GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR
(Established by State Legislature Act 17 of 1995)
'A+' Grade, NAAC Accredited State Govt. University

Acad./AC-III/BOS&R-12/2023/ 6290
Dated 27/10/23

For n a/c
by
To
Mr Madan 28/10/2023

The Controller of Examinations
GJUS&T, Hisar.

Sub: Approval of scheme of examination and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics (1st & 2nd semester) being run in University Teaching Department w.e.f. academic session 2023-24.

Sir,

I am directed to inform you that the Vice-Chancellor, on the recommendations of Dean, Faculty of Physical Sciences & Technology on 18.10.2023, is pleased to approve the scheme of examinations and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics (1st & 2nd semester) being run in University Teaching Department w.e.f. academic session 2023-24 under Section 11(5) of the University Act, 1995 in anticipation of approval of the Academic Council.

A copy of the scheme of examinations & syllabi of above said programme is enclosed herewith.

You are therefore, requested to take further necessary action accordingly.

Yours faithfully

DA: As above

27/10/23
Assistant Registrar (Academic)
for Registrar

Endst. No. Acad./AC-III/BOS&R-12/2023/ 6291-92 Dated: 27/10/23

A copy of the above is forwarded to the following for information and necessary action:-

3. Dean, Faculty of Physical Sciences & Technology, GJUS&T, Hisar.

4. Chairperson, Deptt. of Mathematics, GJUS&T, Hisar alongwith scheme of examinations and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics (1st & 2nd semester) being run in University Teaching Department w.e.f. academic session 2023-24. He is requested to arrange to upload the scheme of examinations & syllabi of above said programme on the website of the University.

27/10/23
Assistant Registrar (Academic)

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

Scheme of Integrated B.Sc. (Hons/Hons. with Research)-M.Sc. Chemistry/Physics/Mathematics programme under National Education Policy 2020 (w.e.f. 2023-24)

SEMESTER-I

Course Code	Course	Nomenclature	Credits	Hrs/ week	Marks		
					Ext.	Int.	Total
23CHL101	Discipline Specific Course (DSC-A1)	Chemistry-I	4	4	70	30	100
23PHL101	Discipline Specific Course (DSC-B1)	Physics-I (Mechanics)	4	4	70	30	100
23MAL101 OR 23BIL101	Discipline Specific Course (DSC-C1)	Mathematics-I (Algebra) OR Biology-I	4	4	70	30	100
23PHP101	Minor Course (MIC1)	Physics Lab-I	2	4	35	15	50
23MAL102 OR 23MAL103 OR 23BIL102	Multidisciplinary Course (MDC1)	Elementary Mathematics-I OR Basic Statistics OR Elementary Biology-I	3	3	50	25	75
23ENG101	Ability Enhancement Course (AECI)	English	2	2	35	15	50
23MAL104 OR 23CH102 OR 23PHL102 OR 23BIL103	Skill Enhancement Course (SEC1)	Numerical Analysis OR Role of Chemistry in Society OR Physics of sustainable development OR Life style disorder	3	3	50	25	75
23EVL101	Value Added Course (VAC1)	Environmental Science	2	2	35	15	50
			24	**26**	**415**	**185**	**600**

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

Scheme of Integrated B.Sc. (Hons/Hons. with Research)-M.Sc. Chemistry/Physics/Mathematics programme under National Education Policy 2020 (w.e.f. 2023-24)

SEMESTER-II

Paper code	Course	Nomenclature	Credits	Hrs/ week	Marks		
					Ext.	Int.	Total
23CHL201	Discipline Specific Course (DSC-A2)	Chemistry-II	4	4	70	30	70
23PHL201	Discipline Specific Course (DSC-B2)	Physics-II	4	4	70	30	70
23MAL201 OR 23BIL201	Discipline Specific Course (DSC-C2)	Mathematics-II (Calculus) OR Biology-II	4	4	70	30	100
23CHP201	Minor Course (MIC2)	Chemistry Lab-II	2	4	35	15	50
23MAL202 OR 23MAL203 OR 23BIL202	Multidisciplinary Course (MDC2)	Elementary Mathematics-II OR Descriptive Statistics OR Elementary Biology-II	3	3	50	25	75
23HIL201	Ability Enhancement Course (AEC2)	Hindi	2	2	35	15	50
23CSL201 OR 23BIL202	Skill Enhancement Course (SEC2)	Fundamentals of Computers Or Biofertilizer	3	3	50	25	75
23PTL201 OR 23PSL201	Value Added Course (VAC2)	Yoga and Meditation OR Emotional competence and spirituality for wellbeing	2	2	35	15	50
			24	**26**	**415**	**185**	**600**

Notes:

i) Students who have studied Mathematics at 10+1 and 10+2 level shall opt Elementary Biology-I & II and those who have studied Biology shall opt Elementary Mathematics-I&II in 1st and 2nd semesters.

ii) Semester-I & II will be common for all the three Integrated B.Sc. (Hons/Hons with research)-M.Sc. Chemistry/Physics/Mathematics programmes.

iii) The student opting for exit after first year must complete summer internship of 4 credits (120 hrs.) to get UG Certificate.

Mathematics-I (Algebra)

Paper Code: 23MAL101
Marks (Theory) : 70
Marks (Internal Assessment) : 30

Credits: 4:0:0
Marks(Total) : 100
Time : 4 Hrs

Note: Attempt five questions in all. The question paper will consist of **four** sections. **Question No. 1** will contain **seven** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.** Each of the four sections **(I-IV)** will contain two questions and the students are required to attempt **one** question from each section. **All questions carry equal marks.**

CO 1 Enables us to know about different type of matrices, their properties and applications.
CO 2 To know about consistency of different linear using rank.
CO 3 Enables us to get knowledge about relations between roots and coefficients of the polynomial.
CO 4 To know about different methods to solve cubic equations also enables to know the nature of roots of a polynomial.

Section – I

Symmetric, Skew-symmetric, Hermitian and skew Hermitian matrices. Elementary operations on matrices. Rank of a matrix. Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Row rank and column rank of a matrix. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Section – II

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms.

Section – III

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations.

Section – IV

Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.

Books Recommended :

1. H.S. Hall and S.R. Knight, Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan, A Text Books of Matrices.
3. Chandrika Prasad, Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

Elementary Mathematics-I

Paper Code: 23MAL102
Marks (Theory) : 50
Marks (Internal Assessment) : 25

Credits: 3:0:0
Marks(Total) : 75
Time : 3 Hrs

Note: Attempt five questions in all. The question paper will consist of **four** sections. **Question No. 1** will contain **five to seven** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.** Each of the four sections **(I-IV)** will contain two questions and the students are required to attempt **one** question from each section. **All questions carry equal marks.**

Course outcomes:

CO 1. To familiar with the properties satisfied by a collection of objects.
CO 2. To know about the straight lines and trigonometrical function.
CO 3. To know about different types of arrangements of given objects. Also to know about binomial expansions.
CO 4. To familiar with applications of graphs in solutions linear Inequalities in two variables.

Section – I

Sets, Relations and Functions : Sets and their Representations, The Empty Set, Finite and Infinite Sets, Equal Sets, Subsets, Universal Set, Venn Diagrams, Operations on Sets, Complement of a Set, Practical Problems on Union and Intersection of Two Sets, Cartesian Product of Sets, Relations, Functions.

Sequences and Series: Sequences, Series, Arithmetic Progression (A.P.), Geometric Progression (G.P.), Relationship Between A.M. and G.M.

Section – II

Straight Lines: Introduction, Slope of a Line, Various Forms of the Equation of a Line, General Equation of a Line, Distance of a Point From a Line.

Trigonometric Functions: Angles, Trigonometric Functions, Trigonometric Functions of Sum and Difference of Two Angles, Trigonometric Equations.

Section – III

Permutations and Combinations: Fundamental Principle of Counting, Permutations, Combinations.

Binomial Theorem: Introduction, Binomial Theorem for Positive Integral Indices, General and Middle Terms.

Section – IV

Linear Inequalities: Inequalities, Algebraic Solutions of Linear Inequalities in One Variable and their Graphical Representation, Graphical Solution of Linear Inequalities in Two Variables, Solution of System of Linear Inequalities in Two Variables.

Probability: Introduction, Random Experiments, Event, Axiomatic Approach to Probability, Addition Theorems on Probability, Conditional Probability, Multiplicative Law of Probability.

Books Recommended:

1. Mathematics Text Book for Class XI, National Council of Educational Research and Training.
2. R.S. Verma and K.S. Sukla, Text Book on Trigonometry, Pothishala Pvt. Ltd, Allahabad.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons.
4. Ivo Duntsch and Gunther Gediga, Set, Relations, Functions, Methodos Publishers.

Basic Statistics

Paper Code: 23MAL103
Marks (Theory) : 50
Marks (Internal Assessment) : 25

Credits: 3:0:0
Marks(Total) : 75
Time : 3 Hrs

Note: Attempt five questions in all. The question paper will consist of **four** sections. **Question No. 1** will contain **five to seven** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.** Each of the four sections (**I-IV**) will contain two questions and the students are required to attempt **one** question from each section. **All questions carry equal marks.**

Section-I

Introduction of Statistics, types of data, Scales of measurement . Collection, classification and tabulation of data. Presentation of data: histograms, frequency polygon, frequency curve and ogives. Stem- and- Leaf and Box plots.

