SHAILABALA WOMEN'S (AUTONOMOUS) COLLEGE

CUTTACK

SYLLABUS FOR

UNDER GRADUATE

COURSE IN MATHEMATICS

(BACHELOR OF SCIENCE EXAMINATION)

2021-2022

(ADMISSION BATCH)

UNDER

CHOICE BASED CREDIT SYSTEM

PREAMBLE

Mathematics is an indispensable tool for much of science and engineering. It provides the basic language for understanding the world and lends precision to scientific thought. The mathematics program at Universities of Odisha aims to provide a foundation for pursuing research in Mathematics as well as to provide essential quantitative skills to those interested in related fields. With the maturing of the Indian industry, there is a large demand for people with strong analytical skills and broad-based background in the mathematical sciences.

COURSE STRUCTURE FOR MATHEMATICS HONORS

Semester	Course	Course Name	Credits
I	AECC-I	AECC-I	04
	C-I	Calculus – I (P)	04
	C-I	Practical	02
	C-II	Algebra - I	05
	C-II	Tutorial	01
	GE-I	GE-I	05
	GE-I	Tutorial	01
			22
II	AECC-II	AECC-II	04
	C-III	Real Analysis (Analysis – I)	05
	C-III	Tutorial	01
	C-IV	Differential equations (P)	04
	C-IV	Practical	02
	GE-II	GE-II	05
	GE-II	Tutorial	01
			22
III	C-V	Theory of Real functions (Analysis – II)	05
	C-V	Tutorial	01
	C-VI	Group Theory (Algebra-II)	05
	C-VI	Tutorial	01
	C-VII	Partial differential equations and systems of ODEs (P)	04
	C-VII	Practical	02
	GE-III	GE-III	05
	GE-III	Tutorial	01
	SECC-I	SECC-I	04
			28
IV	C-VIII	Numerical Methods (P)	04
	C-VIII	Practical	02

	C-IX	Riemann Integration and Series & Functions (Analysis – III)	05
	C-IX	Tutorial	01
	C-X	Ring Theory and Linear Algebra (Algebra-III)	05
	C-X	Tutorial	01
	GE-IV	GE-IV (Theory)	05
	GE-IV	Tutorial	01
	SECC-II	SECC-II	04
			28
Semester	Course	Course Name	Credits
V	C-XI	Multivariate Calculus (Calculus-II)	05
	C-XI	Tutorial	01
	C-XII	Programming in C++	05
	C-XII	Practical	01
	DSE-I	Discrete Mathematics	05
	DSE-I	Tutorial	01
	DSE-II	Number Theory	05
	DSE-II	Tutorial	01
			24
VI	C-XIII	Metric spaces and Complex analysis (Analysis –IV)	05
	C-XIII	Tutorial	01
	C-XIV	Linear Programming	05
	C-XIV	Tutorial	01
	DSE-III	Differential Geometry	05
	DES-III	Tutorial	01
	DES-IV	Project	06
			24
		TOTAL	**148**

B.A./B.SC.(HONOURS)-MATHEMATICS

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers (out of the 5 papers suggested)

Generic Elective for non Mathematics students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper –

For practical paper: Midterm : 15 marks, End term : 60 marks, Practical- 25 marks

For non practical paper: Midterm : 20 marks, End term : 80 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper –

Practical paper-40 hour theory classes + 20 hours Practical classes

Non Practical paper-50 hour theory classes + 10 hours tutorial

CORE PAPER - I

CALCULUS

Core-I, Calculus-I (Total Marks : 100)

Part-I (Marks:75)

(Theory 60 Marks + Mid-Sem : 15 Marks

Objective: The main emphasis of this course is to equip the student with necessary analytic and technical skills to handle problems of mathematical nature as well as practical problems. More precisely, main target of this course is to explore the different tools for higher order derivatives, to plot the various curves and to solve the problems associated with differentiation and integration of vector functions.

Excepted Outcomes: After completing the course, students are expected to be able to use Leibnitz's rule to evaluate derivatives of higher order, able to study the geometry of various types of functions, evaluate the area, volume using the

techniques of integrations, able to identify the difference between scalar and vector, acquire knowledge on some of the basic properties of vector functions.

