M.K.,Iyengar,S.R.K.,&JainR.K.(2012). *NumericalMethods for Scientific and Engineering Computation*(6th ed.).New Age International Publishers. Delhi.

SEMESTER-VI

MAT0600104: Linear Algebra

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: MAT0300204

Course Outcomes:

CO1 Define linear spaces and discuss their general properties, linear dependence and linear independence of vectors, bases and dimensions of vector spaces

CO2 Explain the basic concepts of linear transformations, dimension theorem, matrix representations of linear transformations, and the change of coordinate matrix.

CO3 Compute the characteristic polynomial, eigenvalues, eigenvectors and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result.

CO4 Determine inner products and orthogonality on vector spaces.

CO5 Use Gram-Schmidt orthogonalization to obtain orthonormal basis.

UNIT 1: Definition and examples of vector spaces, general properties of vector spaces, Definition and examples of subspaces, subspace criterions and algebra of subspaces, null space and column space of a matrix, Linear transformations, Kernel and range of a linear transformation.

[1]: Chapter 4 (Sections 4.1-4.2), [2] : Chapter 4

(No. of classes: 15, Marks: 15)

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UNIT 2: Linear combinations of vectors, linearly dependent and independent sets, bases of vector spaces, coordinate systems, dimension of a vector space, ranks, change of basis.

[1]: Chapter 4 (Sections 4.3-4.7), [2] : Chapter 5

(No. of classes: 15, Marks: 15)

UNIT 3: Eigenvectors and eigenvalues of a matrix, The Characteristic equation, Diagonalization, eigenvector of a linear transformation, Complex eigenvalues. Invariant subspaces and Cayley- Hamilton Theorem.

[1]: Chapter 5 (Sections 5.1-5.5), [2]: Chapter 9, [3]: Chapter 5 (Sections 5.4)

(No. of classes: 15, Marks: 15)

UNIT 4: Inner products, Length and orthogonality, orthogonal sets, orthogonal projections, The Gram-Schmidt process, Inner product spaces.

[1]: Chapter 6 (Sections 6.1-6.4, 6.7), [2]: Chapter 12

(No. of classes: 15, Marks: 15)

Text Books:

1. David C. Lay, *Linear Algebra and its Applications*, 3rd Edition, Pearson Education, Asia, Indian Reprint, 2007
2. Seymour Lipschutz, *Theory and Problems of Linear Algebra*, Schaum's Outline Series, McGraw-Hill Book Company, Singapore
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.

Reference Books:

1. S. Kumaresan, *Linear Algebra- A Geometric Approach*, Prentice Hall of India, 2017
2. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007
3. G. Schay, Introduction to Linear Algebra, Narosa, 1997

SEMESTER-VI

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MAT0600204: Partial Differential Equations (with practical)

Total Marks: 100 (External:45, Practical 25, Internal Assessment: 30)

No. of Credits: 4 (Theory 3, Practical 1)

No. of Contact classes: 75 (15×3+30×1)

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard, Knowledge on computer software

Course Outcomes:

CO1	Formulate, classify and transform first order PDEs into canonical form.
CO2	Explain method of characteristics, separation of variables and solve first order PDE's.
CO3	Classify and solve second order linear PDEs.
CO4	Discuss Cauchy problem for second order PDE and homogeneous and non-homogeneous wave equations.
CO5	Apply the method of separation of variables for solving many well-known second-order PDEs.

UNIT 1: Introduction, Classification, Construction of first order partial differential equations (PDE). Cauchy's problem for first order equations, linear equations of the first order, Integral surfaces passing through a given curve, Nonlinear partial differential equations of the first order, Cauchy's method of characteristics, Charpit's method. Solutions satisfying given conditions, Jacobi's method.

[1] Chapter 2 (Sections 2.1 to 2.3), [2] Chapter 2 (Section 3, 4,5, 7,8,10,12, 13)

(No. of classes: 15, Marks: 15)

UNIT 2: Canonical form of first order PDE, Method of separation of variables for first order PDE.

[1] Chapter 2 (Sections 2.6 and 2.7)

(No. of classes: 15, Marks: 15)

UNIT 3: Reduction to canonical forms, Equations with constant coefficients, General solution.

[1] Chapter 4 (Sections 4.1 to 4.5), [2] Chapter 3 (Sections 4, 5)

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(No. of classes: 15, Marks: 15)

Practical /Lab work to be performed in a Computer Lab:

Modelling of the following similar problems using Mathematica /MATLAB/ Maple/ Maxima/Scilab etc.

