Kamla Nehru Institute of Physical & Social Sciences, Sultanpur (UP)-228118

(An Autonomous Institute)

'NAAC – 'A' Grade'

Structure of syllabus for the program

B.Sc. and M.Sc. : Subject- Mathematics

Syllabus developed/proposed by

S.No.	Name	Designation	Department	College/University/Address
1.	Mr. Yogendra Bahadur Singh	Convenor	Mathematics	K.N.I.P.S.S., Sultanpur
2.	Mr. Atul Kumar Singh	Member	Mathematics	K.N.I.P.S.S., Sultanpur
3.	Dr. Nidhi Srivastava	Member	Mathematics	K.N.I.P.S.S., Sultanpur
4.	Dr. K.B. Pandey	Member	Mathematics	K.N.I.P.S.S., Sultanpur
5.	Dr. Rajeev Kumar Singh	Member (Nominee Academic Council)	Mathematics	P.B. College, Pratapgarh
6.	Dr. Brijesh Pratap Singh	Member (Nominee Academic Council)	Mathematics	R.H.S. P.G. College, Singramau, Jaunpur
7.	Dr. S.K. Tiwari	Member (Nominee V.C., Dr. RMLAU)	Mathematics	K.S. Saket P.G. College, Ayodhya
8.	Sri Baldev Singh (Industrialist)	Member (Nominated Principal)	NA	Punjabi Colony, Kurwara Naka, Sultanpur
9.	Sri Jagjeet Singh (Ex-student)	Member (Nominated Principal)	NA	Near Vijay Delux, Laldiggi, Sultanpur

As per syllabus development guidelines of Higher Education for UG & PG Course-

10/09/2023
(Mr. Atul Kumar Singh)
Member
K.N.I.P.S.S., Sultanpur

10.9.23
(Mr. Yogendra Bahadur Singh)
Convenor
K.N.I.P.S.S., Sultanpur

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(Dr. K.B. Pandey)
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Accredited "A" Grade by NAAC

KAMLA NEHRU INSTITUTE OF PHYSICAL & SOCIAL SCIENCES, SULTANPUR (U.P.)- 228118

(An Autonomous College)

Structure of syllabus for the program

B.A./B.Sc. : Subject – Mathematics

10/9/23 6/9/23 10.9.23 Tr 6.9.23 10/9/23 10/09/23 10/09/23

Semesterwise titles of the papers in UG Mathematics Course:

Certificate Course in Applied Mathematics

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credits
First	I	B030101T	Differential and Integral Calculus	Theory	4
		B030102P	Practical	Practical	2
	II	B030201T	Matrices and Differential Equations & Geometry	Theory	6
				Total	**12**

Diploma in Mathematics

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credits
Second	III	B030301T	Algebra & Mathematical methods	Theory	4
		B030302P	Practical	Practical	2
	IV	B030401T	Differential Equations & Mechanics	Theory	6
				Total	**12**

Degree in Mathematics

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credits
Third	V	B030501T	Group and Ring Theory & Linear Algebra	Theory	4
		B030502T	Numerical Analysis & Operation Research	Theory	4
		B030503P	Practical	Practical	2
	VI	B030601T	Metric Spaces & Complex Analysis	Theory	5
		Any one of the following			
		B030602T	Number Theory & Discrete Mathematics	Theory	5
		B030603T	Differential Geometry & Tensors	Theory	5
				Total	**20**

10/9/23 10/9/23 10/09/23 10/9/23 10/09/23

Program Outcomes (POs)

PO1: It is to give foundation knowledge for the students to understand basics of mathematics including applied aspects for the same.

PO2: It is to develop enhanced quantitative skills and pursuing higher mathematics and research as well.

PO3: Students will be able to develop solution oriented approach towards various issues related to their environment.

PO4: Students will become employable in various government and private sectors.

PO5: Scientific temper in general and mathematical temper in particular will be developed in students.

Program Specific Outcomes (PSOs)

First Year	Certificate in Applied Mathematics	Student should be able to possess recall basic idea about mathematics which can be displayed by them.
Second Year	Diploma in Mathematics	Student should have adequate exposer to many aspects of mathematical sciences.
Third Year	Degree in Mathematics	Student is equipped with mathematical modelling ability, critical mathematical thinking, problem solving skill, etc and apply his/her skill and knowledge in various field of studies including Science, Engineering, Commerce and Management etc.

10/9/23 6/9/23 10/09/23 10/9/23 10/09/23

B.A./B.Sc.-I (Mathematics)

Detailed Syllabus for

CERTIFICATE COURSE

In

APPLIED MATHEMATICS

	Semester-I	Semester-II	Total
Papers	1T+1P	1T	2T+1P
Credit	4+2	6	10+2
No. of Lectures	60+30	90	150+30

B.A./B.Sc.-I (Semester-I) Paper-I

Differential & Integral Calculus (B030101T)

Credit – 4 | No. of Lectures – 60

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The course outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for developing enhanced quantitative skills and pursuing higher mathematics and research as well.

CO2: By the time students complete the course they will have wide ranging application of the subject and have the knowledge of real valued functions along with sequence and series. They will also be able to know about convergence of sequence and series. Also, they have knowledge about curvature, envelope and evolutes and trace curve in polar curves, Cartesian curves as well as parametric curves.

CO3: The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of integral he learns to solve a variety of practical problems in science and engineering.

CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking more advance level course in mathematics.

Part-A : Differential Calculus

Unit	Topics	No. of Lectures
1	Sequences of real numbers – Boundedness, monotonicity, convergence, limit points &Cauchy sequences. Infinite series of real numbers – Convergence & divergence of PTS, Convergence & oscillation of ATS, Absolute & conditional convergence, Basic Tests & Higher Tests, Leibnitz test (without proof) and examples based on them.	9
2	One sided limits, continuity and differentiability of one variable function; Rolle's theorem, mean value theorems; Properties of continuous functions – Borel's theorem, Boundedness theorem, Mostest theorem, Balzano theorem, Intermediate value theorem, Theorem of similar signs, Uniform	8

	continuity, Sign of derivative	
3	Successive differentiation, Leibrnitz theorem; Expansions of functions, indeterminate forms of limits; Tangents &normals, subtangent&subnormals, pedel equations, derivative of arcs; Asymptotes; curvature; Singular points and curve tracing (only cartesian & polar curves)	8
4	Partial Differentiation, Euler's theorem; Jacobians; Envelops & Evolutes.	5

Part-B :Integral Calculus

Unit	Topics	No. of Lectures
5	Limit of a sum (as $n \to \infty$) by definite integral; Riemann integration – Riemann sums & Riemann integrals, Riemann integrability, Integration of continuous & monotonic (bounded) functions, Fundamental theorem of integral calculus, basic idea of integrability of discontinuous bounded functions.	6
6	Evaluation of double & triple integrals, change of order of integration in double integrals, evaluation of double integrals by changing to polars, Dirichlet's theorem; Rectification, intrinsic equations; volumes & Surfaces of Solids of revolution.	8
7	Gamma and Beta functions; Basic idea of improper integrals – examples based on quotient &Mutests for improper integrals of first, second and third kinds; differentiation under the sign of integration (examples only).	7
8	Vector Differentiation – Basics of ordinary and partial derivatives of vector functions; gradient, divergence & curl of point functions, directional derivative, normal to a level surface. Vector Integration – Basics of integration of vector functions; line integral, surface integral & volume integral; Green, Gauss, Stoke theorems (without	9

	proof) & examples based on them.	

Suggested Books

1. Differential and Integral Calculus by Gorakh Prasad (Pothishala, Prayagraj).
2. Differential and Integral Calculus by Shanti Narayan (S. Chand, New Delhi).
3. Differential and Integral Calculus by Ray, Sharma & Seth (Shiv Lal Agarwal & Co. Agra).
4. Differential and Integral Calculus by Lalji Prasad (Paramount Publication, Patna).
5. Differential and Integral Calculus by Das &Mukherji (U.N. Dhur&Sons, Kolkata).
6. Mathematical Analysis by Malik and Arora (New Age International, Delhi).
7. Calculus Vol. I by T.M. Apostal.
8. Schaum's outline of Calculus & Advanced Calculus.
9. Vector Analysis by M.D. Raisinghania (S. Chand, New Delhi).
10. Vector Analysis by Lalji Prasad (Paramount Publication, Patna).
11. Schaum's outline of Vector Analysis

Digital Platform

e-Pathshala on the website of KNIPSS

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Attendance - 05
Assignment - 05
(Topic of assignment: Indian Ancient Mathematicians)

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

B.A./B.Sc.-I (Semester-I) Paper-II
Practical (B030102P)

Credit – 2
Max.Marks – 50

No. of Lab/classes – 30
Min.Passing Marks – 17

Course Outcomes:

CO1: The main objective of the course is to equip the student to plot the different graph and solve the different types of equations by plotting the graph using different computer software such as SageMath/Mathematica/MATLAB/Maple/Scilab/etc.

CO2: After completion of this course student would be able to know the convergence of sequences through plotting.

CO3: Student would be able to verify Bolzano-Weierstrass theorem through plotting the sequence.

CO4: Student would be able to verify cauchy's root test by plotting n^{th} roots and Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ term.

Lab work to be performed in computer lab in 30 lectures.
List of practicals to be done using Python/MATLAB/Mathematica/Scilab etc.

[A] Plotting of the graphs of the following functions:

$y = ax$, $y = |ax+b|$, $y = [x]$, $y = x^{2n} (n \in N)$,
$y = 1/x^{2n} (n \in N)$, $y = |x| / x$, $y = e^x$, $y = e^{-x}$,
$y = \log x$, $y = \sin x$, $y = \cos x$.

[B] Solution of the following equations by plotting the graphs:

$x = e^x$, $x = \log x$, $x = \sin x$, $x = \cos x$

[C] Study of convergence of sequences & convergence of infinite series by plotting.

[D] Study of matrix operations.

[E] Complex numbers and their representation.

Semester Exam (Practical Exam)

Max. Marks - 50
Min. Passing Marks - 17

B.A./B.Sc.-I (Semester-II) Paper-I
Matrices and Differential Equations & Geometry
(B030201T)

Credit – 6 | No. of Lectures – 90

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The subjects of the course are designed in such a way that they focus on developing mathematical skills in matrices, differential equation and geometry from basic level to depth of knowledge.