Unit - I

Hyperbolic functions, higher order derivatives, Leibriz rule and its applications to problems of the type $e^{ax+b} \sin x$, $e^{ax+b} \cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$. Curvature, asymptotes, cure tracing in Cartesian coordinates, tracing in polar coordinates of standard curves L Hospitals rule.

Unit - II

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int (\sin x)^n dx$, $\int (\cos x)^n dx$, $\int (\tan x^n) dx$, $\int (\sec x)^n dx$, $\int (\log x)^n dx$, $\int \sin^n x \cos^m x dx$ volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, arc length, arc length of parametric curves, area of surface of revolution.

Unit - III

Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminated, polar equations of conics.

Unit - IV

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

Part - II (Practical, Marks : 25)

List of Practical's (Using any software) Practical / Lab work to be performed on a computer.

1. Plotting the graphs of the functions e^{ax+b}, $\log (ax+b)$, $1/(ax+b)$, $\sin (ax+b)$, $\cos (ax+b)$, $|ax+b|$ and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of the polynomial of degree 4 and 5, the derivative graphs, the second derivative graph and comparing them.
3. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid)

4. Obtaining surface of revolution of curves.
5. Tracing of conics in Cartesian coordinates / polar coordinates.
6. Sketching ellipsoid, hyperboloid of one and two sheets.
7. Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended :

1. Text Book of Calculus, Part-II - Shantinarayan, S. Chand & Co.Ch-8,10 (33-37)
2. Text Book of Calculus, Part-III-Shantinarayan, S. Chand & Co.Ch-1 ,3,5,6. (15 restricted)
3. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002. Chapters: 5, (5.2-5.5), 6(6.8), 10(10.1 – 10.6 (excluding 10.5)), 12(12.1, 12.2, 12.4)

Books for Reference:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.
3. Shanti Narayan and P.K. Mittal-Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.

CORE PAPER - II

Algebra - I

Total Marks: 100 Theory : 80 Marks + Mid - Sem : 20 Marks

5 Lectures, 1 Tutorial (per week)

Objective: This is a preliminary course for the basic courses in mathematics and all its applications. The objective is to acquaint students with complex analysis, functions and matrix theory.

Expected Outcomes: The acquired knowledge will help students in simple mathematical modeling. They can study advance courses in mathematical modeling, computer science, statistics, physics, chemistry etc.

Unit-I

Polar representation of complex numbers, n-th roots of unity, De Moivres theorem for rational indices and its applications.

Unit-II

Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Unit-III

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax = b$, solution sets of linear systems, applications of linear systems, linear independence.

Unit-IV

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of R^n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

Books Recommended:

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006. Chapter:2
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005. Chapters:2(2.4), 3, 4(4.1 (4.1.1 – 4.1.6), 4.2 (4.2.1 – 4.2.12), 4.3 (4.3.9), 4.4 (4.4.1 – 4.4.9)), 5 (5.1 (5.1.1 – 5.1.4 excluding Mathematical Induction and well ordering).
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. Chapters:1(1.1-1.9), 2(2.1-2.3, 2.8, 2.9), 5(5.1,5.2)

Semester –II

CORE PAPER – III

Real Analysis (Analysis-I)

Total Marks: 100 Theory: 80 Marks+Mid-Sem:20

Marks 5 Lectures, 1 Tutorial (per week)

Objective: The objective of the course is to have the knowledge on basic properties of the field of real numbers, studying Bolzano-Weierstrass Theorem , sequences and convergence of sequences; series of real numbers and its convergence etc. This is one of the core courses essential to start doing mathematics.

Expected Outcome: On successful completion of this course, students will be able to handle fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their use in sequences, series, differentiation and integration. Students will appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

Unit-I

Review of Algebraic and Order Properties of R, Neighborhood of a point in R, Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima. The Completeness Property of R

Unit-II

The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Idea of countable sets, uncountable sets and unaccountability of R.