1. Solution of Cauchy problem for first order PDE.
2. Plotting the characteristics for the first order PDE.
3. Plot the integral surfaces of a given first order PDE with initial data.
4. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ for any two of the following associated conditions:

(a) $u(x,0) = \phi(x);\ u(x,0) = \psi(x), x \in R; t > 0$

(b) $u(x,0) = \phi(x);\ u_t(x,0) = \psi(x);\ \ u(0,t) = 0, x > 0; t > 0$

(c) $u(x,0) = \phi(x);\ u_t(x,0) = \psi(x);\ \ u_x(0,t) = 0, x > 0; t > 0$

(d) $u(x,0) = \phi(x);\ u_t(x,0) = \psi(x);\ \ u(0,t) = 0, u(l,t) = 0; x > 0; t > 0$

5. Solving systems of ordinary differential equations.
6. Solution of one-Dimensional heat equation $u_t = k\, u_{xx}$, for a homogeneous rod of length l.

That is - solve the IBVP:

$$u_t = k\, u_{xx}, \qquad 0 < x < l, \qquad t > 0$$
$$u(0,t) = 0, \qquad u(l,t) = 0, \qquad t \geq 0$$
$$u(0,t) = f(x), \quad 0 \leq x \leq l$$

(No. of practical classes: 30, Marks: 25)

Text Book:

1. Tyn Myint-U and Lokenath Debnath**,** *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.

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2. Sneddon, I. N. (2006). *Elements of Partial Differential Equations*, Dover Publications. Indian Reprint.

Reference Book:

1. Stavroulakis, Ioannis P & Tersian, Stepan A. (2004). *Partial Differential Equations*: *An Introduction with Mathematica and* MAPLE (2nd ed.). World Scientific.
2. M. D. Raisinghania, Advanced Differenti al Equations, S. Chand & Company LTD.

SEMESTER-VI

MAT0600304: Metric Spaces

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites:MAT0400104

Course Outcomes:

CO1 Define various natural and abstract formulations of distance on the sets of usual or unusual entities. Become aware one such formulations leading to metric spaces.

CO2 Analyse how a theory advances from a particular frame to a general frame.

CO3 Construct the mathematical understanding of various geometrical concepts, viz. Balls or connected sets etc. in an abstract setting.

CO4 Develop the two important topological properties of metric spaces, namely connectedness and compactness.

UNIT 1: Definition and examples of Metric spaces, sequences in metric spaces, Cauchy sequences, complete metric spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor's theorem. Subspaces, dense sets, separable spaces.

[1] Chapter 1, Sections: 1.1-1.4, Chapter 2, Sections: 2.1, 2.2, 2.3.12 - 2.3.16

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(No. of classes: 15, Marks: 15)

UNIT 2: Continuity: Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Equivalent metrics, Isometry. Contraction mappings.

[1] Chapter 3, Sections 3.1, 3.4, 3.5, 3.7 (upto 3.7.2)

(No. of classes: 15, Marks: 15)

UNIT 3: Connected metric spaces: Connectedness, connected subsets of real numbers, connectedness and continuous mappings, components. Compact metric spaces: bounded sets and compactness, other characterisations of compactness, continuous functions on compact spaces.

[1] Chapter 4, Sections 4.1, Chapter 5, Sections 5.1, 5.2, 5.3

(No. of classes: 30, Marks: 30)

Text Book:

1. Satish Shirali & Harikishan L. Vasudeva, Metric Spaces, Springer Verlag London (2006) (First Indian Reprint2009)

Reference Books:

1. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
2. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.
3. Micheal O. Searcoid, Metric Spaces, Springer Publication, 2007

SEMESTER-VI

MAT0600404: Mechanics

Total Marks: 100 (External 60, Internal Assessment:40)

No. of Credits: 4

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No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Mathematics in 10+2 or equivalent standard

Course Outcomes:

CO1 Define the concepts in statics such as moments, couples, equilibrium in both two and three dimensions.

CO2 Explain the theory behind friction and center of gravity.

CO3 Formulate conservation of mechanical energy and work-energy equations.

CO4 Illustrate translational and rotational motion of rigid bodies.