CO2: The student will be able to find the rank, eigen values of matrices and study the linear homogeneous and non-homogeneous equations. The course in differential equation intends to develop problem solving skills for solving various types of differential equations.

CO3: The students will be capable of learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surfaces by using analytical geometry.

CO4: On successful completion of the course students have gained knowledge about regular geometrical figures and their properties. They have the foundation for higher course in Geometry.

Part-A :Matrices and Differential Equations

Unit	Topics	No. of Lectures
1	Elementary Transformations & e-matrices; Rank of a matrix; System of linear equations; Characteristic roots and vectors, Caybey-Hamilton theorem	12
2	Transcendental functions of complex quantities and their separation into real and imaginary parts and related examples.	6
3	Ordinary differential equations of first order and first degree, ordinary differential equations of first order and higher degree, Orthogonal Trajectories.	12
4	Linear differential equations with constant coefficients, Cauchy-Euler equations.	6

Part-B :Geometry

Unit	Topics	No. of Lectures
5	Two dimensional geometry – General equation of second degree; confocal conics; polar equations of conics.	14
6	Direction cosines & projections; Planes, straight lines, Spheres	14
7	Cones, Cylinders, Central Conicoids & Paraboloids	14
8	Plane sections of conicoids, Generating lines	12

Suggested Books

1. A course in differential equations by Rai&Chaudhary (Narosa)
2. Ordinary and Partial Differential Equations by M.D. Raisinghania (S. Chand)
3. Schaum's Outline of Differential Equations.
4. Theory of Matrices by B.S. Vatsa (New Age Int.).
5. Higher trigonometry by Das &Mukharjee (U.N. Dhur& Sons, Kolkata).
6. Analytical Geometry of two dimensions by Jain & Khalid Ahmad (New Age Int.).
7. Analytical Geometry by Jain &Khaild Ahmad (New Age Int.).
8. Analytical Geometry by Shanti Narayan (S. Chand).
9. Schaum's Outline of Analytical Geometry.

Digital Platform

e-Pathashala on the website of KNIPSS

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Attendance - 05
Assignment - 05
(Topic of assignment: Indian Ancient Mathematicians)

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

B.A./B.Sc.-II (Mathematics)

Detailed Syllabus for

DIPLOMA

In

MATHEMATICS

	Semester-III	Semester-IV	Total
Papers	1T+1P	1T	2T+1P
Credit	4+2	6	10+2
No. of Lectures	60+30	90	150+30

B.A./B.Sc.-II (Semester-III) Paper-I
Algebra &Mathematical Methods (B030301T)

Credit – 4 | No. of Lectures – 60

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of Group theory, Ring theory and their properties.

CO2:A student learning this course gets a concept of Group, Ring, integral Domain and their properties. This course will lead the student to basic course in advanced mathematics particularly in Algebra.

CO3: The course gives emphasis to enhance students' knowledge of functions of two variables, Laplace Transforms, Fourier Transforms and series.

CO4: On successful completion of the course students would have acquire knowledge about higher different mathematical methods and will help him in going for higher studies and research.

Part-A :Algebra

Unit	Topics	No. of Lectures
1	Congruence modulo n, residue classes; Groups and cyclic groups; Permutation groups.	9
2	Group homomorphisms, Cayley theorem; Subgroups, Cosets; Normal Subgroups, Quotient groups; Normalizer, centre& centralizer.	9
3	Rings, Integral domains, fields, subrings, subfields, Ideals, Quotient rings; Ring-homomorphisms.	9

Part-B :Mathematical Methods

Unit	Topics	No. of Lectures
4	Limits, Continuity and differentiability of f(x,y); Expansion of f(x,y); Max./Min. of f(x,y); Lagrange's multiplier method for max./min. of f(x,y,z).	14
5	Laplace Transforms; Inverse Laplace Transforms, Convolution Theorem; Application of Laplace Transforms & Inverse Laplace Transforms in solving ordinary differential equations (initial value problems); Fourier Transforms (finite and infinite forms)	14

6	Calculus of Variations – Variational problems with fixed boundaries, Euler's equation for functionals containing first order derivative and one independent variable, Extremals, Functionals dependent on higher order derivatives.	5

Suggested Books

1. Modern Algebra by R.S. Agarwal (S. Chand)
2. Modern Algebra by B.S. Vatsa (NewAge Int.)
3. Mathematical Analysis by Malik & Arora (New Age International)
4. Fourier Series and Integral Transform by Sreenath, Rangnathan (S. Chand)
5. Integral Transforms and Fourier Series by A.N. Srivastava (Narosa)
6. Calculus of Variations with applications by A.S. Gupta (PHI)
7. Differential Equations and Calculus of Variations by Kumar & Kumar (CBS)
8. Calculus of Variations by L.A. Pars (Dover Publication)
9. Schaum's outline of Abstract Algebra
10. Schaum's outline of Laplace Transforms
11. Schaum's outline of Fourier Analysis

Digital Plateform

e-Pathshala on the website of KNIPSS

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Attendance - 05
Assignment - 05
(Topic of assignment: Indian Ancient Mathematics)

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

B.A./B.Sc.-II (Semester-III) Paper-II
Practical (B030302P)

Credit – 2
Max.Marks – 50

No. of Lab/classes – 30
Min.Passing Marks – 17

Course Outcomes:

CO1: The objective of the course is to familiarize the students to use mathematical softwares such as SageMath/Mathematica/MATLAB/Maple/Scilab/etc.

CO2: After completion of course students would be able to visualize important properties related to Group and Cyclic group.

CO3: The course will enable the students to solve problems of continuity and differentiability of function of two variables, Maxima and Minima, Laplace transforms and inverse Laplace transforms.

CO4: Students would be able to approximate the expansion of the function of two variables by Taylor's Theorem and plot the outputs.

Lab work to be performed in Computer Lab in 30 lectures.
List of practicals to be done using SageMath/Mathematica/MATLAB/Maple/Scilab etc.

[A] Calculation of addition modulo n & multiplication modulo n; finding elements of group (n) & inverse of each element in (n).
[B] To draw the given surfaces and to find level curves at the given heights [e.g., $f(x,y) = x^2+y^2$; z=1, z=6, z=9].
[C] To draw the tangent planes to the given surfaces at the given points [e.g., $f(x,y) = 10-x^2-y^2$ at (2,2,2)].
[D] Finding the Laplace Transforms of the given functions.
[E] Finding the Inverse Laplace Transforms of the given functions.

Semester Exam (Practical Exam)
Max. Marks - 50
Min. Passing Marks - 17

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B.A./B.Sc.-II (Semester-IV) Paper-I

Differential Equations & Mechanics (B030401T)

Credit – 6 | No. of Lectures – 90

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The objective of this course is to familiarize the students with various methods of solving differential equations, partial differential equations of first order and second order and to have qualitative applications.

CO2: A student doing this course is able to solve differential equations and is able to model problems in nature using ordinary differential equations. After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, non linear evolution equation etc. These entire courses are important in engineering and industrial applications for solving boundary value problems.

CO3: The object of the course is to give students knowledge of basic mechanics such as simple harmonic motion, motion under other laws and forces.

CO4: The student, after completing the course can go for higher quality problems in mechanics such as hydrodynamics. This will be helpful in getting employment in industry.

Part-A :Differential Equations

Unit	Topics	No. of Lectures
1	Second order linear differential equations with variable coefficients; Series solution of differential equations.	12
2	Bessel's function of first kind, Legendre's function of first kind and their properties.	10
3	Formation of partial differential equations; Linear partial differential equations of first order (Lagrange's method); Non-linear partial differential equations of first order (Charpit's method)	12
4	Linear partial differential equations with constant coefficients; Second order partial differential equations with variable coefficients; Monge's method for second order partial differential equations.	10

10/9/23 10.9.23 10/9/23 10/09/23 10/9/23 10/09/23

Part-B :Mechanics

Unit	Topics	No. of Lectures
5	Common Catenary; Stable and Unstable equilibrium	10
6	Virtual Work; Forces in 3-dimenssions; Null point, null line & null plane.	10
7	Kinematics, Rectilinear Motion	10
8	Motion of Particles in central orbit, Kepler's laws of motion; Motion of particle in resisting medium.	10
9	Motion of particle of varying mass & Rocket motion; Motion of particle in three dimensions (basic idea).	6

Suggested Books

1. Ordinary and Partial Differential Equations by M.D. Raisinghania (S. Chand)
2. Ordinary Differential Equations by Rai and Choudhary (Narosa)
3. Ordinary Differential Equations by Bhamra (Narosa)
4. Elements of Partial Differential Equations by Sneddon (Dover Books)
5. Partial Differential Equations by P.C. Biswal (PHI)
6. Statics by R.S. Verma (PothishalaPrayagraj)
7. Statics by Das,Mukharjee (U.N. Dhur& Sons Kolkata)
8. Dynamics by Das, Mukharjee (U.N. Dhur& Sons Kolkata)
9. Dynamics of Particle by M. Ray (S. Chand)
10. Schaum's Outline of Partial Differential Equations
11. Dynamics by Hari Kishan (Atlantic)

Digital Plateform

e-Pathshala on the website of KNIPSS

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Attendance - 05
Assignment - 05
(Topic of assignment: Indian Ancient Mathematics)

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

B.A./B.Sc.-III (Mathematics)

Detailed Syllabus for

DEGREE

In

MATHEMATICS

	Semester-V	Semester-VI	Total
Papers	2T+1P	2T	4T+1P
Credit	8+2	10	18+2
No. of Lectures	120+30	150	270+30

B.A./B.Sc.-III (Semester-V) Paper-I
Group and Ring Theory & Linear Algebra (B030501T)

Credit – 4 | No. of Lectures – 60

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Objective of this course is to sustain the students in Abtract Algebra of almost Advanced level.

CO2: Linear algebra is a basic course in almost all branches of science. The objective of this course is to introduce a student to the basics of linear algebra and some of its applications.

CO3: After successful completion of course, students will enable themselves to knowledge of Orthogonal set, Orthonormal set and Bilinear and Quadratic forms.

CO4: Student will use this knowledge in computer science, finance mathematics, industrial mathematics and Bio mathematics. After completion of this course students will appreciate its interdisciplinary nature.