Section-II

Measures of Central Tendency and Location: Mean, median, mode, geometric mean, harmonic mean, partition values. Measures of Dispersion: Absolute and relative measures of range, quartile deviation, mean deviation, standard deviation (σ), coefficient of variation.

Section-III

Moments, Skewness and Kurtosis: Moments about mean and about any point and derivation of their relationships, effect of change of origin and scale on moments, Sheppard's correction for moments (without derivation), Charlier's checks, Concepts of Skewness and Kurtosis.

Section-IV

Scatter diagram, Karl Pearson Coefficient (r) of correlation and rank correlation coefficient. Linear Regression: Concept of regression, principle of least squares and fitting of straight line, derivation of two lines of regression, properties of regression coefficients, Angle between two lines of regression. Difference between correlation and regression.

Books Recommended

1. Goon, A.M., Gupta, M.K., and B. Das Gupta, Fundamentals of Statistics, Vol-I.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.
3. Bernstein, S. & Bernstein, R. , Elements of Statistics, Schaum's outline series, McGraw-Hill.
4. Neil A. Weiss, Introductory Statistics (10th Edition) - ISBN 9780321989178, published by Pearson
5. Sheldon M. Ross, Introductory Statistics (4th Edition) .

Numerical Analysis

Course Code: 23MAL104
Marks (Theory) : 50
Marks (Internal Assessment) : 25

Credit: 3.0.0
Marks(Total) : 75
Time : 3 Hrs

Note: Attempt five questions in all. The question paper will consist of **four** sections. **Question No. 1** will contain **five to seven** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.** Each of the four sections **(I-IV)** will contain two questions and the students are required to attempt **one** question from each section. **All questions carry equal marks.**

Course Outcomes:

CO1: To get basic outlines of approximation and errors in computations. Be able to investigate the solution of nonlinear equations by Graphical method and various iterative methods.

CO2: Be able to find the numerical solution of a system of linear equations using various direct and iterative methods.

CO3: To acquire the basic knowledge of Difference operators and their relations. Be able to estimate the value of a function for any intermediate value of the independent variable in a given set of data points, by various numerical methods.

CO4: Be able to calculate the value of the derivative of a function at some assigned value of independent variable and to estimate a definite integral from a set of tabulated values of the function by using various numerical methods.

SECTION-I

Approximation and Errors in Computations: Introduction, accuracy of numbers, errors, estimation of errors.

Solution of Algebraic and Transcendental Equations: Introduction, Graphical method to find approximate roots, Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method. Some important deductions from Newton-Raphson formula.

SECTION-II

Solution of Linear Simultaneous Equations: Introduction of a linear system of equations and type of solutions.

Direct Methods of Solution: Cramer's Rule, Matrix inversion method, Gauss elimination method, Gauss-Jordan method.

Iterative Methods of Solution: Jacobi's method, Gauss-Seidal method.

SECTION-III

Finite Differences: Finite difference operators and their relations. Differences of a polynomial.

Interpolation with Equal Intervals: Newton's forward interpolation formula, Newton's backward interpolation formula, Gauss's forward interpolation formula, Gauss's backward interpolation formula.

Interpolation with Unequal Intervals: Lagrange's interpolation formula, Newton's divided difference formula.

SECTION-IV

Numerical Differentiation: Derivatives using Newton's forward difference formula, Newton's backward difference formula, Gauss's forward difference formula, Gauss's backward difference formula and Newton's divided difference formula.

Numerical Integration: Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule.

Reference books:

1. B.S. Grewal: Numerical Methods in Engineering and Science, Khanna Publishers (Ninth Edition), New Delhi (2010).
2. M.K Jain, S.R.K. Iyengar, R.K. Jain: Numerical Methods: Problems and Solutions (Third Edition), New Age International (P) Ltd., New Delhi (2020).
3. S.S. Shastry: Introductory Methods of Numerical Analysis (Fifth Edition), Prentice Hall India Learning (P) Ltd., New Delhi (2012).
4. C.E. Froberg: Introduction to Numerical Analysis (Second Edition), Addison-Wesley Educational Publishers Inc., New Jersey (1970).
5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis (Seventh Edition), Pearson Education India, Noida (2007).

Mathematics –II (Calculus)

Course Code: 23MAL 201
Marks (Theory) : 70
Marks (Internal Assessment) : 30

Credits: 4.0.0
Marks(Total) : 100
Time : 4 Hrs

Note: Attempt five questions in all. The question paper will consist of **four** sections. **Question No. 1** will contain **seven** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.** Each of the four sections **(I-IV)** will contain two questions and the students are required to attempt **one** question from each section. **All questions carry equal marks.**

CO1: Be able to compute limits, derivatives, and integrals. To be able to find higher order derivatives and utilize the Leibnitz rule to solve problems involving such derivatives.
CO2: Use the concept and principles of differential calculus to discover the curvature, concavity, and points of inflection, as well as asymptotes in Cartesian and polar coordinates.
CO3: Be able to trace standard curves in cartesian, parametric and polar coordinates. Derive Reduction formulae for some complex integrations.
CO4: Understand how to determine the arc length of a curve. Be able to determine the volume of a solid of revolution using multiple approaches.

Section – I

Definition of the limit of a function. Basic properties of limits, Continuous functions and classification of discontinuities. Differentiability. Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions.

Section – II

Asymptotes in Cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates. Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves. Newton's method. Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points.

Section – III

Tracing of curves in Cartesian, parametric and polar co-ordinates. Reduction formulae. Rectification: Fundamental theorem. Cartesian curves, parametric curves, polar curves. intrinsic equations of curve.

Section – IV

Quadrature Sectorial area. Area bounded by closed curves. Volumes of solids of revolution: Volume formula for Cartesian curves, parametric curves, polar curves, Volume formula for two solids.

Books Recommended:

1. Differential and Integral Calculus, Shanti Narayan.
2. Murray R. Spiegel, Theory and Problems of Advanced Calculus. Schaun's Outline series. Schaum Publishing Co., New York.
3. N. Piskunov, Differential and Integral Calculus. Peace Publishers, Moscow.
4. Gorakh Prasad, Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
5. Gorakh Prasad, Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

Elementary Mathematics-II

Paper Code: 23MAL202 **Credits: 3.0.0**
Marks (Theory): 50 **Marks(Total) : 75**
Marks (Internal Assessment): 25 **Time : 3 Hrs**

Note: Attempt five questions in all. The question paper will consist of **four** sections. **Question No. 1** will contain **five to seven** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.** Each of the four sections **(I-IV)** will contain two questions and the students are required to attempt **one** question from each section. **All questions carry equal marks.**

Course outcomes:

CO 1. To familiar with the different types of arrangement and their applications.
CO 2. To know about the rate of change of one variable quantity with respect to another. The results discussed in the chapter have many applications in Business, and in extreme value problems of functions.
CO 3. Solutions of many scientific problems come from the solutions of differential equations associated with them, therefore, in the present section we come to know about differential equations and their solutions.
CO 4. To familiar with rate of change of a variable when it is a function of more than one variable.

Section – I

Matrix Algebra: Introduction, types of matrices, addition and multiplication of matrix, transpose of matrix, concept of elementary row and column operations. Determinant and its properties, minors, cofactors. Application of determinants in finding area of triangle. Adjoint and inverse of a square matrix. Solution of homogeneous and non-homogeneous linear equations and condition for solution.

Section – II

Differential Calculus: Differentiation of standard functions including function of a function (Chain rule). Differentiation of implicit functions, logarithmic differentiation,
Integral Calculus: Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, partial fractions and substitution. Formal evaluation of definite integrals.

Section – III

Ordinary Differential Equations: Definition and formation of ordinary differential equations, equations of first order and first degree, variable separable, homogeneous equations, linear equations (Leibnitz form) and differential equations reducible to these types, Linear differential equation of order greater than one with constant coefficients, complementary function and particular integrals.

Section – IV

Partial Differential Equations: Introduction of partial differentiation of first and send order Introduction and formation of P.D.E., solution of P.D.E., linear equation of first order (Lagrange's partial differential equations only).

Books Recommended:

1. Mathematics :Text Book for Class XII, National Council of Educational Research and Training.
2. Shanti Narayan : Differential and Integral Calculus, S. Chand.
3. Shanti Narayan : A Textbook of Matrices, S. Chand.
4. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw Hill.

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR
(Established by State Legislature Act 17 of 1995)
'A+' Grade, NAAC Accredited State Govt. University

Acad /AC-III/ BOS&R-3/2024/ 7616
Dated 19/11/24

To

The Controller of Examinations,
GJUST, Hisar.