UNIT1: Composition and resolution of forces, Parallelogram of forces, Triangle of forces, Converse of triangle of forces, Lami's Theorem, Parallel forces, Moment of a force about a point and an axis. Couple, Resultant of a system of forces. Equilibrium of coplanar forces. Friction, C.G of an arc, plane area, surface of revolution, solid of revolution.

[3] Chapter I-X

(No. of classes: 30, Marks: 30)

UNIT 2: Velocities and acceleration along radial and transverse directions and along tangential and normal directions, motion in a straight line under variable acceleration, simple harmonic motion and elastic string. Newton's law of motion. Work, Energy and momentum, Conservative forces-Potential energy, Impulsive forces, Motion in resisting medium.

[1] Chapter I Sections 1.1, 1.2,1.3, Chapter –2 Sections 2.1,2.2, Chapter 3 Sections 3.1.3.2, Chapter 4 Sections 4.1, Chapter 5Sections5.1,5.3,Chapter 6Sections6.1,6.3.

[2] Chapter 3(Sections:3.1,3.2,3.3,3.4).

(No. of classes: 30, Marks: 30)

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Text Books:

1. S.L. Loney, An elementary treatise on the dynamics of a particle and of rigid bodies, Surjeet publications
2. F.Chorlton,TextbookofDynamics,CBS,Publications2nd Edition,1985
3. B.C. Das & B. N. Mukherjee, Statics, U. N. Dhur & Sons Pvt. Ltd.

Reference books:

1. M.R.Spiegel, Theoretical Mechanics, Schaum Series 2010.

SEMESTER-VII (Honours/Honours with Research)

MAT0700104: Algebra

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact Classes: 60

No. of Non-Contact Classes: 0

Pre-requisite for the paper: MAT0300204: Abstract Algebra and MAT0600104: Linear Algebra

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

CO1: Describe direct product of groups and different kinds of subnormal series of groups.

CO2: Explain polynomial rings over commutative rings, PID, Euclidean Domain and UFD.

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CO3: Discuss field extension and its application to geometry.

CO4: Identify about similarity of linear transforms and classify Jordan canonical forms and quadratic forms.

Unit 1: Direct product and Direct sums of Groups, Internal direct product and Decomposable Groups, Normal and Subnormal series of Groups, Solvable Groups, Composition series of Groups, Jordan-Holder theorem.

[1] Chapter 4 (Section 1), Chapter 5.

(No. of classes: 15, Marks: 15)

Unit 2: Polynomial rings over commutative rings, Divisibility in commutative rings, Principal Ideal Domain (PID), Euclidean Domain, Unique Factorization Domains (UFD) and their properties. Eisenstein's irreducibility criterion.

[1] Chapter 9, Chapter 10.

(No. of classes: 15, Marks: 15)

Unit 3: Subfields and Prime fields, Extensions of fields, Algebraic and Transcendental elements, Algebraic extensions, Splitting fields, Perfect fields, Finite fields, Moore's theorem, Construction by ruler and compass.

[1] Chapter 13, Chapter 14 (Section 4).

(No. of classes: 15, Marks: 15)

Unit 4: Canonical forms, Similarity of linear transforms, Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, Primary decomposition theorem, Jordan blocks and Jordan canonical form, Quadratic forms, Reduction and classification of quadratic forms.

[2] Chapter 6 .

(No. of classes: 15, Marks: 15)

Text Books:

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1. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House, 9th Revised Edition, 2006.
2. I. N. Herstein, Topics in Algebra, John Wiley & Sons, 2nd Edition, 1975.

Reference Books:

1. D. S. Malik, J. M. Mordeson and M. K. Sen, Fundamentals of Abstract Algebra, McGraw Hill Company, 1997.
2. C. Musili, Introduction to Rings and Modules, Narosa Publishing House, 1994.
3. K. Hoffman and R. Kunz, Linear Algebra, Prentice Hall, 1965.
4. K. B. Datta, Matrix and Linear Algebra, Prentice Hall of India, 2004.
5. S. Lipschutz, Schaum's Outline Series of Linear Algebra, McGraw Hill, 2013.

SEMESTER-VII

MAT-0700204: Real Analysis and Lebesgue Measure

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact Classes: 60

No. of Non-Contact Classes: 0

Pre-requisite for the paper: MAT0400104: Real Analysis and MAT0500204: Theory of Real Functions

Course outcome:

After completing this course, the student will be able to:

CO1 Identify the region of convergence of power series.