Part-A :Group and Ring Theory

Unit	Topics	No. of Lectures
1	Group theory – Normalizer and Centre of group; Commutator subgroups; Automorphisms& Inner Automorphisms; Cenjugacy relation, Class equation of a group and related topics; Cauchy theorems on finite groups; Sylow theorem.	12
2	Ring theory – Polynomial over a ring, degree of a polynomial, Monic polynomial, Algebra of polynomials; Polynomial rings; Division algorithm, Euclidean algorithm; Units and Associates, Irreducible polynomials; Unique Factorization theorem, Remainder Theorem.	12

Part-B :Linear Algebra

Unit	Topics	No. of Lectures
3	Linear Spaces and Subspaces; Quotient Sapces; L.I. & L.D. sets of vectors; Bases and Dimensions; Existence theorem, Invariance theorem, Extension theorem.	12

4	Vector Space homomorphisms (Linear Transformations), Algebra of linear transformations, Linear Space of Linear Transformations, Null Space & Range Space, Rank-nullity theorem; Fundamental theorem of homomorphism, Non-singular linear transformations, Similar operators, Inverse of a linear operator, Matrix of linear transformations	12
5	Linear Functionals; Algebra of linear functionals, non-singular linear functionals, Dual basis, Second Dual Space, Annihilators. Inner Product Spaces: Inner products and their properties, existence theorem, normalized vector; Cauchy-Schwarz inequality, Triangle inequality, Orthogonal vectors, Orthogonal & Orthonormal sets of vectors, GSO-process; Orthogonal Complement.	12

Suggested Books

1. Modern Algebra by R.S. Agarwal (S. Chand)
2. Modern Algebra by B.S. Vatsa (New Age Int.)
3. Group Theory by Shah & Shankar (Pearson)
4. Linear Algebra by R.D. Sharma & Ritu Jain (Wiley)
5. Schaum's Outline on Abstact Algebra
6. Schaum's Outline on Linear Algebra
7. Linear Algebra Step by Step by Kuldeep Singh (Oxford University Press)
8. Matrix and Linear Algebra by K.B. Dutta (Prentice Hall)

Digital Plateform

e-Pathshala on the website of KNIPSS

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Attendance - 05
Assignment - 05
(Topic of assignment: Programming in C)

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

10/9/23 10/09/23 10/09/23 10/9/23 10/09/23

B.A./B.Sc.-III (Semester-V) Paper-II
Numerical Analysis & Operation Research (B030502T)

Credit – 4 | No. of Lectures – 60

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The aim of this course is to teach the students the application of various numerical technique for variety of problems occurring in daily life. At the end of the course the student will be able to understand the basic concept of Numerical Analysis and to solve algebraic and differential equation.

CO2: The main outcome will be that students will be able to handle problems and finding approximated solution. Later he can opt for advance course in Numerical Analysis in higher Mathematics.

CO3: The student will be able to solve various problems based on convex sets and linear programming. After successful completion of this paper will enable the students to apply the basic concepts of transportation problems and its related problems to apply in further concepts and application of operation research.

CO4: After successful completion of this course students have basic knowledge of Numerical Analysis and Operations Research for higher study and Research.

Part-A :Numerical Analysis

Unit	Topics	No. of Lectures
1	Calculus of finite differences-different operators, fundamental theorem of difference calculus, separation of symbols, factorial polynomials, differences of zero.	6
2	Interpolation – Newton Gregory forward and backward interpolation formulae, Newton's divided difference interpolation formula, Lagrange's interpolation formula, Gauss forward and backward interpolationformulae, Stirling interpolation formula, Bessel's interpdatio formula.	8
3	Numerical differentiation and Integration – numerical differentiation, trapezoidal rule for numerical integration, Simpson's one third & three eighth rule for numerical integration, Weddle's rule for numerical integration.	8
4	Solutions of equations – Solutions of algebraic and transcendental equations by bisection method, Regulafalsi method, Newton-Raphson method; solutions of ordinary differential equations by Enler's method RungeKutta method, Milne Method.	8

Part-B :Operation Research

Unit	Topics	No. of Lectures
5	Linear programming problems, statement and formation of general linear programming problems, graphical method, slack & surplus variables, standard and matrix forms of linear programming problems, basic feasible solution.	6
6	Convex Sets, fundamental theorem of linear programming, basic solution, simplex method, artificial variables, two phase & Big-M methods and their comparison.	8
7	Resolution of degeneracy, duality in linear programming problems, primal dual relationships, revised simplex method, sensitivity analysis.	8
8	Transportation problems & Assignment problems.	8

Suggested Books

1. Schaum's outline of Numerical Analysis.
2. Numerical Analysis by Lalji Prasad (Paramount, Patna)
3. Numerical Analysis by Rangnathan (S. Chand)
4. Finite differences and Numerical Analysis by H.C. Saxena (S. Chand)
5. Linear Programming (Optimization) by Lalji Prasad (Paramount)
6. Linear Programming and Game theory by Das & Sanyal (U.N. Dhur & Sons, Kolkata)
7. Linear Programming by G. Hadley (Narosa)
8. Schaum's Outline of Operation Research.

Digital Plateform
e-Pathshala on the website of KNIPSS

Internal Assessment
Max. Marks – 25 Min. Passing Marks – 8

Marks division
Sessional Exam - 15 (Time duration – 1 hr.)
Objective test - 10

Semester Exam
Max. Marks – 75 Min. Passing Marks – 25

B.A./B.Sc.-III (Semester-V) Paper-III

Practical (B030503P)

Credit – 2

Max.Marks – 25+75

No. of Lab/classes – 30

Min.Passing Marks – 8+25

Course Outcomes:

The main objective of the course is to equip the student to solve the transcendental and algebraic equations, system to linear equations, Interpolation, Numerical Integration, Method of finding Eigenvalue by Power method, ordinary differential equations, ordinary difference equations and Linear Programming Problem.

Lab work to be performed in Computer Lab in 30 lectures.

List of practicals to be done using Sage Math/Mathematica/MATLAB/Maple/Scilab etc.

[A] Solutions of algebraic equations by Bisection method, RegulaFalri method, Newton Raphson method.

[B] Solutions of system of linear equations by Gaussian elimination method, Gauss Jacobi method, Gauss – Seidel method.

[C] Interpolation by Newton – Gregory forward formula, Newton – Gregory backward formula, Newton's divided difference formula.

[D] Numerical Integration by Trapezoidal rule, Simpson's one third rule, Simpson's three-eighth rule.

[E] Solutions of ordinary differential equations by Euler method, Runge Kutta method (order three).

Internal Assessment

Max. Marks - 25 Min. Passing Marks - 08

Marks Division

Sessional Exam - 20

Attendance - 05

Semester Exam (Practical Exam)

Max. Marks - 75 Min. Passing Marks - 25

10/9/23 10/9/23 10.9.23 10/09/23 10/9/23 10/09/23

B.A./B.Sc.-III (Semester-VI) Paper-I

Metric Spaces & Complex Analysis (B030601T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The course is aimed at exposing the students to foundations of analysis which will be useful in understanding various physical phenomena and gives the student the foundation in mathematics.

CO2: After completion of this course the student will have rigorous and deeper understanding of fundamental concepts in Mathematics. This will be helpful to the student in understanding pure mathematics and in research.

CO3: Students will be able to know the concepts of metric space, basic concepts and developments of complex analysis which will prepare the students to take up further applications in the relevant fields.

CO4: The course enables the students the basic of analytic function and contour integration for further application in higher studies.

Part-A :Metric Spaces

Unit	Topics	No. of Lectures
1	Metric Spaces, Distances and Diameters; open spheres, open sets; Neighbourhoods, Bases; Induced metric & subspaces.	10
2	Interior of a set, exterior of a set, frontier of a set, boundary of a set; adherence of a set, derivative of set, closure of a set; Dense sets, perfect sets.	10
3	Continuity and Homeomorphism; Complete metric spaces.	10

Part-B :Complex Analysis

Unit	Topics	No. of Lectures
4	Equations of lines & circles in Argand plane, circle of Apollonius; Analytic functions, CR-equations, derivative of analytic function, construction of analytic functions, Harmonic conjugate; Power series & its convergence.	15

10/9/23 10.9.23 10/9/23 10/09/23 10/09/23

10/9/23

5	Mobius transformations & Conformal Mappings; Complex Integration, Cauchy theorems, Morera theorem, Cauchy integrals, Cauchy inequality, Liouville theorem, Taylor series, Laurent Series, Maximum modulus principle.	15
6	Singularities; Residue at pole, Residue at infinity, Cauchy Residue theorem; Meromorphic function, number of zeros and poles of a meromorphic function, Argument principle, Rouche theorem, Fundamental theorem of algebra; Evaluation of integrals of the type	15

Suggested Books

1. Metric Spaces by R.S. Agarwal (S. Chand)
2. Metric Spaces and Complex Analysis by Banerjee & Day (New Age Int.)
3. Metric Spaces by Jain & Khalil Ahmad (Narosa)
4. Metric Spaces by Shirali & Vasudeva (Springer)
5. Topology of Metric Spaces by Kumarsen (Narosa)
6. A Pathway to complex analysis by Kumarsen (Techno World)
7. Complex Analysis by Duraipadian&Pachaiyappa (S. Chand)
8. Foundation of Complex Analysis by Ponnusamy (Narosa)

Digital Plateform

e-Pathshala on the website of KNIPSS

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 08

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Attendance - 05
Assignment - 05
(Topic of assignment: Programming in JAVA)

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

10/9/23 2nd 10.9.23 10/9/23 10/09/23 10/09/23 10/9/23

B.A./B.Sc.-III (Semester-VI) Paper-II

Any one of the following –

(i) Number Theory & Discrete Mathematics (B030602T)

(ii) Differential Geometry & Tenser Analysis (B030603T)

B.A./B.Sc.-III (Semester-VI) Paper-II (i)
Number Theory & Discrete Mathematics (B030602T)

Credit – **5**
Max.Marks – **25+75**
No. of Lectures – **75**
Min.Passing Marks – **8+25**

Course Outcomes:

CO1: Upon successful completion, students will have the knowledge and skills to solve problems in elementary number theory and Discrete Mathematics.

CO2: The students will be able to analyse the result based on Ferma& Wilson theorems, Chinese Remainder theorem. Also they will be able to solve Diophantic equation.

CO3: This course covers the basic concepts of discrete mathematics used in computer science and other disciplines that involve formal reasoning. The topics include logic, proof, counting, discrete probability, relations, graphs, trees and Boolean algebra.