Sub: **Approval of scheme of examinations and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics – ~~(3rd and 4th semester)~~ 3rd to 6th Semester w.e.f. academic session 2024-25 (Batch 2023-24) under NEP-2020 being run in University Teaching Department.**

Sir,

I am directed to inform you that the Vice-Chancellor, on the recommendations of Dean, Faculty of Physical Sciences & Technology on 14.11.2024 and the Chairperson, Deptt. of Mathematics, is pleased to approve the scheme of examinations and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics – ~~(3rd and 4th semester)~~ 3rd to 6th Semester w.e.f. academic session 2024-25 (Batch 2023-24) under NEP-2020, being run in University Teaching Department, under Section 11(5) of the University Act, 1995 in anticipation of approval of the Academic Council.

A copy of the scheme of examinations & syllabi of above said programme is enclosed herewith.

You are therefore, requested to take further necessary action accordingly.

Yours faithfully

DA: As above

19/11/24
Assistant Registrar (Academic)
for Registrar

Endst. No. Acad./AC-III/BOS&R-3/2024/ 7617-20 Dated: 19/11/24

A copy of the above is forwarded to the following for information and necessary action:-

1. Dean, Faculty of Physical Sciences & Technology, GJUST, Hisar.
2. Chairperson Department of Mathematics, GJUST, Hisar alongwith copy of scheme of examinations and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics – ~~(3rd and 4th semester)~~ 3rd to 6th Semester w.e.f. academic session 2024-25 (Batch 2023-24) under NEP-2020, being run in University Teaching Department. He is requested to arrange to upload the scheme of examinations & syllabi of above said programme on the website of the University.
3. CSD to Vice-Chancellor (for kind information of the Vice-Chancellor), GJUST, Hisar.
4. Secretary to Registrar (for kind information of the Registrar), GJUST, Hisar.

19/11/24
Assistant Registrar (Academic)

Status of 1st Page Only

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GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR
(Established by State Legislature Act 17 of 1995)
'A+' Grade, NAAC Accredited State Govt. University

Acad./AC-III/ BOS&R-3/2024/ 7616
Dated: 19/11/24

To

The Controller of Examinations,
GJUST, Hisar.

Sub: Approval of scheme of examinations and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics – (3rd and 4th semester) w.e.f. academic session 2024-25 (Batch 2023-24) under NEP-2020 being run in University Teaching Department.

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A copy of the scheme of examinations & syllabi of above said programme is enclosed herewith.

You are therefore, requested to take further necessary action accordingly.

Yours faithfully

DA: As above

19/11/24
Assistant Registrar (Academic)
for Registrar

Endst. No. Acad./AC-III/BOS&R-3/2024/ 7617-20 Dated: 19/11/24

A copy of the above is forwarded to the following for information and necessary action:-

1. Dean, Faculty of Physical Sciences & Technology, GJUST, Hisar.
2. Chairperson, Department of Mathematics, GJUST, Hisar alongwith copy of scheme of examinations and syllabi of Integrated B.Sc. (Hons./Hons. with Research) – M.Sc. Mathematics – (3rd and 4th semester) w.e.f. academic session 2024-25 (Batch 2023-24) under NEP-2020, being run in University Teaching Department. He is requested to arrange to upload the scheme of examinations & syllabi of above said programme on the website of the University.
3. OSD to Vice-Chancellor (for kind information of the Vice-Chancellor), GJUST, Hisar.
4. Secretary to Registrar (for kind information of the Registrar), GJUST, Hisar.

19/11/24
Assistant Registrar (Academic)

mbheshwar University of Science and Technology
Hisar-125001, Haryana
('A+' NAAC Accredited State Govt. University)

Department of Mathematics

Schem ...on and Syllabus for Integrated Five Years Programme of UTD
[UG Four Years Programme (Multidisciplinary) (Single Major from Third Semester) + PG One Year Programme]

Name of the Programme: Integrated B.Sc. (Hons./Hons. with Research) - M.Sc. Mathematics
According to National Education Policy-2020
(w.e.f. Session 2024-25)

4D YEAR

Semester - III

Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
e Specific DSC)	24MAT0301T	Number Theory and Trigonometry	4	4	70	30	100	3
	24MAT0302T	Ordinary Differential Equations	4	4	70	30	100	3
	24MAT0303T	Advanced Calculus	4	4	70	30	100	3
Course/ nal Course OC))		To be opted from the pool of MIC(VOC)	4					
sciplinary (MDC)		To be opted from the pool of MDC	3					
ement (AEC)	24AEC0301T	English for Effective Communication - II	2	2	35	15	50	2
nhancement (SEC)		To be opted from the pool of SEC	3					
		Total	**24**					

Semester - IV

of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
pline Specific se (DSC)	24MAT0401T	Vector Calculus	4	4	70	30	100	3
	24MAT0402T	Transform Techniques	4	4	70	30	100	3
	24MAT0403T	Partial Differential Equations	4	4	70	30	100	3
	24MAT0404T	Statics	4	4	70	30	100	3
or Course/ ational Course C(VOC))		To be opted from the pool of MIC(VOC)	4					
lity ancement rse (AEC)	24AEC0302T	संचार कौशल	2	2	35	15	50	2
lue Added urse (VAC)		To be opted from the pool of VAC	2	2	35	15	50	2
		Total	**24**					

Note: Students exiting the programme after fourth semester and securing 100 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject.

Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana
('A+' NAAC Accredited State Govt. University)

Department of Mathematics

Scheme of Examination and Syllabus for Integrated Five Years Programme of UTD

[UG Four Years Programme (Multidisciplinary) (Single Major from Third Semester) + PG One Year Programme]

~~Name of the Programme: Integrated B.Sc. (Hons./Hons. with Research) - M.Sc. Mathematics~~

According to National Education Policy-2020

(w.e.f. Session 2024-25)

Pools

Subject : Mathematics

D YEAR

Semester - III

ourse	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
Specific SC)	24MAT0301T	Number Theory and Trigonometry	4	4	70	30	100	3
	24MAT0302T	Ordinary Differential Equations	4	4	70	30	100	3
	24MAT0303T	Advanced Calculus	4	4	70	30	100	3
urse/ al Course DC))	24VOC0325T	Programming with C	2	2	35	15	50	2
	24VOC0325P	Programming with C Lab	2	4	35	15	50	3
ciplinary MDC)	24MDC0321T(i) OR 24MDC0321T(ii)	Operations Research OR Calculus and Optimization	3	3	50	25	75	2.5
hancement SEC)	24SEC0320T(i)	Special Functions	3	3	50	25	75	2.5

Semester - IV

f Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
ine Specific (DSC)	24MAT0401T	Vector Calculus	4	4	70	30	100	3
	24MAT0402T	Transform Techniques	4	4	70	30	100	3
	24MAT0403T	Partial Differential Equations	4	4	70	30	100	3
	24MAT0404T	Statics	4	4	70	30	100	3
Course/ ional Course VOC))	24VOC0425T	Programming with C++	2	2	35	15	50	2
	24VOC0425P	Programming with C++ Lab	2	4	35	15	50	3
Added e (VAC)	24VAC0408T	Mathematics in Everyday Life	2	2	35	15	50	2

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Semester - V

ourse	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
Specific SC)	24MAT0501T	Real Analysis	4	4	70	30	100	3
	24MAT0502T	Groups and Rings	4	4	70	30	100	3
	24MAT0503T	Solid Geometry	4	4	70	30	100	3
	24MAT0504T	Sequences and Series	4	4	70	30	100	3
p	24MAT0505I	Internship	4	30	----	100	100	
		Total	**20**	**46**	**280**	**220**	**500**	

Semester - VI

f Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
ine Specific (DSC)	24MAT0601T	Real and Complex Analysis	4	4	70	30	100	3
	24MAT0602T	Linear Algebra	4	4	70	30	100	3
	24MAT0603T	Mathematical Modeling	4	4	70	30	100	3
	24MAT0604T	Dynamics	4	4	70	30	100	3
Course/ ional Course (VOC))		To be opted from the pool of MIC(VOC)	4					
		Total	**20**					

tes:

(i) Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programme without taking exit option.

(ii) The evaluation of the internship shall be done by a committee comprising of at least two senior teachers appointed by the Chairperson of the Department. Marks will be awarded by the committee out of 100 marks on the basis of the report and viva-voce examination as per university rules.

(iii) Students will be awarded 3-year UG Degree in relevant major Discipline/Subject upon securing 136 credits.

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Semester - V

ourse	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
Specific SC)	24MAT0501T	Real Analysis	4	4	70	30	100	3
	24MAT0502T	Groups and Rings	4	4	70	30	100	3
	24MAT0503T	Solid Geometry	4	4	70	30	100	3
	24MAT0504T	Sequences and Series	4	4	70	30	100	3
	24MAT05051	Internship	4	30	----	100	100	
		Total	**20**	**46**	**280**	**220**	**500**	

Semester - VI

Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/ Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
ne Specific (DSC)	24MAT0601T	Real and Complex Analysis	4	4	70	30	100	3
	24MAT0602T	Linear Algebra	4	4	70	30	100	3
	24MAT0603T	Mathematical Modeling	4	4	70	30	100	3
	24MAT0604T	Dynamics	4	4	70	30	100	3
Course/ onal Course VOC))	24VOC0625T	Programming with Python	2	2	35	15	50	2
	24VOC0625P	Programming with Python Lab	2	4	35	15	50	3
		Total	**20**	**22**	**350**	**150**	**500**	

tes:

(i) Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programme without taking exit option.