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CO2 Illustrate Lebesgue measure on R, and construct integrals using Lebesgue measure.

CO3 Explain basic convergence theorems for the Lebesgue integral.

CO4 Explain sequences of functions and their uniform convergence

CO5 Develop the core skills of the subject and research skills in this areas.

Unit 1: Pointwise and uniform convergence, Cauchy Criterion for Uniform Convergence, Interchange of Limits, Series of Functions, Tests for Uniform Convergence, Power series. **(No. of classes: 15, Marks: 15)**

Unit 2: Definition of the Riemann Integral, examples, Some Properties of the Integral, Riemann Integrable Functions, The Fundamental Theorem, The Darboux Integral, Definition of Riemann Steiltjes integral, examples and properties, Integration and Differentiation, Fundamental theorem of calculus.

(No. of classes: 15, Marks: 15)

Unit 3: Set functions, Construction of Lebesgue measure, Measure spaces, Measurable functions, simple functions. **(No. of classes: 15, Marks: 15)**

Unit 4: Lebesgue integration, Lebesgue's monotone convergence theorem, Fatou's theorem, Lebesgue's dominated convergence theorem, Comparison with Riemann integral, Integration of complex functions. **(No. of classes: 15, Marks: 15)**

Text Books:

1. W. Rudin, Principles of Mathematical Analysis, McGraw-Hill Education, 1976
2. Bartle R.G. and Sherbert R.D., Introduction to Real Analysis, John Wiley & Sons, Inc

Reference Books:

1. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International Private Limited,2017
2. R.R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing, 2012.

SEMESTER VII

MAT-0700304: Complex Analysis-II

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Total Marks: 100 (External: 60, Internal: 40)

No of credit: 4

No of contact classes; 60

No of non contact classes: 0

Prerequisites: MAT0400204: Complex Analysis-I

Course learning outcomes: This course will enable the students to:

CO1: Define Conformal mappings and illustrate with examples.
CO2: Discuss analytic continuation and Gamma function.
CO3: Compute integrals of complex functions using Residue theorem.
CO4: Understand the concept of Riemann surface.
CO5: Formulate Power series expansions of complex valued functions.

Unit1: Power Series: Taylor's and Laurent's Theorem, Zero and Singularity of an analytic function, The Argument Principle, Rouche's theorem.

(No. of classes: 15, Marks: 15)

Unit 2: Theory of Residues: Residue, Calculation of Residues, Cauchy's residue theorem, Evaluation of definite integrals, Special theorems used in evaluating integrals, Mittag-Leffer's theorem. **(No. of classes: 15, Marks: 15)**

Unit 3: Analytic functions as mappings: Isogonal and Conformal Transformation, Necessary and sufficient condition of conformal transformation, Bilinear transformations, Geometrical inversion, Invariance of cross ratio, Fixed points of a bilinear transformation, some special bilinear transformation e.g. real axis on itself, unit circle on itself, real axis on unit circle etc. Branch point and Branch line, Concept of the Riemann surface.

(No. of classes: 15, Marks: 15)

Unit 4: Analytic Continuation: Analytical continuation, Schwarz's reflection principle, Infinite products, Gamma Function and its properties

(No. of classes: 15, Marks: 15)

Text Books:

1. M.R. Spiegel, Complex Variables. Schaum's Outlines series, McGraw Hill Education, 2017
2. E.G. Philips, Functions of acomplex variables with applications, Oliver and Boyd,1957.

Scanned with OKEN Scanner

Reference Books:

1. Walter Rudin, Real and Complex Analysis, McGraw Hill Education, 2017
2. L.V. Ahlfors, Complex Analysis, McGraw Hill, 2000
3. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press Oxford, 1990
4. Mark J. Ablowitz and A.S. Fokas, Complex Variables, Introduction and Application, CUP, 1998.
5. John B Conway, Functions of Complex Variable, Springer, 1872.

SEMESTER VII

MAT-0700404: Differential Equations

Total Marks: 100 (External: 60, Internal: 40)

No of credit: 4

No of contact classes: 60

No of non contact classes: 0

Prerequisites: MAT0300104: Ordinary Differential Equations, MAT0600204: Partial Differential Equations.

Course Outcomes:

Students will be able to:

CO1: Identify critical point of an autonomous system and analyse their stability.

CO2: Discuss Frobenius method of series solution for differential equations.