CO4: After successful completion of this course the students will have the knowledge in mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking and applications and modeling.

Part-A :Number Theory

Unit	Topics	No. of Lectures
1	Divisibility; Euclidean algorithm; primes; congruences; Fermat's theorem, Euler's theorem, Wilson's theorem; Solutions of congruences;	8

	Chinese remainder theorem; Euler's Φ-function.	
2	Congruence modulo powers of prime; primitive roots and their existence; quadratic residues; Legendre symbol, Gauss lemma about Legendre symbol; quadratic reciprocity law.	7
3	Diophantic equations – Solutions of $ax+by=c$, $x^n+y^n=z^n$; properties of Pythagorean triples; sums of two, four and five squares; assorted examples of Diophantine equations.	8
4	Generating functions and Recurrence Relations – Generating function models, calculating coefficient of generating functions, Partitions, exponential generating functions, A summation method, Recurrence relations, recurrence relation models, Solution of linear recurrence relations, solutions with generating function.	12

Part-B :Discrete Mathematics

Unit	Topics	No. of Lectures
5	Proposition logic – proposition logic, logical connectives, truth tables, tautologies, contradiction; normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, universal and existential quantification, proof by implication; converse, inverse and contrapositive; contradiction; direct proof by using truth table.	10
6	Relation – definition, types, domain and range; pictorial representation of relation; properties of relation; partial ordering relation. Boolean Algebra – Basic definitions, sum of products and products of sums, logic gates and Karnaugh maps.	10
7	Combinatories – Recurrence relations; nth order recurrence relation with constant coefficients; homogeneous recurrence relations, inhomogeneous recurrence relations; Generating functions; closed form expression, properties of G.F., Solution of recurrence relations using G.F.,	10

	Solution of combinational problem using G.F.	
8	Finite Automata – Basic concepts of automation theory, deterministic finite automation, transition function, transition table, non deterministic finite automata, Mealy and Moore machine.	10

Suggested Books

1. An introduction to Basic Number Theory by Saha, Dutta&Kar (PHI)
2. Number Theory by George E Andrews (Dover Books)
3. Elementary Number Theory by V.K. Krishnan (University Press)
4. Discrete Mathematics by Samarjeet Kar (U.N. Dhur & Sons, Kolkata)
5. Discrete Mathematics by S.K. Sarkar (S. Chand)
6. Discrete Mathematics by Sastry & Nayak (Wiley India)
7. Discrete Mathematics by Babu Ram (Pearson)

Digital Plateform

e-Pathshala on the website of KNIPSS

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 08

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Seminar - 10

B.A./B.Sc.-III (Semester-VI) Paper-II (ii)
Differential Geometry & Tensor Analysis (B030603T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: After Successful completion of this course, students should be able to determine and calculate curvature of curves in different titles of Space.

CO2: This course covers the Local theory of Curves, Local theory of surfaces, Geodesics, Geodesics curvature, Geodesic polars, Curvature of curves on surfaces, Gaussian curvature, Normal curvature etc.

CO3: After successful completion of this course, students should have the knowledge of tensor algebra, different types of tensors, Riemannian space, Ricci tensor, Einstein space and Einstein tensor etc.

CO4: This course enables students to make basic plateform for higher studies and research in Geometry of different types.

Unit	Topics	No. of Lectures
1	Curves in Space – Unit tangent vector & equation of tangent; are-length; contact of curve & surface; Osculating plane; Fundamental lines, unit vectors & planes	12
2	Curvature and torsion & their geometrical meaning; Serret – Frenet formulae &Darboux vector; Helix and its properties.	8
3	Surfaces and parametric curves; Fundamental forms – geometric meaning and properties; umbilics, Weingarten equations; Direction coefficients of a direction, orthogonal trajectories; Conjugate directions.	10
4	Lines of curvature – principal curvatures, first and second curvatures, minimal & developable surfaces, Rodrigue formula, Euler's theorem, Dupin's theorem. Asymptotic Lines – basic concepts & properties, curvature & torsion of asymptotic lines, Beltrami-Enneper theorem; Gauss characteristic equation, Mainardi – Codazzi Equations.	15

5	Tensor algebra – definition, classification and algebra of tensors; contraction of a tensor; quotient law; Symmetric, skew-symmetric and reciprocal tensors; metric tensors and related topics.	15
6	Tensor calculus – Christoffel's symbols; covariant derivatives, Ricci theorem; curvature tensor, Ricci tensor; covariant curvature tensor, Bianchi identities.	15

Suggested Books

1. Tensor calculus and Differential Geometry by P.K. Nayak (PHI).
2. Differential Geometry; A first course by D. Somsundaram (Alpha Science)
3. Introduction to Differential Geometry by K.S. Amur (Narosa)
4. Tensor Calculus by U.C. De (Narosa)
5. Differential Geometry of Three Dimensions by C.E. Weatherburn (Cambridge University Press)

Digital Plateform

e-Pathshala on the website of KNIPSS

Internal Assessment

Max. Marks – 25

Min. Passing Marks – 08

Marks division

Sessional Exam - 15 (Time duration – 1 hr.)
Seminar - 10

Semester Exam

Max. Marks – 75

Min. Passing Marks – 25

Summary of Assessment/Marking Pattern

Semester	Theory		Practical	
	Internal Assessment	Semester Exam	Internal Assessment	Semester Exam
First (1T+1P) 100+50 marks	Sessional Exam-15 Assignment-5 Attendance-5 **Total=25**	75 Written exam	-	50 Practical Exam
Second (1T) 100 marks	Sessional Exam-15 Assignment-5 Attendance-5 **Total=25**	75 Written exam	-	-
Third (1T+1P) 100+50 marks	Sessional Exam-15 Assignment-5 Attendance-5 **Total=25**	75 Written exam	-	50 Practical Exam
Fourth (1T) 100 marks	Sessional Exam-15 Assignment-5 Attendance-5 **Total=25**	75 Written exam	-	-
Fifth (2T+1P) 100+100+100 marks	Sessional Exam-15+15 Assignment-5+0 Attendance-5+0 Objective Test-0+10 **Total=25+25**	75+75 Written exam	Sessional Exam-20 Attendance-5 **Total=25**	75 Practical Exam
Sixth (2T) (100+100) marks	Sessional Exam-15+15 Assignment-5+0 Attendance-5+0 Seminar-0+10 **Total=25+25**	75+75 Written exam	-	-

- Certificate Course (Credit 12) : 2T+1P : Marks 250
- Diploma Course (Credit 12) : 2T+1P : Marks 250
- Degree Course (Credit 20) : 4T+1P : Marks 500

G.Total : Credit-44, Theory Papers-8, Practical-3, Marks-1000

10/9/23 10.9.23 10/9/23 10/09/23 10.9.23 10/09/23 10/9/23

Syllabus

M.Sc. (MATHEMATICS)

Based on National Education Policy-2020

(To be Effective from Session 2023-24)

KAMLA NEHRU INSTITUTE
OF PHYSICAL & SOCIAL SCIENCES
Sultanpur (UP)

Accredited 'A' Grade by NAAC

(An Autonomous Institute)

Accredited "A" Grade by NAAC

KAMLA NEHRU INSTITUTE OF PHYSICAL & SOCIAL SCIENCES, SULTANPUR (U.P.)-228118

(An Autonomous College)

Structure of syllabus for the program

M.A./M.Sc. : Subject – Mathematics

10/9/23 6/9/23 10/09/23 10.9.23 10.9.23 10/09/2023 10/9/23

Semesterwise titles of the papers in PG Mathematics Course:

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credits
First	First (Credit-25)	B030701T	Advanced Abstract Algebra	Theory	5
		B030702T	Advanced Real Analysis	Theory	5
		B030703T	Topology	Theory	5
		Any one of the following:			
		B030704T	Mathematical Modeling	Theory	5
		B030705T	Theory of Modules	Theory	5
		B030706P	Programming in Python-I	Practical	5
	Second (Credit-25)	B030801T	Analytical Dynamics	Theory	5
		B030802T	Theory of Differential Equations and Boundary Value Problems	Theory	5
		B030803T	Measure and Integration	Theory	5
		Any one of the following:			
		B030804T	History of Mathematics	Theory	5
		B030805T	Elementary Statistics	Theory	5
		B030806P	Programming in Python-II	Practical	5

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credits
Second	Third (Credit-25)	B030901T	Functional Analysis	Theory	5
		B030902T	Integral Equations	Theory	5
		B030903T	Advanced Numerical Methods	Theory	5
		Any one of the following:			
		B030904T	Special Theory of Relativity	Theory	5
		B030905T	Advanced Discrete Mathematics	Theory	5
		B030906P	Introduction to Scilab	Practical	5
	Fourth (Credit-25)	B031001T	Advanced Operation Research	Theory	5
		B031002T	Fluid Dynamics	Theory	5
		Any one of the following:			
		B031003T	Special Functions	Theory	5
		B031004T	General Theory of Relativity	Theory	5
		B031005R	Research Project (Dissertation)	Practical	10

Program Outcomes (POs)

PO1: To develop deep understanding of the fundamental axioms in mathematics and capability of developing ideas based on them.

PO2: To provide advanced knowledge of topics in pure mathematics particularly in Analysis and Geometry empowering the students to proceed with the area at higher level.

PO3: To develop understanding of applied mathematics and motivating the students to used mathematical techniques as a tool in the study of other scientific domains.

PO4: To provide students for research studies in Mathematics and related fields.

PO5: To provide students a wide variety of employment options as they can adopt research as a career or take up teaching jobs or can get employment in banking or can go for any other profession.

PO6: To inculcate problem solving skills, thinking and creativity through presentations, assignments and project work.

M.A./M.Sc. (Mathematics)

Detailed Syllabus for Previous Year

	Semester-I	Semester-II	Total
Papers	4T+1P	4T+1P	8T+2P
Credit	20+5	20+5	40+10
No. of Lectures	300+50	300+50	600+100

M.A./M.Sc.-I (Semester-I) Paper-I
Advanced Abstract Algebra (B030701T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to define Isotropic groups, solvable groups, cauchy's theorem for finite abelian group.

CO2: The students will be able to define Maximal subgroups, simple groups, composition series, normal and subnormal series, Jordan-Holder theorem, modules, Schur's leema, Jordan canonical and rational canonical forms.

CO3: The students will be able to define Field extensions, splitting or decomposition field, normal and separable field extension, perfect field.