(ii) The evaluation of the internship shall be done by a committee comprising of at least two senior teachers appointed by the Chairperson of the Department. Marks will be awarded by the committee out of 100 marks on the basis of the report and viva-voce examination as per university rules.

(iii) Students will be awarded 3-year UG Degree in relevant major Discipline/Subject upon securing 136 credits.

24MAT0301T: Number Theory and Trigonometry

Semester: III
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: After completing this course, the learner will be able:

CO1: To know about arithmetic functions which are useful in calculation and cryptosystems.
CO2: To understand multiplicative functions and their properties.
CO3: To know about trigonometrical functions and their expansions.
CO4: To get knowledge about hyperbolic functions, logarithm of any complex number and Gregory series.

Unit – I

Divisibility, G.C.D. (greatest common divisors), L.C.M. (least common multiple) Primes, Fundamental Theorem of Arithmetic. Linear Congruences, Fermat's theorem. Wilson's theorem and its converse.

Unit – II

Complete residue system and reduced residue system modulo m. Euler's ϕ function, Euler's generalization of Fermat's theorem. Chinese Remainder Theorem. Quadratic residues. Legendre symbols. Lemma of Gauss; Gauss reciprocity law. The number of divisors and the sum of divisors of a natural number n (The functions d(n) and $\sigma(n)$).

Unit – III

De Moivre's Theorem and its Applications. Expansion of trigonometrical functions. Direct circular and hyperbolic functions and their properties.

Unit – IV

Inverse circular and hyperbolic functions and their properties. Logarithm of a complex quantity. Gregory's series.

Books Recommended:

1. S.L. Loney, Plane Trigonometry Part – II, Macmillan and Company, London.
2. R.S. Verma and K.S. Sukla, Text Book on Trigonometry, Pothishala Pvt. Ltd. Allahabad.
3. Ivan Ninen and H.S. Zuckerman, An Introduction to the Theory of Numbers.

24MAT0302T: Ordinary Differential Equations

Semester: III
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: After completing this course, the learner will be able to:

CO1: Define differential equations of first and higher orders.
CO2: Derive orthogonal trajectories in Cartesian and polar coordinates.
CO3: Solve differential equations with constant/ variable coefficients.
CO4: Apply the concepts in solving physical problems.

Unit – I

Exact differential equations, integrating factors. First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations. Equation reducible to Clairaut's form. Singular solutions.

Unit – II

Orthogonal trajectories in Cartesian coordinates and polar coordinates. Self orthogonal family of curves. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous linear form.

Unit – III

Linear differential equations of second order: Reduction to normal form. Transformation of the equation by changing the dependent variable/ the independent variable. Solution by operators of non-homogeneous linear differential equations. Reduction of order of a differential equation. Method of variations of parameters. Method of undetermined coefficients.

Unit – IV

Ordinary simultaneous differential equations. Solution of simultaneous differential equations involving operators (d/dx)or (d/dt) etc. Simultaneous equation of the form $dx/P = dy/Q = dz/R$. Total differential equations. Condition for $Pdx + Qdy + Rdz = 0$ to be exact. General method of solving $Pdx + Qdy + Rdz = 0$ by taking one variable constant. Method of auxiliary equations.

Books Recommended:

1. D.A. Murray, Introductory Course in Differential Equations. Orient Longaman (India). 1967
2. A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd., London
3. E.A. Codington, Introduction to Differential Equations.
4. S.L. Ross, Differential Equations, John Wiley & Sons
5. B. Rai & D.P. Chaudhary, Ordinary Differential Equations, Narosa Publishing House Pvt. Ltd.

24MAT0303T: Advanced Calculus

Semester: III
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completing this course, the students will be able to:

CO1: describe the concept of continuity, uniform continuity, properties of continuous functions.
CO2: understand the Mean value theorems, Taylor's and Maclaurin theorems.
CO3: evaluate the limits by using L'Hospital's rule.
CO4: calculate the partial derivatives and their maxima and minima of the functions having two or more independent variables.

Unit – I

Continuity, Sequential Continuity, Properties of continuous functions, Intermediate value theorem, Uniform continuity, Chain rule of differentiability. Darboux intermediate value theorem for derivatives. Mean value theorems; Rolle's Theorem and Lagrange's mean value theorem and their geometrical interpretations.

Unit – II

Cauchy's mean value theorem. Taylor's and Maclaurin's theorem with Lagrange's and Cauchy' forms of remainders, Indeterminate forms: L' Hospital's rule for evaluation of intermediate forms, Limit and continuity of real valued functions of two variables.

Unit – III

Partial differentiation: Homogenous functions & Euler's theorem on homogeneous functions, Total Differentials, Composite functions & implicit functions. Change of variables method. Taylor's theorem for functions of two variables.

Unit – IV

Differentiability of real valued functions of two variables. Schwarz and Young's theorems and its applicability. Maxima, Minima and saddle points of two variables functions, Critical point. Lagrange's method of multipliers for evaluation of maxima and minima of two variables.

Books Recommended:

1. G. B. Thomas and R. L. Finney: Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998.
2. G. Prasad, Differential Calculus, Pothishala Pvt. Ltd., Allahabad, 2016.
3. S.C. Malik and S. Arora , Mathematical Analysis, New age international publisher, 5th Edition, 2017.
4. S. Narayan, A Course in Mathematical Analysis, S.Chand and company, New Delhi, 2005.
5. M. R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing co., New York, 1974.

24VOC0325T: Programming with C

Semester: III
Credits: 2-0-0
Hours/Week: 2
Course Type: MIC (VOC)

Marks (External): 35
Marks (Internal): 15
Maximum Marks (Total): 50
Examination Duration: 2 Hours

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: After completing this course, the learner will be able to:

CO1: Memorize and define the programming terminology and syntax of various functions of C programming language.
CO2: Understand various data types and file handling functions in C.
CO3: Apply control structures to develop modular programs.
CO4: Represent data in the form of arrays and manipulate them through a program.

Unit - I

Preliminaries of C Language: Introduction and importance of C, Basic structure of a C program, Execution of a C program, C character set, C tokens, Keywords and identifiers, Constants and variables, Data types, Operators and expressions, Hierarchy of operators, Type conversion and cast operator, Library functions in C, Input and Output statements, Assignment statement.

Unit - II

Decision Control Structures: Decision making with IF statement, if-else statement, Nested IF statement, else-if ladder, Switch statement, goto statement.
Loops: while, do-while and For loops, Jumps in loops, Break statement, Continue statement.
Functions: Overview of a function, Need for user defined functions, Form of C functions, Return values and their types, Calling a function, Function declaration, Recursion.
Arrays: Definition, Types, Initialization, Processing an array, Passing arrays to functions.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie, The C Programming Language, 2nd Edition, Pearson Education India, 2015.
2. V. Rajaraman, Computer Programming in C, 2nd Edition, Prentice Hall of India, 2019.
3. B.S. Gottfried, Theory and Problems of Programming with C, 3rd Edition, Schaum's Outlines Series, McGraw Hill Education, 2017.
4. E. Balagurusamy, Programming in ANSI C, 6th Edition, McGraw Hill Education (India) Pvt. Ltd., 2012.

24VOC0325P: Programming with C Lab

Semester: III
Credits: 0-0-2
Hours/Week: 4
Course Type: MIC (VOC)

Marks (External Practical): 35
Marks (Internal Assessment): 15
Maximum Marks (Total): 50
Examination Duration: 3 Hours

List of Programs:

Write down and execute the following programs using C Programming Language:

1. To calculate compound interest
2. To find area and circumference of a circle
3. To interchange the values of two variables
4. To check whether a given number is odd or even
5. To find the greatest of three numbers
6. To find roots of a quadratic equation
7. To find sum of first 'n' terms of an A.P.
8. To find sum of first 'n' terms of a G.P.
9. To reverse the digits of a positive number
10. To convert decimal number to its binary equivalent
11. To calculate exp(x) using series expansion
12. To calculate factorial of a number using for loop
13. To generate a Fibonacci series
14. To check whether the given number is prime or not
15. To generate prime numbers upto a limit
16. To find factorial of a number using recursion
17. To find g.c.d. of three numbers
18. To find the sum of all elements of an array
19. To find mean and standard deviation
20. To find the transpose of a matrix
21. To find the addition of two matrices
22. To find the product of two matrices

Note: Atleast twenty programs are to be performed by students from the above list. The list of programs may vary. The course coordinator may also design programs in addition to the above list/topic as per the scope and requirement of syllabus.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie, The C Programming Language, 2nd Edition, Pearson Education India, 2015.
2. V. Rajaraman, Computer Programming in C, 2nd Edition, Prentice Hall of India, 2019.
3. B.S. Gottfried, Theory and Problems of Programming with C, 3rd Edition, Schaum's Outlines Series, McGraw Hill Education, 2017.
4. E. Balagurusamy, Programming in ANSI C, 6th Edition, McGraw Hill Education (India) Pvt. Ltd., 2012.