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CO3: Explain the existence and uniqueness of solution of first order differential equations

CO4: Construct Green's function, and illustrate Sturm Liouville systems

CO5: Explain the characteristics second order linear PDE.

Unit 1: Well posed problems, Existence, uniqueness and continuity of solution of ODEs of first order, Picard's method, Existence and uniqueness of solution of differential equations of first order, Sturm separation and comparison theorems, Homogeneous linear systems, Non-homogeneous linear systems. **(No. of classes: 10, Marks: 10)**

Unit 2: Linear homogeneous differential equation-Ordinary and singular points, Series solution, Method of Frobenius, Solutions of Bessel's and Legendre equations. **(No. of classes: 10, Marks: 10)**

Unit 3: Two point boundary value problems, Green's function, Construction of Green's function, Sturm Liouville systems, Eigen values and eigen functions, Stability of autonomous system of differential equations, Critical point of an autonomous system and their classification as stable, Asymptotically stable, Strictly stable and unstable, Stability of linear systems with constant coefficients, Linear plane autonomous systems, Perturbed systems, Method of Lyapunov for nonlinear systems. **(No. of classes: 20, Marks: 20)**

Unit 4: Second order linear PDE-Classification, General solution of higher order PDE with constant coefficients, Method of Characteristics. **(No. of classes: 20, Marks: 20)**

Text Books:

1. S.L. Ross, Differential Equations, Second Edition, John Wiley & Sons, India, 2007.
2. I.N. Sneddon, Elements of Partial Differential Equations, Mcgraw Hill 2006
3. K.S. Rao, Introduction to partial differential equations, Prentice Hall, New Delhi, 1997.

Reference Books:

1. Lawrence C. Evans, Partial Differential Equations, Second Edition, American Mathematical Society, 2014.
2. Erich Zauderer, Partial Differential Equations of Applied Mathematics, A Wiley-Interscience Publication, John Wiley and Sons, 1983.
3. H.F. Weinberger, A first course in partial differential equations, Blaisdell, 1965.
4. C.R. Chester, Techniques in partial differential equations, McGraw Hill, New York, 1971.
5. R. Courant and D. Hilbert: Methods of Mathematical Physics: Partial differential equations, Vol –II, Wiley-VCH, 1989
6. W.E. Williams, Partial Differential Equations, Oxford University Press,1980

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7. F.H. Miller, Partial Differential Equations, J. Wiley & Sons; London, Chapman & Hall, 1941.
8. A. Sommerfeld, Partial differential equations in physics, Academic Press, New York, 1967.
9. I. Stakgold, Green's functions and boundary value problems, Wiley, New York, 1979.

SEMESTER-VII

MAT0700504: RESEARCH METHODOLOGY

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: Nil

Course Outcomes:

CO1: Identify iimportance of hypothesis in different types of research.
CO2: Classify the different types of research methods.

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CO3: Discuss the criteria of a good problem.
CO4: Analyze and distinguish the interpretation of data
CO5: Develop the idea of formulation of scientific articles, report writing and synopsis
CO6: Explain the subject classification number and the preparation of bibliography.

Unit-1: (a) Research-Introduction: Knowledge and Research, Research and Scientific Thinking, Distinguishing characteristics of scientific thinking. Steps in the progress of scientific thinking. Characteristics of research. Classifications of research. Comparison of fundamental research and action research.

(b) Research Problem: The source of problem. Criteria of a good problem. A guide to judge a research problem. Formulating and starting the problem. Definition of problem. Determination of the problem. Justification of the problem. **(Marks: 10, No of class 10)**

Unit-2: (a) Hypothesis: The meaning of hypothesis. Importance of hypothesis, Source of hypothesis, Characteristics of hypothesis. The use of hypothesis in different types of research. Different forms of hypothesis. Difficulties in the formulation of hypothesis. Testing of hypothesis.

(b) Survey of related studies: Purpose of survey of related studies, Research reading. The search of sources. Use of library, Note-taking. The bibliography. **(Marks: 10, No of class 10)**

Unit-3: Classification of Research Methods: Historical methods, normative survey method, Survey testing. The questionnaire, Documentary frequency studies, Interview, Observation. Appraisal procedure, Experimental methods (Bases of experiential method, Variable control, Control of the experiment, purpose of control, methods of control, types of experiments, characteristics of an experiment, major steps in the experimental methods, experimental designs, limitations of experimental method). **(Marks: 10, No of class 10)**

Unit-4 (a) Some tools and Techniques of Research: Inquiry forms, Schedule, Opinionnaire, Sociometry, Social distance scale, Guess-who technique, Q-sort technique, Situational test, follow-up study, Quantitative studies, qualitative studies.