CO4: The students are able to analyse Galois group, fundamental theorem of Galois group.

CO5: The student is equipped with standard concepts and tools at advance level that will serve him/her well towards pursuing research in algebra.

Unit	Topics	No. of Lectures
1	Action of group G on set, G-set, Stabilizers and faithful action of G, Isotropic groups, Cauchy's theorem for finite abelian groups and for finite group.	20
2	Subnormal series, composition series, Jordan-Holder theorem, Solvable groups, Nilpotent groups.	20
3	Field extensions, finite field extensions, simple field extensions, algebraic field extensions, decomposition field, normal and separable field extension, perfect fields.	20
4	Galois group, fundamental theorem of Galois group, Galois group of separable polynomials, Galois field, Construction of Galois field and its subfield.	15

Suggested Books

1. Abstract Algebra by Dummit and Foote (Wiley India)
2. Topics in Algebra by Herstein (Wiley India)
3. A first course in Abstract Algebra by Fraleigh (Pearson)

4. Field and Galois Theory by Morandi (Springer)
5. Field theory by Roman (Springer)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-I) Paper-II
Advanced Real Analysis (B030702T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to analyse Sequence and series of functions of real numbers, Uniform convergence.

CO2: The students will be able to analyse Riemann-Stieltjes integration and their properties, Relation between Riemann and R-S integrals.

CO3: The students will be able to analyse the rearrangement to terms in an infinite series & removal of brackets from a series. Also, the students will be acquainted with power series of real numbers.

CO4: The students will be able to analyse Functions of bounded variation and their properties, Absolutely continuous functions and their properties, Relation between absolute continuity and function of bounded variation.

Unit	Topics	No. of Lectures
1	Sequences & series of real valued functions; Pointwise and uniform convergence; Cauchy's criterion theorem; Mn-test, Weierstrass M-test, Abel's test, Dirichlet's tes; Uniform convergence and continuity, Uniform convergence and differentiability, Uniform convergence and integrability.	20
2	Riemann-Stieltjes integration and its properties; RS-integration of continuous & bounded monotonic functions; RS-integration w.r.t arbitrary integrator; Relation between R-integral and RS-integrals.	20
3	Conditional and Absolute convergence of infinite series of real numbers; Re-arrangement of terms in a series, removable of brackets from a series; Power series of real numbers, radius of convergence; Abel's theorem & Tauber's theorem.	20
4	Functions of bounded variation and their properties; Absolute continuous functions and their properties; Relation between absolute continuity and function of bounded variation.	15

Suggested Books

1. Real Analysis by H.L. Royden (Mac Millan)
2. A first course in Mathematical Analysis by Somasundaram (Narosa)
3. Mathematical Analysis by Malik and Arora (New Age International)
4. Mathematical Analysis by T.M. Apostol (Wesley)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-I) Paper-III
Topology (B030703T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students are able to analyse Topological space, open and closed sets in Topological space, neighborhoods, closure, interior, exterior, derived and dense sets, bases and sub-bases.

CO2: The students are able to analyse Continuous functions and Homeomorphism, first and second countable spaces and separability.

CO3: The students are able to understand various concepts like: T_0, T_1, T_2, T_3, T_4 spaces and basic properties.

CO4: The students are able to understand various concepts like: Compactness, Connectedness and Tychonoff product topology.

Unit	Topics	No. of Lectures
1	Definition and example of Topological space, open and closed sets in Topological space, neighborhoods, closure, interior, exterior, derived and dense sets, bases and sub-bases, sub-spaces.	20
2	Continuous functions and Homeomorphism, first (1^{st}) and second (2^{nd}) countable spaces, separability.	20
3	T_0, T_1, T_2, T_3, T_4 spaces and their basic properties.	20
4	Connectedness and compactness, definition and some basic theorem.	15

Suggested Books

1. K.D. Joshi: Introduction to general topology – Wiley Eastern, New Delhi
2. J.L. Kelly: General Topology – Van Nostrand Reinhold Company, Newyork
3. James R Munkres: Topology – Prentice Hall India Private Ltd., New Delhi
4. Topology: R.S. Agarwal – S. Chand, New Delhi
5. General Topology: Schaum's Outline

Internal Assessment
Max. Marks – 25 Min. Passing Marks – 8

Marks division
Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam
Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-I) Paper-IV (i)
Mathematical Modelling (B030704T)

Credit – **5** | No. of Lectures – **75**

Max.Marks – **25+75** | Min.Passing Marks – **8+25**

Course Outcomes:

CO1: The students will be able to convert a real-world problem into a mathematical model.

CO2: The students will be able to analyse mathematical modelling: need, classification, modelling process, Elementary mathematical models, Role of mathematics in problem solving and Single species population model.

CO3: The students will be able to mathematical modelling through ordinary differential equations of first order and second order and Some applications in economics, ecology, Modelling in epidemiology (SIS, SIR, SIRS models) and basic reproduction number.

CO4: The students will be able to do mathematical modelling through difference equations, Some simple models, Basic theory of linear difference equations with constant coefficients.

Unit	Topics	No. of Lectures
1	Introduction to mathematical modelling: need, classification, modelling process, Elementary mathematical models; Role of mathematics in problem solving. Single species population model: The exponential model and the logistic model, Harvesting model.	20
2	Modelling with ordinary differential equations: Overview of basic concepts in ODE and stability of solutions: steady state and their local and global stability, Linear and non-linear growth and decay models. Compartment models. Some applications in economics, ecology, Modelling in epidemiology (SIS, SIR models) and basic reproduction number.	20
3	Mathematical models through difference equations, Basic theory of linear difference equations with constant coefficients, Mathematical modelling through difference equations in economics and finance, Mathematical modelling through difference equations in population dynamics.	20

4	Mathematical modelling through partial differential equations, Situations giving rise to of partial differential equation models. Village development model.	15

Suggested Books

1. Mathematical Modelling (Third Edition) by J.N. Kapur (New Age International)
2. Fundamental Mathematical Modelling by Jana, Raychaudhari & Pal (CBCS, New Delhi).
3. Mathematical Models in Biology and Medicine by J.K. Kapur (East West Press)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-I) Paper-IV (ii)
Theory of Modules (B030705T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to define module, submodule and simple module.

CO2: The students will be able to define module homomorphism, natural homomorphism.

CO3: The students will be able to define linear span, linear & direct sums, basis. Also, they will be acquainted with the cyclic & free modules.

CO4: The students will be able to define Noetherian & Artinian modules. Also, they will know Noetherian & Artinian rings.

Unit	Topics	No. of Lectures
1	Right R-module, Left R-module, Basic properties and Examples, Module over ring of integers; Relation between Ideals & Modules, Submodules, Irreducible Modules, Simple Modules, Quotient Module.	20
2	Module homomorphisms & isomorphisms, Basic properties, kernel and range, Natural homomorphism, Fundamental theorem of module homomorphism, Relation of module isomorphism, Schur's Lemina.	20
3	Linear Combination of elements of an R-module, Linear span, linear sum, direct sum; cyclic module, relation between simple module & cyclic module; Basis of a module, free module.	20
4	Noetherian & Artinian modules, examples & basic properties; submodules of Noetherian & Artinian modules; Homomorphic images of Noetherian & Artinian modules; Noetherian & Artinian rings (definitions only).	15

Suggested Books

1. Groups, Rings, Modules by Auslander (Dover Books)

2. Introduction to Rings and Modules by C. Musili (Narosa)
3. Algebra by M. Artin (Pearson)
4. Basic Algebra: Vol. I by Jacobson (Dever)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-I) Paper-V

Programming in Python-I : Practical (B030706P)

Credit – **5** | No. of Lectures/Labs – **50**

Max.Marks – **50+50** | Min.Passing Marks – **17+17**

Course Outcomes:

CO1: The students will be able to describe the basic principles of Python programming language.

CO2: The students will be able to implement object-orient concepts.

CO3: The students will be able to making use of software easily right out of the box.

CO4: The students will be able to experience with an interpreted language.

Basics of Python Programming

Introduction to Python, Python Identifiers, Key words, Variables & Operators, Data Types, Strings, Lists and Tuples, Dictionary & Sets, Input-Output, Conditional Statements and Expressions, Loops, Control Flow statements, Functions, Modules & Recursions, introduction to Classes and Inheritance, Working with files

1. Getting started, Anaconda Installation, Python notebooks and Editors, Github
2. Calculate the distance between two points in three dimensions
3. Write a program to calculate average of two numbers and print their deviation.
4. Write a program to calculate factorial of a number.
5. Write a program to find GCD of two numbers.
6. Write a program greatest number from three numbers.
7. Write a program to print the reverse of a number.
8. Write a program to classify a given number as prime or composite.
9. Write a program that computes permutations P(n,r) and combinations C(n,r)
10. Write a program that computes displays all leap years from 1900-2101
11. Write a program to print Fibonacci series up to a given number
12. Write a program to convert binary number to decimal number and vice versa
13. Opening, closing, editing, deleting and creating files in Python
14. Create a simple function and call it from the main program
15. Loops in Python: examples

Suggested Books

1. Python Programming for Beginners by Anthony Adam
2. Let us Python by Kanetkar (bpb publication)
3. Programming in Python by R.S. Salaria (Khanna Publishers)
4. Learn Python the Hard way by ZED-SHAW (Addition Wesley)
5. Introduction to Python Programming by Gaurishankar & Veena (CRC Press)

Internal Assessment

Max. Marks – 50 Min. Passing Marks – 17

Marks division

Sessional Exam	- 20 (Time duration – 1 hr.)
Seminar	- 25
Attendance	- 05

Semester Exam (Practical Exam)

Max. Marks – 50 Min. Passing Marks – 17

M.A./M.Sc.-I (Semester-II) Paper-I
Analytical Dynamics (B030801T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to classify dynamical systems, and define generalized coordinates, Classification of Dynamical System and D' Alembert's Principle, Lagrange's equations.

CO2: The students will be able to define Hamilton's canonical equations, Hamilton's principle and principle of least action.

CO3: The students will be able to define two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations and examples.

CO4: The students will be able to define Lagrange Bracket, Poisson Bracket, Canonical Transformation, Jacobi Identity, Hamilton Jacobi Theorem and Poisson's Theorem.