24MDC0321T(i): Operations Research

Semester: III
Credits: 3-0-0
Hours/Week: 3
Course Type: MDC

Marks (External): 50
Marks (Internal): 25
Maximum Marks (Total): 75
Examination Duration: 2.5 Hours

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the learner will be able to:

1. Explain the meaning and scope of operational research.
2. Use graphical method to solve simple programming problem.
3. Use Simplex Method to solve general programming problem
4. Determine the optimal solution for Transportation problems.
5. Determine the optimal solution for Assignment problems
6. Understand Minimax and Maximin principles and solve a two-person zero sum game.

Unit - I

Definition, scope, methodology and applications of Operations Research (OR). Types of OR models. Linear Programming: Introduction, Formulation of a Linear Programming Problem (LPP), Advantages and limitations of LP. Graphical solution: Multiple, unbounded and infeasible solutions. Principle of simplex method: standard form, basic solution, basic feasible solution. Computational Aspect of Simplex Method: Cases of unique feasible solution, no feasible solution, multiple solution, unbounded solution and degeneracy.

Unit - II

Two Phase and Big- M methods. Duality in LPP, primal-dual relationship. Transportation Problem: Methods for finding basic feasible solution of a transportation problem, Modified distribution method for finding the optimum solution, Unbalanced and degenerate transportation problems.

Unit - III

Assignment Problem: Solution by Hungarian method, unbalanced assignment problem, maximization in an assignment problem.

Game Theory: Two-person zero sum game, Game with saddle points, the rule of dominance; Algebraic, graphical and linear programming methods for solving mixed strategy games.

Books Recommended:

1. J.K. Sharma, Operations Research Theory and Applications (Sixth edition), Laxmi Publication (2017).
2. H.A. Taha, Operations Research – An Introduction (Tenth Global edition), Pearson Education Limited (2017).
3. Kanti Swarup, Gupta, P.K. and Manmohan. Operations Research, Sultanchand (2010).
4. P.K. Gupta and D.S Hira, Operations Research, S. Chand & Co. (2021).
5. S.D. Sharma, Theory Methods and Applications, Kedar Nath Ram Nath (2020)

24MDC0321T(ii): Calculus and Optimization

Semester: III
Credits: 3-0-0
Hours/Week: 3
Course Type: MDC

Marks (External): 50
Marks (Internal): 25
Maximum Marks (Total): 75
Examination Duration: 2.5 Hours

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:

CO1: Describe the concepts of limits, continuity, differentiability of a function, and their properties.
CO2: Evaluate the indeterminate forms using L' Hospital's rule.
CO3: Acquire the knowledge and understanding about the partial differentiation, maxima and minima of the functions having two or more independent variables.
CO4: Explain the basic concepts of linear programming problems and its dual.
CO5: Solve linear programming problems using different methods, namely graphical method, simplex method and dual simplex method.

Unit - I

Functions of Single Variable: Definition of the limit of a function, Basic properties of limits, Continuous functions, Classification of discontinuities, Differentiability, Successive differentiation, Leibnitz's theorem, Maclaurin's and Taylor's series expansions, Indeterminate forms, L' Hospital's rule for evaluation of indeterminate forms.

Unit - II

Functions of Two Variables: Limit and continuity of real valued functions of two variables, Partial differentiation, Total Differentials, Composite functions and implicit functions, Change of variables method, Homogenous functions, Euler's theorem on homogeneous functions, Taylor's theorem for functions of two variables, Maxima, Minima and saddle points of two variables functions, Lagrange's method of multipliers for the evaluation of maxima and minima of functions of two variables.

Unit - III

Optimization: Linear Programming - Definitions and Basic Concepts, Formulation of a Linear Programming Problem, Solution of Linear Programming Problems using Graphical Method, Simplex Method and Dual Simplex Method.

Books Recommended:

1. Shanti Narayan, *A Course in Mathematical Analysis*, S. Chand and Company, New Delhi, 2005.
2. S.C. Malik and S. Arora, *Mathematical Analysis*, 5th Edition, New Age International Publisher, 2017.
3. Shanti Narayan, *Differential Calculus*, S. Chand Publishing Company, 2005.
4. Murray R. Spiegel, *Theory and Problems of Advanced Calculus*, Schaum's Publishing Co., New York, 1974.
5. G. Prasad, *Differential Calculus*, Pothishala Pvt. Ltd., Allahabad, 2016.
6. W. Winston and M. Ventataraman, *Introduction to Mathematical Programming*, 4th Edition, Duxbury, 2003.
7. G. Hadley, *Linear Programming*, Addison-Wesley Publishing Company, 1978

24SEC0320T(i): Special Functions

Semester: III
Credits: 3-0-0
Hours/Week: 3
Course Type: SEC

Marks (External): 50
Marks (Internal): 25
Maximum Marks (Total): 75
Examination Duration: 2.5 Hours

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the learner will be able to:
CO1: Derive the solution of differential equations in the form of power series.
CO2: Know the various special functions represented by different series.
CO3: Familiarize the properties of special functions.
CO4: Know the representation of special functions in the various integral forms.

Unit – I

Series solution of differential equations: Power series method, Radius of convergence, Ordinary and Singular points, Definitions of Beta and Gamma functions.
Bessel equation and its solution: Bessel functions and their properties-convergence, Recurrence relations and generating function, Orthogonality of Bessel functions.

Unit– II

Legendre's differential equation and its solutions: Legendre's functions and their properties, Recurrence relations and generating function. Orthogonality of Legendre's polynomials. Rodrigue's Formula for Legendre Polynomials, Laplace Integral Representation of Legendre's polynomial. Hypergeometric functions and their properties, integral representation.

Unit– III

Hermite differential equation and its solutions: Hermite functions and their properties, Recurrence relations and generating function. Orthogonality of Hermite polynomials. Rodrigue's Formula for Hermite polynomials. Laguerre functions: Laguerre's equation and its solution, the generating function, Alternative expression for the Laguerre polynomials, Orthogonality properties of Laguerre polynomials, Recurrence relations.

Books Recommended:

1. Erwin Kreyszing (1999), Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York,
2. A.R. Forsyth (2018), A Treatise on Differential Equations, Macmillan and Co. Ltd.
3. I.N. Sneddon (1966), Special Functions of Mathematical Physics & Chemistry. Oliver and Boyd: Interscience Publishers.
4. W.W. Bell (2004), Special Functions for Scientists and Engineers, Dover Publication.

24MAT0401T: Vector Calculus

Semester: IV
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: After completing this course, the learner will be able to:

CO1: Develop general interest in directions as well as magnitude in advance level of learning of Vector Calculus.
CO2: Build on basic vector ideas by learning about gradient fields and route independent fields, as well as computing directional derivatives, gradients, and curls.
CO3: Evaluate line integral as work over a closed curve including parameterized curves.
CO4: Evaluate integral using applications of Green's theorem and stokes theorem.
CO5: Compute surface and volume integrals through surfaces such as Cylinders, Cuboids, Spheres etc., Evaluating surface integral using Gauss Divergence in a plane.

Unit – I

Scalar and vector product of three vectors, Product of four vectors. Reciprocal vectors. Vector differentiation. Scalar Valued point functions, Vector valued point functions, Derivative along a curve, Directional derivatives

Unit – II

Gradient of a scalar point function, geometrical interpretation of grad Φ, character of gradient as a point function. Divergence and curl of vector point function, characters of Div $\vec{f}$ and Curl $\vec{f}$ as point function, examples. Gradient, divergence and curl of sums and product and their related vector identities. Laplacian operator.

Unit – III

Orthogonal curvilinear coordinates Conditions for orthogonality fundamental triad of mutually orthogonal unit vectors. Gradient, Divergence, Curl and Laplacian operators in terms of orthogonal curvilinear coordinates, Cylindrical co-ordinates and spherical co-ordinates.

Unit – IV

Vector integration; Line integral, Surface integral, Volume integral. Theorems of Gauss, Green & Stokes and problems based on these theorems.

Books Recommended:

1. Murrary R. Spiegal, Theory and Problems of Advanced Calculus, Schaum Publishing Company, New York (1974).
2. Murrary R. Spiegal, Vector Analysis, Schaum Publishing Company (Second Addition), New York (2009).
3. N. Saran and S.N. Nigam, Introduction to Vector Analysis (Sixth Addition), Pothishala Pvt. Ltd., Allahabad (1990).
4. Shanti Narayna, A Text Book of Vector Calculus. S. Chand & Co., New Delhi (2003).

24MAT0402T: Transform Techniques

Semester: IV
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: After completing this course, the learner will be able to:

CO1: Understand the basic concept of some transform techniques namely Laplace, Fourier, Mellin and Hankel transforms.
CO2: Evaluate the transforms of some elementary functions.
CO3: Solve ordinary/partial differential equations using appropriate transform techniques.
CO4: Apply the transform techniques to solve physical problems arising in various scientific fields.

Unit – I

Laplace Transforms: Definition, Laplace transform of some elementary functions, Linear property, Shifting and Scaling properties, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Inverse Laplace transforms, Convolution theorem, Inverse Laplace transforms of derivatives and integrals, Solution of ordinary differential equations using Laplace transform.