(b) Sampling: The sampling theory, Bases of sampling, Importance of sampling. Advantage of sampling, Disadvantages of sampling, Characteristics of a good sampling. Steps in sampling procedure. Methods of sampling, Size of sampling. Errors in sampling. **(Marks: 10, No of class 10)**

Unit-5: Analysis and Interpretation of Data: Analysis from the very beginning, Various steps in analysis and interpretation, Common statistical methods of analysis, Interpretation, Necessary precautions in interpretation, Comparison in interpretation, Conclusions and generalizations. **(Marks: 10, No of class 10)**

Unit-6: The Research Report: Preliminary Section, Main body of the report, Reference section, Style of writing, Tables, Figures, Quotations, Footnotes, Bibliography, Headings, Preparations of the report, Typing the report. Writing style of Synopsis. Strategy and steps for writing scientific articles.

(Marks: 10, No of class 10)

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Text Books:

1. C.R. Kothari: Research Methodology, Methods and Techniques, 3rd Ed, New Age Publ. 2004
2. Antony Edward Kelly, Richard A. Lesh: Handbook of Research Design in Mathematics and Science Education, Lawrence Erlbaum Associates, Inc 2000
3. Michael P. Marder: Research Methods for Science, Cambridge University Press 2011

Reference Books

1. Steven J. Taylor, Robert Bogdan, Marjorie DeVault: Introduction to Qualitative Research Methods: A Guide Book and Resource, Wiley Publ. 2016
2. Nicolas J. Higham: Handbook of *Writing* for the Mathematical Sciences, Siam Pub. 1998
3. Margaret Cargill, Patrick O'Connor: Writing scientific articles: strategy and steps, Wiley-Blackwell 2013.

SEMESTER-VIII (HONOURS)

MAT0800104: Topology

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: MAT0600304: Metric Spaces

Course Outcomes: The course will enable the students to:

CO1: identify topological spaces and construct examples of such spaces.

CO2: classify different spaces like first countable, second countable, separable spaces and give the characterization of these spaces using some

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important results like Urysohn's lemma, Tietze extension theorem.

CO3: use the idea of compactness and connectedness and give their different characterizations.

CO4: explain the product topology and its relationship with compactness, connectedness, and countability.

CO5: provide examples of metrizable spaces and explain the relationship between embedding and metrization.

Unit 1: Definition and examples of topological spaces, Closed sets and closure, Dense subsets, Neighbourhood, Interior, Exterior and Boundary, Accumulation Points and Derived sets, Bases and subbases. Subbase and Relative Topology, Continuous Functions and Homeomorphism.

(No. of classes: 11, Marks: 10)

Unit 2: Countable and uncountable sets, First and second Countable spaces, Lindelof's theorem, Separable spaces, Second Countability and Separability. **(No. of classes: 5, Marks: 10)**

Unit 3: Separation Axioms: T_0, T_1, T_2, $T_{3\frac{1}{2}}$, T_4 ; their characterizations and basic properties, Urysohn's lemma, Tietze Extension Theorem.

(No. of classes: 10, Marks: 10)

Unit 4: Compactness, continuous functions and compact sets. Basic properties of compactness and related theorems, Sequentially and Countably compact sets, Local Compactness and one point compactification, Stone-Cech Compactification. **(No. of classes: 11, Marks: 10)**

Unit 5: Connected spaces, connectedness on the real line, components, totally disconnected spaces, Locally connected spaces.

(No. of classes: 11, Marks: 10)

Unit 6: Tychonoff product topology in terms of standard subbase and its characterizations, Projection Maps, Separation Axioms and Product Spaces, Connectedness and Product spaces, Compactness and Product Spaces (Tychonoff's Theorem), Countability and Product Spaces, Embedding and Metrization, Urysohn's Metrization theorem. **(No. of classes: 12, Marks: 10)**

Text Books:

1. J. R. Munkres, Topology: A first course, Prentice Hall of India, 1974.

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2. S. Willard, General Topology, Dover Publications, 2004.
3. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India By PHI)

Reference Books:

1. K.D. Joshi, Introduction to General Topology, New Age International Private Limited, 2017
2. S. Lipschutz, Theory and Problems of General Topology, Schaum's Outline Series, McGraw-Hill Book Company, 1965.
3. M. G. Murdeshwar, General Topology, New Age International, 1990

SEMESTER-VIII

MAT0800204: Number Theory-II

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

No. of Contact Classes: 60

No. of Non-Contact Classes: 0

Pre-requisite for the paper: MAT0400404: Number Theory-I and MAT0300204: Abstract Algebra

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

CO1: Describe primitive roots and indices for solvability of congruence of higher order.