Unit	Topics	No. of Lectures
1	Introduction of Analytical Dynamics, Generalized coordinates, Degree of Freedom, Classification of Dynamical System, Conservative and Non Conservative System, generalized Forces, D' Alembert's Principle, Lagrange's equations	20
2	Hamilton's canonical equations, Hamilton's principle and principle of least action, Conservation of Momentum and Displacement of the System, Hamiltonian Function and total Energy, Cyclic or Ignorable Coordinate.	20
3	Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations and examples.	20
4	Lagrange Bracket, Poisson Bracket, Canonical Transformation, Jacobi Identity, Hamilton Jacobi Theorem, Poisson's Theorem.	15

Suggested Books

1. Analytical Dynamics: Theory and Applications by Ardema (Springer)
2. Analytical Dynamics: A New Approach by Udwadia & Robert (Cambridge University Press)
3. Classical Mechanics by Rana and Jog (McGraw Hil)
4. Classical Mechanics by J.C. Upadhyay (Himalaya Publication)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-II) Paper-II
Theory of Differential Equations and Boundary Value Problems
(B030802T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to analyse Laplace's Equation, Harmonic functions, Head and Wave equations and their Fundamental solutions.

CO2: The students will be able to analyse Existence and uniqueness theorem, initial value problems and picardes theorem, Peano's existence theorem and corollaries.

CO3: The students will be able to analyse Ordinary Differential Equations of Sturm-Liouville boundary value problem, Green's function, Poisson representation formula.

CO4: The students will be able to analyse Application of Laplace transform to solve differential equations and Fourier transforms to boundary value Problems.

Unit	Topics	No. of Lectures
1	Method of separation of variables for Laplace, Fundamental solution of Laplace's Equation, Harmonic functions and properties, Heat and Wave equations, Solution of Wave equation with initial values, Fundamental solutions of Head Equation.	20
2	Existence and uniqueness theorem for first order ODE (Statements only), initial value problem and picardes theorem, convergence of solution of initial value problems, Peano's existence theorem (statement only) and corollaries.	20
3	Ordinary Differential Equations of Sturm-Liouville boundary value problem, Eigen value and Eigen functions, Orthogonality theorem, Expansion theorem, Green's function.	20
4	Application of Laplace transform to solve differential equations, Application of Fourier transforms to boundary value Problems.	15

Suggested Books

1. G.F. Simmons, Differential Equations with Applications and Historical Notes, McGraw Hill Education.
2. Coddington, E.A. and Levinson, N. (1955) Theory of Ordinary Differential Equations, TMH Education.
3. M.D. Raisinghania, Advance Differential Equations, S. Chand, 2016.
4. D.P. Choudhary and H.I. Freedman: A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.
5. I.N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1988.
6. Robert C Mcowen, Partial Differential Equations: Methods and Applications, Pearson Education Inc. 2003.

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-II) Paper-III
Measure and Integration (B030803T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Students will be efficient to know the measurability of a set calculating meter and inner measure only meter measure gives the measurability of a set. Student will easily classify some measurable and non-measurable sets.

CO2: Students will enable themselves to know measurable and non-measurable functions. Countability and measurability of a set is clearly known to students with Boral.

CO3: Students will be defined Lebesgue integral, Relation between Riemann integral and Lebesgue integral, Lebesgue integral of bounded measurable function and it's properties.

CO4: The students will be able to analyse L^p-space, some basic definitions and theorem, Holder's inequality, Minikowski inequality, Schwarz's and Jensen Inequality.

Unit	Topics	No. of Lectures
1	Measurable sets, outer and inner measure of a bounded set. Union and intersection of a Measurable sets. Lebesgue measurable sets. Sets of measure zero. Boral sets, measure of countable and uncountable sets.	20
2	Measurable functions, algebra of measurable functions, Boral measurable function, measurability of a continuous function, non-measurable function.	20
3	Lebesgue integral, Relation between Riemann integral and Lebesgue integral, criterion theorem for Lebesgue integral, Lebesgue integral of bounded measurable function and it's properties, Lebesgue integral of unbounded functions.	20
4	L^p-space, some basic definitions and theorem, Holder's inequality, Minikowski inequality, Schwarz's and Jensen Inequality.	15

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Suggested Books

1. Measure theory : Krishna B. Athreya, Soumendra N. Lahiri – Trim Hindustan Book Agency
2. Measure theory and Integration : G. DE Barra – New Age International Publisher
3. Measure theory and Integratism : A K Malik, S C Malik, S K Gupta – Willy Eastern Publisher
4. Real Variables : Lebesgue Measure and Integration – Schaum's outline

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-II) Paper-IV (i)
History of Mathematics (B030804T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to know that how the concepts have been developed in Mathematics.

Unit	Topics	No. of Lectures
1	Ancient Mathematics: The Babylonians. The Egyptians. The Greeks. The Romans, The Maya, The Chinese, The Japanese. The Hindus. The Arabs	20
2	Mathematics in Europe during the middle age.	20
3	Mathematics during the sixteenth, seventeenth, eighteenth, nineteenth, and twentieth centuries.	20
4	There naissance Vieta and Descartes to Newton, Euler, Lagrange, Laplace, Hardy, and Ramanujan	15

Suggested Books

1. F. Cajon: A History of Mathematics, 1894.
2. J. Stillwell: Mathematics and its History, Springer International Edition, 4th Indian Reprint, 2005.
3. A Consise History of Mathematics (Fourth Edition) by Dirk J. Struik (Dover Books)
4. Ganit ka Itihas by Dr. Brajmohan (Vani Prakashan, ND)

Internal Assessment

Max. Marks – 25 | Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)

Attendance - 05

Semester Exam

Max. Marks – 75 | Min. Passing Marks – 25

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M.A./M.Sc.-I (Semester-II) Paper-IV (ii)
Elementary Statistics (B030805T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Students will learn basic concepts of statistics used in various disciplines

CO2: Students will be able to study various measures of dispersion like range, mean deviation, quartile deviation and standard deviation.

CO3: Students will be able to analyze and solve various concepts related to probability and probability distributions.

CO4: Students will be able to learn and use concepts in confidence intervals, hypothesis testing, linear regression

Unit	Topics	No. of Lectures
1	Measure of Central Tendency: mean, median & mode. Measure of Dispersion: M.D., Variance, S.D.	20
2	Correlation & Regression; Probability – introduction, set theoretic approach, addition theorem.	20
3	Probability – Conditional probability, multiplication theorem, Theorem of total probability, Baye's theorem	20
4	Random Variables & Distribution – Mean & S.D. of random variables, probability distribution, binormal distribution; Introduction of normal distribution, t-distribution & Chi square distribution	15

Suggested Books

1. Fundamentals of Statistics by Gun, Gupta & Dasgupta (World Press Kolkata)
2. Basic Statistics by B.L. Agarwal (New Age International)
3. Fundamentals of Mathematical Statistics by Gupta and Kapoor (Sultan Chand, New Delhi)
4. Introduction to Probability and Statistics: Schaum's Outline (McGraw Hill)

5. Probability and Statistics by Iyengar, Gandhi, Ranganathan & Prasad (S. Chand, New Delhi)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-I (Semester-II) Paper-V

Programming in Python-II : Practical (B030806P)

Credit – 5 | No. of Lectures/Labs – 50

Max.Marks – 50+50 | Min.Passing Marks – 17+17

Course Outcomes:

CO1: The students will be able to analyze the data by plotting Bar chart/Pie chart/Histogram using Python programming.

CO2: The students will be able to solve simultaneous equations by using Python Programming.

CO3: The students will be able to solve ordinary and partial differential equations by using Python Programming.

CO4: The students will be able to find roots of equations by using different methods with Python Programming.

Use of Matplotlib for plotting and data representation. Introduction to numpy, scipy, sympy, using these libraries for Fourier series and Fourier transform,

Practicals:

I Data Visualization – I

1. Scatter plots
2. Bar charts
3. Histograms
4. Pie Charts

II Data Visualization – II

5. Interactive plots – 1 : modifying display.
6. Interactive plots – 2: editing data and plots.
7. How to make a simple animation in Python

III Numpy

8. Array Arithmatic
9. Matrix Arithmatic
10. Numerical Methods through numpy

IV Scipy

11. Regression
12. Optimization
13. Root-Finding

Suggested Books

1. S. Gowrishankar and A. Veena A, Introduction to Python Programming, CRC Press (2019)
2. Adam Stewart – Python Programming (2016)
3. Kenneth A. Lambert, Fundamentals of Python First Programs with Mindtap, Cengage Learning India (2011)
4. John V. Guttag, Introduction to Computation and Programming using Python, MIT Press (2021)

Internal Assessment

Max. Marks – 50 Min. Passing Marks – 17

Marks division

Sessional Exam	- 20 (Time duration – 1 hr.)
Assignment on Python Programming	- 25
Attendance	- 05

Semester Exam (Practical Exam)

Max. Marks – 50 Min. Passing Marks – 17

M.A./M.Sc. (Mathematics)

Detailed Syllabus of Final Year

	Semester-III	Semester-IV	Total
Papers	4T+1P	3T+1R	7T+1P+1R
Credit	20+5	15+10	35+15
No. of Lectures	300+50	225+50	525+100

M.A./M.Sc.-II (Semester-III) Paper-I
Functional Analysis (B030901T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to analyse normed linear spaces & Banach Spaces.

CO2: The students will be able to analyse continuous and bounded linear operators & linear functionals.

CO3: The students will be able to analyse inner product spaces & Hilbert spaces.

Unit	Topics	No. of Lectures
1	Norm function, metric generated by norm, normed linear space, Banach space, Sequences and continuous functions in Banach spaces, inequalities in Banach space, open/closed spheres and sets in Banach space, Convex sets, Standard Banach spaces: R,C, C[a,b], R^n, C^n, l^∞, l_∞, l^p, l_p spaces; Riesz-Fisher theorem & lemma.	25
2	Continuous and bounded linear operators & linear functionals in Banach space, norm of bounded operator /functional, equivalent norms, linear spcace of continuous linear operators & linear space of continuous linear functionals, open mapping theorem, closed graph theorem.	25
3	Inner product space, Hilbert space, norm of a vector, parallelogram law, Cauchy-Schwarz inequality, triangle inequality, orthogonal vectors, orthogonal & orthonormal sets, Bessel's inequality, Gram-Schmidt orthogonalization process, complete orthonormal set, orthogonal complement, projection theorem.	25

Suggested Books

1. Elements of functional analysis by B.K. Lahiri (World Press, Kolkata)
2. Functional Analysis: A first course by Kumaresan & Sukumar (Narosa New Delhi)

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3. Functional Analysis by Balmohan (New Age International)
4. Functional Analysis by Jain & Ahuja (New Age International)
5. Foundation of Functional Analysis by Ponnusamy (Narosa)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-II (Semester-III) Paper-II
Integral Equations (B030902T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Understand the methods to reduce Initial value problems associated with linear differential equations to various integral equations.