Unit – II

Fourier Transforms: Definition, Properties of Fourier transforms: Linearity, Scaling, Shifting, Modulation; Convolution theorem, Fourier transforms of the derivatives, Relation between Fourier and Laplace transforms, Parseval's identities for Fourier transforms, Solution of partial differential equations using Fourier transforms.

Unit – III

Mellin Transform: Definition and elementary properties of Mellin transform, Mellin transforms of derivatives and integrals, Inverse Mellin transform, the Mellin inversion theorem, Convolution theorem of Mellin transform and Inverse Mellin transform.

Unit – IV

Hankel Transform: Definition and elementary properties of Hankel transform, Parseval relation for Hankel transform, Hankel transforms of derivatives of function, Hankel transforms of some elementary functions, Use of Hankel transform in the solution of partial differential equations.

Books Recommended:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons Inc., New York, 2006.
2. A.R. Forsyth, A Treatise on Differential Equations, 6th Edition, Macmillan and Co. Ltd., London, 1929.
3. I.N. Sneddon, The Use of Integral Transforms, 1st Edition, McGraw Hill Education, 1972.
4. M.R. Spiegel, Laplace Transforms, 1st Edition, Schaum's Outlines Series, McGraw Hill Education, 1965.
5. L. Debnath and D. Bhatta, Integral Transforms and Their Applications, 3rd Edition, CRC Press, Boca Raton, 2015.

24MAT0403T: Partial Differential Equations

Semester: IV
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completing this course, the students will be able to:

CO1: construct a partial differential equation for various real life problems.
CO2: discuss Lagrange's linear equation, Lagrange's solution to the linear equations, and also solve partial differential equations using Charpit and Monge's method.
CO3: classify linear partial differential equations of second order.
CO4: solve partial differential equations such as Heat, Wave and Laplace by using the variable separable method.

Unit – I

Partial differential equations: Formation, Order and Degree, Linear and Non-Linear Partial differential equations of the first order: Complete solution, Singular solution, General solution. Solution of Lagrange's linear equations, Charpit's general method of solution. Jacobi's method.

Unit – II

Linear partial differential equations of second and higher orders, Linear homogeneous and non-homogeneous differential equations with constant coefficients, Partial differential equation with variable coefficients reducible to equations with constant coefficients, their complimentary functions and particular integrals.

Unit – III

Classification of linear partial differential equations of second order; Hyperbolic, Parabolic and Elliptic types. Reduction of second order linear partial differential equations to Canonical forms and their solutions. Monge's method for partial differential equations of second order.

Unit – IV

Cauchy's problem for second order partial differential equations, Characteristic equations and characteristic curves of second order partial differential equation, Method of separation of variables: Solution of Laplace's equation, Wave equation (one dimension), Diffusion (Heat) equation (one dimension) in Cartesian Co-ordinate system.

Books Recommended:

1. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw Hill Book Company, 1988.
2. D.A. Murray, Introductory Course on Differential Equations, Orient Longman, (India), 1967.
3. J.N. Sharma and Kehar Singh, Partial Differential Equations for Engineers and Scientists, Narosa publishing house, 2009.

24MAT0404T: Statics

Semester: IV
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: After completing this course, the learner will be able to:

CO1: Interpret the concept of concurrent and parallel forces.
CO2: Solve the various problems on rods and ladders.
CO3: Understand the concept of virtual work and forces in three dimensions.
CO4: Analyze wrenches and types of equilibrium of forces.

Unit – I

Composition of two forces acting at a point, Resolution of force, Triangle law of forces, $\lambda - \mu$ theorem, Lami's theorem, Polygon law of forces, Theorem of resolved parts, Conditions of equilibrium of concurrent forces; Parallel forces; Moment about a point, Centre of parallel forces, Moment about a line; Couples.

Unit – II

Equilibrium of three forces, Trigonometrical theorem; Friction, Equilibrium of rods and ladders; Centre of Gravity.

Unit – III

Virtual work, Principle of virtual work; Forces in three dimensions, Conditions of equilibrium of a rigid body, Poinsots central axis.

Unit – IV

Wrenches; Null lines, Null point and Null planes; Stable, unstable and neutral equilibrium, Conditions of stability of equilibrium.

Books Recommended:

1. S.L. Loney, An Elementary Treatise on Statics, Cambridge University Press (2016).
2. R.S. Verma, A Text Book on Statics (Fifth Edition), Pothishala Pvt. Ltd., (1962).

24VOC0425T: Programming with C++

Semester: IV
Credits: 2-0-0
Hours/Week: 4
Course Type: MIC(VOC)

Marks (External): 35
Marks (Internal): 15
Maximum Marks (Total): 50
Examination Duration: 2 Hours

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: At the end of this course, the students will be able to:

CO1: understand basic concepts of C++.
CO2: know about input/output statements and control structures in C++.
CO3: understand the concept of loops, functions, and arrays.
CO4: develop programs using arrays and functions.

Unit - I

Introduction to C++: About C++, character set, tokens, keywords, identifiers, constants, data types, input/output statements, and variables.
Operators in C++: Arithmetic, relational, logical, increment and decrement operators, bitwise operators, precedence of operators, type conversion in C++, and type casting.
Control Structures: if statement, if-else statement, nested if, if-else-if ladder, switch statement, goto statement.

Unit - II

Loops: while loop, do...while loop, for loop, nested loops, break and continue statements, exit () statement.
Functions: Declaration and Definition, calling a function, formal and actual arguments, parameters passing in functions, return by reference.
Arrays: Array definition, initialization, multidimensional arrays, Manipulation of array elements.
Introduction to object-oriented programming: classes and objects.

Books Recommended:

1. E. Balagurusamy: Object-Oriented Programming with C++, 8th Edition, Tata McGraw-Hill (2020).
2. R. Subburaj: Object-Oriented Programming with C++, 1st Edition, Vikas Publishing House, New Delhi (2013).
3. B. Chandra: Object Oriented Programming Using C++, 1st Edition, Narosa Publishing House, New Delhi (2002).
4. B. Stroustrup: The C++ Programming Language, 4th Edition, Addison-Wesley (2013).
5. S. Lippman, J. Lajoie, B. E. Moo: C++ Primer, 5th Edition, Addison-Wesley (2012).
6. H. Schildt: C++: The Complete Reference, 4th Edition, Tata McGraw-Hill (2003).

24VOC0425P: Programming with C++ Lab

Semester: IV
Credits: 0-0-2
Hours/Week: 4
Course Type: MIC (VOC)

Marks (External Practical): 35
Marks (Internal Assessment): 15
Maximum Marks (Total): 50
Examination Duration: 3 Hours

List of Programs:

Write down and execute the following programs using C++ Programming Language:

1. To calculate compound interest
2. To find the area and circumference of a circle
3. To interchange the values of two variables
4. To check whether a given number is odd or even
5. To find the greatest of three numbers
6. To find the roots of a quadratic equation
7. To find the sum of the first 'n' terms of an A.P.
8. To find the sum of the first 'n' terms of a G.P.
9. To reverse the digits of a positive number
10. To convert decimal numbers to its binary equivalent
11. To calculate exp(x) using series expansion
12. To calculate the factorial of a number using for loop
13. To generate a Fibonacci series
14. To check whether the given number is prime or not
15. To generate prime numbers up to a limit
16. To find the factorial of a number using recursion
17. To find the g.c.d. of three numbers
18. To find the sum of all elements of an array
19. To find the mean and standard deviation
20. To find the transpose of a matrix
21. To find the addition of two matrices
22. To find the product of two matrices

Note: At least twenty programs are to be performed by students from the above list. The list of programs may vary. The course coordinator may also design programs in addition to the above list/topic as per the scope and requirement of the syllabus.

Books Recommended:

1. E. Balagurusamy: Object-Oriented Programming with C++, 8th Edition, Tata McGraw-Hill (2020).
2. R. Subburaj: Object-Oriented Programming with C++, 1st Edition, Vikas Publishing House, New Delhi (2013).
3. B. Chandra: Object Oriented Programming Using C++, 1st Edition, Narosa Publishing House, New Delhi (2002).
4. B. Stroustrup: The C++ Programming Language, 4th Edition, Addison-Wesley (2013).
5. S. Lippman, J. Lajoie, B. E. Moo: C++ Primer, 5th Edition, Addison-Wesley (2012).
6. H. Schildt: C++: The Complete Reference, 4th Edition, Tata McGraw-Hill (2003).

24VAC0408T: Mathematics in Everyday Life

Semester: IV
Credits: 2-0-0
Hours/Week: 2
Course Type: VAC

Marks (External): 35
Marks (Internal): 15
Maximum Marks (Total): 50
Examination Duration: 2 Hours

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: After completing this course, the learner will be able to:

CO1: develop general interest in Mathematics as a discipline.
CO2: make predictions and draw conclusions based on statistical data.
CO3: develop problem solving skills and apply mathematical concepts to real life situations.
CO4: familiarize the students with basics of probability, random variable & its probability distribution.

Unit - I

Simple interest, Compound interest, Equated monthly installment (EMI), Direct tax calculation (Simple problems), Profit and loss, Work, time and distance, Percentage, Ratio and proportion, Trigonometric Functions: Angles, trigonometric functions of sum and difference of two angles, trigonometric equations.