CO2: Explain the quadratic reciprocity law using Legendre's and Jacobi's symbol.

CO3: Generate Fibonacci numbers and discuss related identities.

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CO4: Explain partition functions and develop graphical representations.

Unit 1: Primitive roots: order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, theory of indices.

[1] Chapter 8 (Sections 8.1 to 8.4). **(No. of classes: 15, Marks: 15)**

Unit 2: Quadratic residues: Euler's criterion, Legendre's symbol and its properties, Quadratic Reciprocity Law, Quadratic congruences with composite moduli.

[1] Cha pter 9 (Sections 9.1 to 9.4). **(No. of classes: 15, Marks: 15)**

Unit 3: Fibonacci numbers: certain identities involving Fibonacci numbers, Continued fractions, Pell's equation.

[1] Chapter 14 (Sections 14.1 to 14.3), Chapter 15 (Sections 15.2, 15.3 and 15.5). **(No. of classes: 15, Marks: 15)**

Unit 4: Partitions, Graphical representation of partitions. Euler's partition theorem, Searching for partition identities, Partition generating functions.

[2] Chapter 12 (Sections 12-1 to 12-4) Chapter 13(Section 13-1). **(No. of classes: 15, Marks: 15)**

Text Books:

1. David M. Burton, Elementary Number Theory, McGraw Hill Education, Seventh Edition, 2011.
2. G. E. Andrews, Number Theory, Dover Publications, 2012.

Reference Books:

1. I. Niven, H. S. Zuckerman and H. L. Montgomery, Introduction to Theory of Numbers, Wiley, 2008.

SEMESTER-VIII

MAT 0800304- Mechanics and Tensor Calculus

Total Marks: 100 (External Assessment 60, Internal Assessment 40)

No. of Credits: 4

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No. of Contact classes: 60

No. of Non-Contact classes: 0

Prerequisites: MAT0500104: Multivariate Calculus, MAT0600404: Mechanics

Course outcome: Students will be able to:

CO1 Explain various physical laws of motion, Hamiltonian's principle etc. with mathematical tools.

CO2 Distinguish Tensors and perform algebraic operations on tensors, to obtain covariant derivatives of various tensors and to express Laplacian in tensor form.

CO3 Apply various tools of vector algebra as well as vector calculus, calculus of variations to discuss the motion of rigid bodies under certain constraints.

CO4 Differentiate the properties of motion in various coordinate systems viz. cylindrical, spherical, conical surfaces.

CO5 Construct mathematical models viz. rigid body to describe motions under certain constraints or no constraints which are able to analyse the physical scenario.

Group-A: Mechanics

Total marks: 30 **Credit: 2**

Unit1: Central forces, Central orbit, Laws of inverse square, Kepler's laws of planetary motion; Velocity and acceleration in cylindrical and spherical polar coordinates.

Motion of a rigid body about a fixed point: Euler's equations, Motion under no external forces. **(No. of classes 15, Marks 15)**

Unit 2: Generalized coordinates: Lagrange's equations of motion for finite forces in holonomic systems, Case of conservative forces and theory of small oscillations. Hamilton's equations of motion, Variational methods, Hamilton's principle and Principle of least action. **(No of classes 15, Marks 15)**

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Group-B: Tensor Calculus

Total Marks: 30 **Credit: 2**

Unit 3: Transformation laws of covariant and contravariant tensors, Mixed tensor, Rank of tensors. Kronecker delta. Algebraic operations on tensors: addition, subtraction, contraction, inner and outer product of tensors, Quotient law, Group property of tensors, symmetric and anti-symmetric tensors. Related theorems.