CO2: Categories and solve different integral equations using various techniques.

CO3: The students will be able to analyze Fredholm and Volterra integral operations, Solution by the successive approximations, Neumann series and resolvent kernel, equations with convolution type kernels.

CO4: The students will be able to analyze and solve the solution of integral equations by transform methods.

Unit	Topics	No. of Lectures
1	**Integral Equations:** Definition and classification of linear integral equations. Conversion of initial and boundary value problems into integral equations. Conversion of integral equations into differential equations.	20
2	**Fredholm Integral Equations:** Solution of integral equations with separable kernels, Eigen values and Eigen functions. Solution by the successive approximations, Neumann series and resolvent kernel. Solution of integral equations with symmetric kernels, Hilbert-Schmidt theorem.	20
3	**Volterra Integral Equations:** Successive approximations, Neumann series and resolvent kernel. Equations with convolution type kernels.	20
4	**Solution of integral equations by transform methods:** Singular integral equations, Hilbert transform and solutions by Laplace transformation.	15

Suggested Books

1. Kanwal, R.P.: Linear Integral Equation. Theory and Techniques. Academic Press, 2014.

2. Raisinghania M.D.: Integral Equation & Boundary Value Problem. S. Chand Publishing, 2007.
3. Jerri, A.: Introduction to Integral Equations with Applications, John Wiley & Sons, 1999.
4. Hildebrand, F.B.: Method of Applied Mathematics, Courier Corporation, 2012.
5. Wazwaz, A.M.: A First Course in Integral Equations. World Scientific Publishing Co. Inc, 1997.

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-II (Semester-III) Paper-III
Advanced Numerical Methods (B030903T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Student will be able to solve System of Linear Algebraic Equations, ordinary differential equations, and Partial differential equations.

CO2: The students will be able to understand and apply various iterative techniques for solving system of algebraic equations.

CO3: The students will be able to analyze the consistency and convergence of a given numerical scheme.

CO4: The students will be able to explain what kind of numerical schemes are best suited for each type of PDEs (hyperbolic, parabolic and elliptic) and the reasons behind these choices.

Unit	Topics	No. of Lectures
1	**Numerical Solution of System of Linear Equations:** Gauss Elimination Method with Partial and Complete Pivoting. Triangular factorization methods. Iterative methods: Jacobi method, Gauss-Seidel method and Gauss Jacobi method and their convergence, diagonal dominance.	20
2	**Numerical Solution of Ordinary Differential Equations:** Numerical solution of ODE by Picard's, Euler's and Runge-Kutta methods, Boundary value problems: Finite difference method.	20
3	**Numerical Solution of Partial Differential Equations:** Classification of second order general PDE, Difference Method. Difference methods for Parabolic PDE. Heat conduction equation and its numerical solutions with finite difference methods (Two and three level difference methods).	20
4	Difference methods for Hyperbolic PDE. Wave equation and its numerical solutions with finite difference methods (First order only). Difference methods for Elliptical PDE.	15

Suggested Books

1. M.K. Jain, S.R.K. Iyengar – R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, 6th Edition 2012.
2. S.D. Conte and C. DeBoor, Elementary Numerical Analysis: An Algorithmic Approach, McGraw Hill, N.Y., 1980.
3. C.F. Gerald and P.O. Wheatly – Applied Numerical Analysis, Pearson Education, Inc., 1999.
4. A. Ralston and P. Rabinowitz – A First Course in Numerical Analysis, 2nd Edition, McGraw Hill, New York, 1978.
5. K.E. Atkinson, An Introduction to Numerical Analysis, John Wiley and Sons, 1989.
6. F.B. Hilderbrand, Introduction to Numerical Analysis, Dover Publication.
7. W.F. Ames, Numerical Methods for PDEs, Academic Press, N.Y., 1977.

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

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M.A./M.Sc.-II (Semester-III) Paper-IV (i)
Special Theory of Relativity (B030904T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: After completion of the syllabus content, students understand the beauty of special theory of relativity.

CO2: Students will able to understand geometrical interpretation of space and time.

CO3: Students will able to analyse relativistic entities.

CO4: Students will able to analyse electromagnetism through Maxwell's equations.

Unit	Topics	No. of Lectures
1	Review of Newtonian Mechanics – inertial frame, speed of light & Galilean relativity, Michelson-Morley experiment, Lorentz – Fitzeralt contraction hypothesis, relative character of spaces & time, Postulates of special theory of relativity, Lorentz transformation equations and its geometrical interpretation.	20
2	Group properties of Lorentz transformations, Relativistic Kinematics: Composition of paralled velocities, length contraction, time dilation, transformation equations for components of velocity and acceleration of a particle and Lorentz contraction factor.	20
3	Geometrical representation of space & time – four dimensional Minkowskian space & time of special relativity; time like, light like and space like intervals; null cone, proper time, world line of a particle; Four vectors and tensors in Minkowskian space & time, variation of mass with velocity.	15

4	Equivalence of mass and energy; transformation equations of mass, momentum and energy; energy-momentum four vector, relativistic force and transformation equations for its components; relativistic equations of motion of a particle; Maxwell's equations in vacuum, invariance of De Alembertian operator under Lorentz transformation, Lorentz transformations of E & H, invariance of E-H & E.H under Lorentz transformation; invariance of Maxwell's equations under Lorentz transformations.	20

Suggested Books

1. Introduction to Special Relativity by Robert Resnick (Wiley India)
2. The Special Theory of Relativity by Benerji & Benerji (PHI)
3. Special Theory of Relativity by S.P. Puri (Pearson India)
4. A Primer of Special Relativity by Sardesai (New Age International)
5. Fundamentals of Special and General Relativity by K.D. Krori (PHI)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-II (Semester-III) Paper-IV (ii)
Advanced Discrete Mathematics (B030905T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Understand the basics of combinatorics, and be able to apply the methods from these subjects in problem solving.

CO2: Be able to use effectively algebraic techniques to analyse basic discrete structures and algorithms.

CO3: To provide a formal connection between algorithmic problem solving and the theory of languages and automata and develop them into a mathematical (abstract) view towards algorithmic design and in general computation itself.

Unit	Topics	No. of Lectures
1	Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers Principle of Inclusion and Exclusion, Derangements, Inversion formulae	15
2	Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph.	20
3	**Generating Functions:** Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions. **Recurrence Relations:** Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions.	20

4	**Languages:** Alphabets, string, language, Basic Operations on language, Concatenation, KleeneStar **Finite Automata and Regular Languages:** Regular Expressions, Transition Graphs, Deterministics and non-deterministic finite automata, NFA to DFA Conversion, Regular languages and their relationship with finite automata.	20

Suggested Books

1. C.L. Liu: Elements of discrete mathematics, Tata McGraw Hill Education, 2008.
2. Ram Babu: Discrete Mathematics, Pearson Edition India, 2011.
3. J.H. Van Lint and R.M. Wilson, A Course in Combinations, 2nd Ed., Cambridge University Press, 2001.
4. S.S. Sane, Combinatorial Techniques, Hindustan Book Agency, 2013.
5. J.E. Hopcroft, R. Motwani and J.D. Ullman, Introduction to Automata Theory, Languages, and Computation, 2nd Ed., Addison-Wesley, 2001.
6. Advance Discrete Mathematics by Sharma & Jain (USP)
7. Advanced Discrete Mathematics by Uday Singh Rajput (PHI)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

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M.A./M.Sc.-II (Semester-III) Paper-V

Introduction to Scilab : Practical (B030906P)

Credit – **5** | No. of Lectures/Labs – **50**

Max.Marks – **50+50** | Min.Passing Marks – **17+17**

Course Outcomes:

CO1: The students will be able to use SciLab/MATLAB in their mathematical problem solving.

CO2: The students will be able to use these software in working problems related to polynomials and Linear Algebra.

Introduction to SciLab, Installation, Basic elements of the language, Looping and Branching: If, select, for, break, continue, Functions, return, Contour plots, tiles, axes, legends.

Matrices: Creating matrices, sum, product of matrices, inverse, rank determinant, comparing matrices, system of equations, working with polynomials, defining a function and output arguments.

Practicals:

1. To print the prime numbers between 1 and 100.
2. Write a program to add, subtract, multiply and divide common fractions.
3. To find the average of between n and 12n where n is an integer.
4. Write a program to check a number is Armstrong or not?
5. Write a program to display table from 11 to 20.
6. To find the roots of a cubic equation.
7. To sum and difference of any two matrices and hence find the row sum and column sum of a given matrix.
8. To find inverse of a given 3x3 matrices.
9. Write a program to find the transpose, trace and norm of a matrix.
10. To sort all the elements of a 4x4 matrix.
11. Program to accept a matrix and determine whether it is a symmetric matrix, skew-symmetric or not.
12. Write a program to print Fibonacci numbers.

Suggested Books

1. SicLab a Beginner's Approach by A.K. Verma (Cengage India)
2. Introduction to SciLab by Nagar (Apress)

Internal Assessment

Max. Marks – 50 Min. Passing Marks – 17

Marks division

Sessional Exam	- 20 (Time duration – 1 hr.)
Seminar	- 25
Attendance	- 05

Semester Exam (Practical Exam)

Max. Marks – 50 Min. Passing Marks – 17

M.A./M.Sc.-II (Semester-IV) Paper-I
Advanced Operation Research (B031001T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Student will be able to define Inventory theory and Models.

CO2: Student will be able to define Quening theory and its characteristics, stochastic Processes under steady and transient states. Study of M/M/l and M/M/s quening models and Parametric Linear Programming.

CO3: Student will be able to analyse Network analysis, CPM and PERT.

CO4: Student will be able to define Game theory and Solution of rectangular game with saddle point, Solution of 2x2 game without saddle point, Graphical method of solution for 2xn and mx2 games.