Unit - II

Sequence and series: Arithmetic progression, Arithmetic mean, Geometric progression, sum of n terms of G.P., Infinite G.P. & its sum, Geometric mean, Relation between A.M. & G.M., Permutation and combinations (simple applications), Mean, Mode, Median, Standard deviation, Variance, Bar graphs, Pie Charts, Probability: Sample space, event, types of events, algebra of events, probability of an event,

Books Recommended:

1. Richa Aggarwal (2019), How to Crack Test of Arithmetic, Arihant Publications.
2. Mritunjay Kumar (2015), Business Mathematics, Vikas Publishing House.
3. S. C Gupta and V. K. Kapoor (2020), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
4. Jaikishan and Premkishan (2022), How to Crack Test of Reasoning in all Competitive Exams., Arihant Publications.

24MAT0501T: Real Analysis

Semester: V
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completed this course, the learner will be able to:

CO1: get the knowledge of Riemann integral, examples and related theorems.
CO2: get the knowledge of the basic idea of metric spaces, examples and related concepts.
CO3: get the knowledge of the completeness of metric spaces, continuity and homomorphism.
CO4: get the knowledge of the concepts of compactness and connectedness of metric spaces and related theorems.

Unit – I

Riemann integral: Definition and examples, Existence theorems of Riemann's integral, Riemann's sum, Properties of Riemann's integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus.

Unit – II

Definition and examples of metric spaces, neighborhoods, limit points, interior points, open and closed sets, closure and interior, boundary points, subspace of a metric space, equivalent metrics.

Unit – III

Complete metric space, Cantor's intersection theorem, Completeness. First and second category spaces, Baire's category theorem, Separable space, first and second countable spaces. Continuity and Homomorphism: continuous functions, uniform continuity, isometry and homomorphism. Extension theorem.

Unit – IV

Compactness of metric spaces, Sequential compactness, Bolzano-Weierstrass property, Total boundedness, Finite intersection property, Continuity and compactness.
Connectedness: separated sets, connected and disconnected sets. Components, continuity and connectedness.

Books Recommended:

1. C.G. Denlinger, Elements of Real Analysis, First Ed., Jones and Bartlett India pvt. Ltd., 2011.
2. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
3. R.R. Goldberg, Real Analysis, Oxford & IBH publishing Co., New Delhi, 1970
4. D. Somasundaram and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
5. P.K. Jain and Khalil Ahmad, Metric Spaces, 2nd Ed., Narosa, 2004
6. Babu Ram, Metric Spaces, Vinayaka Publication
7. E.T. Copson, Metric Spaces, Cambridge University Press, 1968.
8. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill, 1963.

24MAT0502T: Groups and Rings

Semester: V
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completing this course, the students will be able to:

CO1: describe the concepts of groups, subgroups, cyclic groups, and structure preserving maps between groups and their consequences.
CO2: explain the significance of the notions of cosets, normal subgroups, and factor groups.
CO3: analyze various consequences of Lagrange's theorem.
CO4: explain the properties of integral domain, Euclidean domain, principle ideal domain and polynomial rings.
CO5: apply Eisenstein's irreducibility criteria to check the irreducibility of a polynomial.

Unit – I

Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, Cyclic groups, Center of a group. Cosets, Left and right cosets, Index of a sub-group, Coset decomposition. Largrage's theorem and its consequences.

Unit – II

Normal subgroups, Quotient groups. Homomorphisms, Isomophisms, Automorphisms and Inner automorphisms of a group, Kernal of a homomorphism, Fundamental theorem of homomorphism and related theorems. Permutations groups. Even and odd permutations. Cayley's theorem.

Unit – III

Introduction to rings, Subrings, Integral domains, Skew fields and fields, Ring homomorphisms and its basic properties only, Kernal of a Homomorphism. Ideals (Principle, Prime and Maximal), Sum and product of ideals, and Quotient rings.

Unit – IV

Euclidean rings, Principal ideal rings, Polynomial rings, Polynomials over the rational field, Eisenstein's irreducibility criterion and its applications, Polynomial rings over commutative rings.

Books Recommended:

1. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House , 2006.
2. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
3. P. B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra, 2nd Edition, 2002.

24MAT0503T: Solid Geometry

Semester: V
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: After completing this course, the learner will be able to:

CO1: Learn sketching of various curves.
CO2: Find the equation of sphere under various conditions and check for the orthogonality of the spheres.
CO3: Write the equation of a cone, cylinder and conicoid under given conditions.
CO4: Analyze the properties of enveloping cones and cylinder, right circular cone and cylinder.
CO5: Identify different Conicoids and sketch them.

Unit – I

General equation of second degree. Tracing of conics. Tangent at any point to the conic, Chord of contact, Pole of line to the conic, Director circle of conic. System of conics. Confocal conics.

Unit – II

Sphere: Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, radical plane of two spheres.
Cones. Right circular cone and enveloping cone.
Cylinder: Right circular cylinder and enveloping cylinder.

Unit – III

Central Conicoids: Equation of tangent plane. Director sphere. Normal to the conicoids. Polar plane of a point. Enveloping cone of a coincoid. Enveloping cylinder of a coincoid.

Unit – IV

Paraboloids: Circular section, Plane sections of conicoids.
Generating lines. Confocal conicoid. Reduction of second degree equations.

Books Recommended:

1. R.J.T. Bell, An Elementary Treatise on Coordinate Geometry of Three Dimensions, MacMillan India Ltd. (1994).
2. P.K. Jain and Khalil Ahmad: A Textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. (1999).

24MAT0504T: Sequences and Series

Semester: V
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completed this course, the learner will be able to:

CO1: get the knowledge of the boundedness of the set of real numbers and concepts related to the open sets, closed sets and compact sets.
CO2: get the knowledge of the convergence and divergence of the sequence and series of real numbers.
CO3: to get the knowledge of various tests of convergence of infinite series.
CO4: get the knowledge of the alternating series, arbitrary series and their tests of convergence and rearrangement of terms in a series.

Unit – I

Boundedness of the set of real numbers, neighbourhood of a point, interior points, isolated points, limit points, Bolzano-Weiestrass theorem.
Open sets, closed set, closure of a set and their properties, compact sets, Heine-Borel Theorem.

Unit – II

Sequences and subsequences. Bounded and monotonic sequences, convergence of sequences. Theorems on limits. Cauchy general principle of convergence. Limit superior and limit inferior.
Infinite series: Convergence and divergence of infinite series, Comparison Tests of positive terms, Convergence and divergence of geometric series, generalized harmonic series or p-series.

Unit – III

Infinite series: D-Alembert's ratio test, Raabe's test, Logarithmic test, De Morgan and Bertrand's test, Cauchy's root test, Gauss's Test, Cauchy's integral test, Cauchy's condensation test.

Unit – IV

Alternating series, Leibnitz's test, absolute and conditional convergence. Arbitrary series: Abel's lemma, Abel's test, Dirichlet's test.
Rearrangement of terms in a series: Cauchy product and its convergence. Convergence and absolute convergence of infinite products.

Books Recommended:

1. R.R. Goldberg, Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970.
2. S.C. Malik, Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
3. Shanti Narayan, A Course in Mathematical Analysis, S. Chand and Company, New Delhi.
4. Murray, R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing Co., New York.
5. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
6. Earl D. Rainville, Infinite Series, The Macmillan Co., New York.

24MAT0505I: Internship

Semester: V
Credits: 4-0-0
Hours/Week: 30
120 Hours (4 Weeks)
Time: Presentation (30 Minutes)

Marks (External): 00
Marks (Internal): 100
Maximum Marks (Total): 100

Note: The evaluation of the internship shall be done by a committee comprising of at least two senior teachers appointed by the Chairperson of the Department. Marks will be awarded by the committee out of 100 marks on the basis of the report and viva-voce examination as per university rules.

24MAT0601T: Real and Complex Analysis

Semester: VI
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completed this course, the learner will be able to:

CO1: get the knowledge of improper integral and their tests of convergence.
CO2: get the knowledge about the Fourier series expansion of different kind of functions.
CO3: get the knowledge of the concept of analytic functions in complex plane.
CO4: get the knowledge of the conformal mapping, mobius transformation and critical mapping.

Unit – I

Improper integrals and their convergence. Comparison tests, Abel's and Dirichlet's tests. Frullani's integral. Continuity, differentiability and integrability of an integral of a function of a parameter.

Unit – II

Fourier's series: Fourier expansion of piecewise monotonic functions, Properties of Fourier Coefficients, Dirichlet's conditions, Parseval's identity for Fourier series, Fourier series for even and odd functions, Half range series, Change of Intervals.

Unit – III

Extended Complex Plane, Stereographic projection of complex numbers, continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations. Harmonic functions.

Unit – IV

Mappings by elementary functions: Translation, rotation, Magnification and Inversion. Conformal Mappings, Mobius transformations. Fixed pints, Cross ratio, Inverse Points and critical mappings.