Riemannian metric and Fundamental tensors. Christoffel symbols of the first and second kinds and their properties. Transformation laws of Christoffel symbols.
(No of classes 15, Marks 15)

Unit 4: Covariant derivatives of tensors A_i, A^i, A_{ij}, A^{ij} and A^i_j , Generalizations. Covariant derivatives of fundamental tensors and scalar invariant function. Gradient of an invariant function. Divergence and curl of vectors. Laplacian in tensor form. Application in problems. **(No of classes 15, Marks 15)**

Text Books:

1. S L Loney, An Elementary Treatise on the Dynamics of a Particle and Rigid Bodies, Cambridge University Press, 2017
2. Murray Spiegel, Theory & Problems of Theoretical Mechanics (Schaum's Outline Series), McGraw Hill Education, 2017
3. C. E. Weatherburn, An Introduction to Riemannian Geometry and the Tensor Calculus, Cambridge University Press, Paperback, 2008

Reference Books:

1. F. Chorlton, Text Books of Dynamics, John Wiley & Sons, 1983
2. B. C. Kalita, Tensor Calculus and Applications: Simplified Tools and Techniques, CRC Press, Taylor &Francis Group, 2019
3. David C. Kay, Tensor Calculus (Schaum's Outline Series), McGraw Hill Education, 2011
4. L. P. Eisenhart, Riemannian Geometry, Princeton University Press, 1997.

SEMESTER-VIII

MAT0800404: Mathematical Methods

Total Marks: 100 (External 60, Internal Assessment 40)

No. of Credits: 4

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No. of Contact classes: 60

No. of Non-Contact classes: 0

Course Outcomes: Students will be able to:

CO1: identify Fredholm integral equations and Volterra integral equations.

CO2: apply Fourier transform to solve ordinary and partial differential equations of initial and boundary value problems.

CO3: apply Laplace transform to solve ordinary, partial differential equations of initial and boundary value problems, and to evaluate definite integrals.

CO4: use calculus of variations to extremize a functional with fixed boundaries.

CO5: formulate and solve isoperimetric problems.

Unit 1: Integral Equations:

Definition of Integral Equation, Reduction of ordinary differential equations into integral equations. Fredholm integral equations with separable kernels, Eigen values and Eigen functions, Method of successive approximation, Iterative scheme for Fredholm Integral equations of second kind. Volterra Integral Equations of second kind, Resolvent kernal of Volterra equation and its results, Application of iterative scheme to Volterra equation of the second kind, Convolution type kernals. **(No of classes 15, Marks 15)**

Unit 2: Fourier Transform:

Fourier Integral Transform. Properties of Fourier Transform, Fourier sine and cosine transforms, Application of Fourier transform to ordinary and partial differential equations of initial and boundary value problems. Evaluation of definite integrals. **(No of classes 15, Marks 15)**

Unit 3: Laplace Transform:

Basic properties of Laplace Transform, Convolution theorem and properties of convolution, Inverse Laplace Transform. Application of Laplace Transform to solution of ordinary and partial differential equations of initial and boundary value problems. The inversion theorem, Evaluation of inverse transforms by residue method. **(No of classes 15, Marks 15)**

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Unit 4: Calculus of variations:

Calculus of variation with one independent variable: Basic ideas of calculus of variations, Euler's equation with fixed boundary of the functional Containing only the first order derivative of the only dependent variable with respect to one independent variable, Variational problems with functional having higher order derivatives of the only dependent variable, general case of Euler's equation, applications. Calculus of Variation with several independent variables: Variational problems with functional dependent on functions of several independent variables having first order derivatives. Variational problems in parametric form, Variational problems with subsidiary condition: Isoperimetric problems. **(No of classes 15, Marks 15)**

Text Books:

1. M. D. Raisinghania, Integral Equation & Boundary Value Problem, S. Chand, 2010.
2. Murray Spiegel, Schaum's Outline of Fourier Analysis with Applications to Boundary Value Problems , McGraw-Hill Education, 1974
3. M. R. Spiegel, Schaum's Outline Series: Theory and Problems of Laplace Transforms, McGraw- Hill Book Company, 1965.
4. I.M Gelfand and S.V. Fomin: Calculus of Variations, Prentice Hall, INC, 1963, Edited by R.A. Silvarman

SEMSTER-VIII

MAT0800504: SEMINAR/ PROJECT

Total Marks: 100

No. of Credits: 4

SEMESTER-VIII (HONOURS AND RESEARCH)

MAT0800116: Dissertation

Total Marks: 400

No. of Credits: 16

MAT0800204: SEMINAR

Scanned with OKEN Scanner

Total Marks: 100

No. of Credits: 4

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