Unit	Topics	No. of Lectures
1	Game theory, Zero-sum Game, Solution of rectangular game with saddle point, Solution of 2x2 game without saddle point. Graphical method of solution for 2xn and mx2 games. Integer Programming, Branch and Bound technique.	20
2	Network analysis, CPM and PERT, Transportation, NLPP, Assignment	20
3	Inventory theory, economic order Quantity Models under various demands having shortages and no shortages, Probabilistic Inventory models with discrete or continuous demand. Simple replancement model for Equipments that deteriorates with time in descreteand continuous form.	20
4	Quening theory and its characteristics, stochastic Processes under steady and transient states. Study of M/M/l and M/M/s quening models, Parametric Linear Programming.	15

Suggested Books

1. Operations Research – Kantiswarup, P.K. Gupta, Man Mohan – Sultan Chand & Sons, New Delhi.

2. Operations Research (An Introduction) – Hamdy A. Taha – Pearson.
3. Operations Research – K. Nagrajan – New Age International Publications.
4. Operation Research – V.K. Kapoor (Sultan Chand, New Delhi)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-II (Semester-IV) Paper-II
Fluid Dynamics (B031002T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The Students will be able to identify the fundamental concepts of Fluid dynamics and their role in modern mathematics and applied contexts.

CO2: The students will be able to apply the Fluid dynamics concepts to diverse situations in physics, engineering, and other mathematical contexts.

Unit	Topics	No. of Lectures
1	Lagrangian and Eulerian methods to describe the fluid motion, Equation of continuity, Boundary conditions, Stream Lines. Pathlines and streak lines, Velocity potential. Irrotational and rotational motions.	20
2	Euler's equations of motion, Pressure equation, Bernoulli's theorem, Impulsive actions, Flow and circulation, The permanence of irrotational motion. Stream function. Irrotational motion in two dimensions. Complex velocity potential. Sources, sinks, doublets, and their images.	20
3	The two-dimensional irrotational motion is produced by the motion of circular and elliptic cylinders in a liquid, Kinetic energy of liquid, Milne-Thomson circle theorem. The theorem of Blasius, Stoke's stream function.	20
4	Wave motion in gas, speed of sound, equation of motion of a gas, subsonic, sonic, super-sonic flow of a gas, isentropic of a gas, shock formation.	15

Suggested Books

1. F. Chorlton: Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985.
2. W.H. Besaint and A.S. Ramsey: A Treatise on Hydrodynamics, Part II, C.B.S. Publishers, Delhi, 1988.

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3. B.G. Verma: Hydrodynamics, Pragati Prakashan, Meerut, 1995.
4. M.D. Raisinghania: Fluid Dynamics, S. Chand and Co., 2003.
5. Fluid Dynamics: Schaum's Outline.

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-II (Semester-IV) Paper-III (i)
Special Functions (B031003T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: Student will be able to define Fundamental System of integrals, Singularity of a Linear Differential Equation. Series solution to Legendre, Bessel differential equations by Frobenius method.

CO2: Student will be able to define Hermite equation and its solution, Generating function, Rodrigue's formula, Recurrence relations, Orthogonal Properties of Hermite Polynomials.

CO3: Student will be able to define Lagurre equation and its solution.

CO4: Student will be able to define Hypergeometric Functions and Series Solution.

Unit	Topics	No. of Lectures
1	Ordinary and Singular points of a differential equation of second order; Frobenius method, Ascending series solutions of Legendre's equation, Bessel's equation, Hermite's equation, Laguerre's equation, Hypergeometric equation; Descending series solution of Legendre's equation & Hermite's equations; Series solutions of Bessel's equation when n=0,1,2.	10
2	Hermite polynomials – Expression for Hermite's polynomial & its sigma representation, generating function, Differential formula (Rodrigue formula) Orthogonal property, Recurrence relations, Relation between Hn(x) & Hn(-x)	20
3	Laguerre's Polynomial – Expression for Laguerre's polynomial & its sigma representation, generating function, Differential formula (Rodrigue formula), Orthogonal property, recurrence relations.	20

4	Hypergeometric function – Expression for Gauss hypergeometric function & its sigma representation, relation between $P_n(x)$ & hypergeometric function; Gauss theorem, Kummer theorem, Pochhammer symbol; derivative of hypergeometric function, integral formulae for hypergeometric function. Confluent hypergeometric function: (Kummer's function), Differentiation of confluent hypergeometric function, integral formula for confluent hypergeometric function.	25

Suggested Books

1. Special Functions and their Applications by Lebedev (Dover Books)
2. Special Functions by Bell (Dover Books)
3. Mathematical Special Function by Prasad & Sharma (S. Chand, New Delhi)
4. Ordinary and Partial Differential Equations by M.D. Raisinghania (S. Chand)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

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M.A./M.Sc.-II (Semester-IV) Paper-III (ii)
General Theory of Relativity (B031004T)

Credit – 5 | No. of Lectures – 75

Max.Marks – 25+75 | Min.Passing Marks – 8+25

Course Outcomes:

CO1: The students will be able to understand metric tensor and Riemannian space.

CO2: The students will be able to learn Ricci tensor, Bianchi Identities, examples of symmetric space time.

CO3: The students will be able to understand Einstein's field equation, gravitational waves in empty space.

Unit	Topics	No. of Lectures
1	Transformation of coordinates, transformation law of tensor, Product of two tensor, Contraction, Quotient law, Metric tensor and Riemannian space, Conjugate tensor, symmetric and anti-tensor, Levi-Civita tensor, Christoffel symbol, Covariant derivative, Riemannian metric.	15
2	Tensor form of gradient, divergence and curls, Parallel transport, Riemannian curvature tensor, Ricci tensor, Bianchi identities, Geodesic, Null geodesic, Geodesic deviation, Einstein tensor, Einstein space.	20
3	Introduction to General Relativity, Principle of Equivalence, Principle of General covariance, Mach's Principle, geodesic postulate, Energy momentum tensor, Newtonian approximation of equation of motion, Search for Einstein's field equation, Einstein's field equation reduces to Poisson's equations, deviation of Einstein's field equation from vibrational principle.	20
4	Gravitational field in empty space, Schwarzschild exterior solution, Singularities in Schwarzschild line element, Isotropic form of Schwarzschild exterior line element, Planetary orbits, Three Crucial tests in General relativity, Birkhoff's theorem.	20

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Suggested Books

1. An introduction to Relativity by J.V. Narlikar (Cambridge University Press)
2. General Theory of Relativity by S.P. Puri (Pearson)
3. Mathematical Theory of General Relativity by L.N. Kathkar (Narosa)
4. Introduction to General Relativity by Parthasarathy (Narosa)

Internal Assessment

Max. Marks – 25 Min. Passing Marks – 8

Marks division

Sessional Exam - 20 (Time duration – 1 hr.)
Attendance - 05

Semester Exam

Max. Marks – 75 Min. Passing Marks – 25

M.A./M.Sc.-II (Semester-IV) Paper-IV

Research Project: Dissertation (B031005R)

Credit – **10**

No. of Lectures for guidance – **100**

Max.Marks – **200**

Min.Passing Marks – **66**

Division of Marks -

Evaluation of Dissertation File	- 100
Presentation	- 50
Viva	- 50

Note:

1. Topics of dissertation will be decided by the supervisors.
2. Minimum number of pages of dissertation should be 20, hand written or typed.

Summary of Assessment/Marking Pattern

(A) 15 Theory Papers (Each of 100 marks)

Internal Assessment (25)

Sessional Exam	- 20	Time duration – 1 hr.
Attendance	- 05	

Semester Exam (75) :

(B) 03 Papers of Practical Subjects (each of 100 marks)

(i) Semester I & III

Internal Assessment (50)

Sessional Exam	- 20 (1 hr.)
Seminar	- 25
Attendance	- 05

Semester Exam: Practical – 50 (2 hrs.)

(ii) Semester II

Internal Assessment (50)

Sessional Exam	- 20 (1 hr.)
Assignment	- 25
Attendance	- 05

Semester Exam: Practical – 50 (2 hrs.)

(C) 01 Research Project/Dissertation (Marks-200)

Evaluation of dissertation	– 100
Presentation	– 50
Viva	– 50

- Semester I (4T+1P) : 400+100 marks
  Semester II (4T+1P) : 400+100 marks
- Semester III (4T+1P) : 400+100 marks
  Semester IV (3T+1R) : 300+200 marks

G.Total : 15T+3P+1R : 1500+300+200 = 2000

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कमला नेहरू भौतिक एवं सामाजिक विज्ञान संस्थान, सुलतानपुर

स्वायत्तशासी संस्थान

दिनांक: 10.09.2023

निर्णय संख्या–02–

प्रश्न–पत्र प्रारूप निर्धारण निर्णय निम्नवत् है:–

1. समस्त प्रश्न–पत्र 2 घण्टे का होगा।
2. प्रश्न–पत्र का पूर्णांक 75 अंकों का होगा।
3. प्रश्न–पत्र कुल 3 खण्डों में विभक्त होगा।

- प्रथम खण्ड A में कुल 20 अति लघु उत्तरीय प्रश्न होंगे। जिसमें बहुविकल्पीय, सत्य/असत्य (ट्रू/फाल्स) एवं रिक्त स्थानों की पूर्ति (फिल इन द ब्लैंक) आदि प्रारूप शामिल किए जा सकते हैं। प्रत्येक प्रश्न पर 2 अंक निर्धारित हैं। अति लघु उत्तरीय प्रश्न पूरे पाठ्यक्रम को कवर करते हुए बनाया जाएगा। शब्द सीमा 25 शब्द की होगी।
- प्रश्न–पत्र के दूसरे खण्ड B में कुल 05 लघु उत्तरीय प्रश्न होंगे। जिनकी शब्द सीमा 200 शब्दों की होगी। प्रत्येक प्रश्न पर 04 अंक निर्धारित होंगे। हर प्रश्न का विकल्प भी आवश्यक है।
- प्रश्न–पत्र के खण्ड C में मात्र 01 प्रश्न होगा। अधिकतम शब्द सीमा 500 शब्द की होगी। इसके कम से कम 03 विकल्प आवश्यक होंगे। इस एक प्रश्न पर 15 अंक निर्धारित हैं। इस तरह कुल अंक एक प्रश्न–पत्र का 75 अंक का होगा।

4. समिति ने यह निर्णय लिया कि किसी असंगत स्थिति में समिति को अधिकार होगा कि वह आवश्यक सुझाव व परिवर्तन हेतु स्वतंत्र होगी।

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