Books Recommended:

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
2. R.R. Goldberg, Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
3. D. Somasundaram and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
4. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Co., New Delhi
5. R.V. Churchill and J.W. Brown, Complex Variables and Applications, 5th Edition, McGraw-Hill, New York, 1990
6. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi.

24MAT0602T: Linear Algebra

Semester: VI
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completing this course, the students will be able to:

CO1: describe the concepts of vector spaces, subspaces, bases, dimensions, and their properties.
CO2: determine linear independence and dependence for vectors in R^n, the rank and nullity of a linear transformation.
CO3: find eigen roots, vectors of linear transformations.
CO4: find the orthornormal set by using the concept of Gram-Schmidt orthogonalization.

Unit – I

Vector spaces, Subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Extension theorem, Existence theorem for basis of a finitely generated vector space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets. Dimensions.

Unit – II

Quotient space and its dimension. Homomorphism of vector spaces (Linear transformation), One-one, Onto Linear transformation, Vector space isomorphism, Finding a linear transformation when images of basis set is given. Null Space, Range space of a linear transformation, Fundamental theorem of vector space homomorphism, Rank and Nullity theorem.

Unit – III

Algebra of Linear Transformation, Singular and non-singular linear transformations, Invertible linear transformation, Matrix of a linear Transformation. Eigen values and Eigen vectors of linear transformations. Minimal Polynomial of a linear transformation.

Unit – IV

Inner product spaces, Cauchy-Schwarz inequality, Orthogonal vectors, Orthogonal complements, Orthogonal sets and Basis, Bessel's inequality for finite dimensional vector spaces, Gram-Schmidt orthogonalization process and associated numericals.

Books Recommended:

1. V. K. Krishnamurthy, V. P. Mainra, V.P. and J. L. Arora, An introduction to Linear Algebra, Affiliated East West Press, 1976.
2. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House, 2006.
3. P. B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra, 2nd Edition, 2002.
4. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

24MAT0603T: Mathematical Modeling

Semester: VI
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completed this course, the learner will be able to:

CO1: Understand the techniques of mathematical modeling.
CO2: Construction of mathematical models and interpretation of output data for physical problem.
CO3: Dealing with real life multidisciplinary problem.
CO4: Extrapolation of outcomes based on physical parameters.

Unit – I

Introduction, need, classification, characteristics and limitations of mathematical modeling. Techniques of mathematical modeling: Through algebra, geometry and calculus.

Unit – II

Mathematical modeling through ordinary differential equation of first order: Linear growth and decay models, non-linear growth and decay models, motion of a rocket, orthogonal trajectories. Population dynamics: Prey-predator models, competition models and multi-species models. Epidemic models: A simple epidemic model, SIS model, SIS model with constant number of carriers, model with removal, model with removal and immigration.

Unit – III

Mathematical modeling in economics, in medicine, Arms race, Battle, international trade and dynamics through ordinary differential equations. Mathematical modeling through ordinary differential equation of second order: Motion under a central force (without proof), motion under the inverse square law (without proof) and Kepler's law of planetary motion (without proof). Mathematical modeling of circular motion and motion of satellites. Rectilinear motion, electric circuits and phillip's stabilization model for a closed economy.

Unit – IV

Mathematical modeling through Difference Equations: Introduction, basic theory. Application in economics and finance: the Harrod model, the Cobweb model, Samuelson's interaction models, population dynamics and Genetics.

Books Recommended:

1. J.N. Kapur: Mathematical modeling (second edition), Wiley Eastern limited, 2015.
2. J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press (P) Ltd., 1985.
3. D.N. Burghes and A.D. Wood, Mathematical Models in the Social, Management and Life Science, Ellis Horwood Ltd., 1980.
4. J.G. Andrews & R.R. Mclone, Mathematical Modeling, Butterworths Heinemann Ltd., 1976.

24MAT0604T: Dynamics

Semester: VI
Credits: 4-0-0
Hours/Week: 4
Course Type: DSC

Marks (External): 70
Marks (Internal): 30
Maximum Marks (Total): 100
Examination Duration: 3 Hours

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: On completion of this course, the student will be able to:

CO1: To understand and use basic terms for the description of the motion of particles.
CO2: To analyze the fundamental laws of Newtonian Mechanics.
CO3: To solve problems related to the motion of a projectile in the absence of air resistance.
CO4: To analyze the motion of a particle in three dimension

Unit – I

Velocity and acceleration along plane curve, Radial, transverse, tangential and normal directions. Relative velocity and acceleration. Simple harmonic motion. Elastic strings.

Unit – II

Mass, momentum and force. Newton's laws of motion. Motion of a body resting on a horizontal plane. Motion of two bodies connected by a string. Work, power and energy. Principle of conservation of energy.

Unit – III

Motion on inside and outside of a vertical circle. Motion on rough plane curves. Projectile motion of a particle in a horizontal plane.

Unit – IV

General motion of a rigid body. Central orbits, Kepler laws of motion. Motion of a particle in three dimensions. Acceleration in terms of different co-ordinate systems.

Books Recommended:

1. S.L. Loney, An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press (1998).
2. F. Chorlton, A Text Book of Dynamics (Second Edition), CBS Publishers, New Delhi (1983).
3. A.S. Ramsey, Dynamics Part-1 & 2, Cambridge University Press (1962).

24VOC0625T: Programming with Python

Semester: VI
Credits: 2-0-0
Hours/Week: 2
Course Type: MIC (VOC)

Marks (External): 35
Marks (Internal): 15
Maximum Marks (Total): 50
Examination Duration: 2 Hours

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: At the end of this course, the students will be able to:
CO1: Set up Python to develop simple applications.
CO2: Make use of Python programming language to construct basic programs.
CO3: Know how to use collections such as lists, tuples, ranges, dictionaries, and sets.
CO4: Understand the concept of loops, and functions.

Unit - I

Introduction to Python, identifiers, character set, keywords and indentation, comments, assignment operator, operators and expressions, print() function, input() function, data types, variables, mutable vs immutable variables, namespaces, decision statements, Boolean type, Boolean operators, loop control statements, break statement, continue statement, pass statement, introduction to strings, string operations.

Unit - II

Lists, operations on the list: slicing, inbuilt functions for lists, list processing: searching and sorting, tuples, dictionaries: need of dictionary, operations on dictionaries: creation, addition, retrieving values, deletion; tuples, operations on tuples, introduction to sets, operations on sets, inbuilt functions for tuples, Python functions, inbuilt functions, user-defined functions.

Books Recommended:

1. A. N. Kamthane, A. A. Kamthane: Programming and problem solving with Python, McGraw Hill, 2018.
2. J. Guttag: Introduction to computation and programming using Python, MIT- Press, 2013.
3. M. T. Goodrich, R. Thamassia, M. S. Goldwasser: Data structures and algorithms in Python, Wiley, 2016.
4. Y. D. Liang: Introduction to programming using Python, Pearson, 2013.
5. R. Thareja: Python programming using a problem-solving approach, Oxford University Press, 2017.
6. R. N. Rao: Core Python programming, Dreamtech Press, 2019.
7. A. B. Downey: Think Python, O'Reilly Media, 2012.
8. K. A. Lambert: Fundamentals of Python: First programs, Cengage Learning, 2011.

24VOC0625P: Programming with Python Lab

Semester: VI
Credits: 0-0-2
Hours/Week: 4
Course Type: MIC (VOC)

Marks (External Practical): 35
Marks (Internal Assessment): 15
Maximum Marks (Total): 50
Examination Duration: 3 Hours

List of Programs:

Write down and execute the following programs using Python programming language:

1. To find the maximum from a list of numbers.
2. To compute the GCD of two numbers.
3. To find the square root of a number.
4. To find the parameter and area of a circle.
5. To find the volume of the cube and cuboid.
6. To check number is prime or not.
7. To print first n prime numbers.
8. To remove duplicate numbers from a given list.
9. To print the Fibonacci series.
10. To perform various operations on strings like creation, deletion, and concatenation.
11. To perform a list operation like inserting new numbers into a list, delete numbers from the list, and sum all numbers in a list.
12. To perform indexing and slicing operations on the list.
13. To create a dictionary and apply various functions to the dictionary.
14. To check whether a key is present in the dictionary.
15. To implement and demonstrate the functions and various types of parameter-passing techniques.

Note: At least twelve programs are to be performed by students from the above list. The list of programs may vary. The course coordinator may also design programs in addition to the above list/topic as per the scope and requirement of the syllabus.

Books Recommended:

1. A. N. Kamthane, A. A. Kamthane: Programming and problem solving with Python, McGraw Hill, 2018.
2. J. Guttag: Introduction to computation and programming using Python, MIT- Press, 2013.
3. M. T. Goodrich, R. Thamassia, M. S. Goldwasser: Data structures and algorithms in Python, Wiley, 2016.
4. Y. D. Liang: Introduction to programming using Python, Pearson, 2013.
5. R. Thareja: Python programming using a problem-solving approach, Oxford University Press, 2017.
6. R. N. Rao: Core Python programming, Dreamtech Press, 2019.
7. A. B. Downey: Think Python, O'Reilly Media, 2012.
8. K. A. Lambert: Fundamentals of Python: First programs, Cengage Learning, 2011.