Unit-III

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchys Convergence Criterion.

Unit-IV

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchys n-th root test, Integral test.

Book Recommended:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Publishing Co. Chapters: 2(2.1 to 2.4, 2.6), 3(3.1-3.4), 4(4.1 to 4.7, 4.10, 4.11)

Books for References:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
4. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, Ne:.y York, 1994.
5. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.
6. D. Smasundaram and B. Choudhury-A First Course in Mathematical Analysis, Narosa Publishing House.
7. S.L. Gupta and Nisha Rani-Real Analysis, Vikas Publishing House Pvt. Ltd., New Delhi.

CORE PAPER – IV
Differential Equations (Total Marks:I00)
Part-I(Marks:75)
Theory:60 Marks+ Mid-Sem:15 Marks
04 Lectures (per week)

Objective: Differential Equations introduced by Leibnitz in 1676 models almost all Physical, Biological, Chemical systems in nature. The objective of this course is to familiarize the students with various methods of solving differential equations and to have a qualitative applications through models. The students have to solve problems to understand the methods.

Expected Outcomes: A student completing the course is able to solve differential equations and is able to model problems in nature using Ordinary Differential Equations. This is also prerequisite for studying the course in Partial Differential Equations and models dealing with Partial Differential Equations.

Unit-I

Differential equations and mathematical models. First order and first degree ODE (variables separable, homogeneous, exact, and linear). Equations of first order but of higher degree.

Unit-II

Second order linear equations(homogeneous and non-homogeneous) with constant coefficients, variation of parameters, method of undetermined coefficients, equations reducible to linear equations with constant coefficients, Euler's equation.

Unit-III

Second order equations with variable coefficients Power series solutions of second order differential equations.

Unit-IV

Laplace transforms and its applications to solutions of differential equations.

Part-II (Practical: Marks:25)

List of Practicals (Using any Software) Practical/Lab work to be performed on a Computer.

1. Growth model (exponential case only).
2. Decay model (exponential case only)
3. Oxygen debt model
4. Economic model
5. Vibration problems
6. Plotting of second order solution family of differential equations.
7. Plotting of third order solution family of differential equations.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2(2.1 to 2.7), 3, 4(4.1 to 4.8), 5, 7(7.1-7.3.1), 9 (9.1-9.5, 9.10, 9.11, 9.13 (excluding 9.13.1).

Books for References:

1. Martin Braun, Differential Equations and their Applications, Springer International.
2. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
3. G. Dennis Zill-A First Course in Differential Equations with Modeling Applications, Cengage Learning India Pvt. Ltd.
4. S.L. Ross, Differential Equations, John Wiley & Sons, India, 2004.

Semester – III

CORE PAPER –V

Theory of Real Functions (Analysis –II)

Total Marks : 100 Theory : 80 Marks + Mid-Sem : 20 Marks

5 Lectures,

1 Tutorial (per week)

Objective: The objective of the course is to have knowledge on limit theorems on functions, limits of functions, continuity of functions and its properties, uniform continuity, differentiability of functions, algebra of functions and Taylor's theorem and, its applications. The student how to deal with real functions and understands uniform continuity, mean value theorems also.

Expected Outcome: On the completion of the course, students will have working knowledge on the concepts and theorems of the elementary calculus of functions of one real variable. They will work out problems involving derivatives of function and their applications. They can use derivatives to analyze and sketch the graph of a function of one variable, can also obtain absolute value and relative extrema of functions. This knowledge is basic and students can take all other analysis courses after learning this course.

Unit-I

Limits of functions (ε-δ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity.

Unit-II

Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem. Differentiability of a function at a point and in an interval, algebra of differentiate functions.

Unit-III

Rolles theorem, Mean value theorem, intermediate value property of derivatives, Darbouxs theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylors theorem to inequalities.

Unit-IV

Cauchys mean value theorem. Taylors theorem with Lagranges form of remainder, Taylors theorem with Cauchys form of remainder, application of Taylors theorem to convex functions, relative extreme. Taylors series and Maclaurins series expansions of exponential and trigonometric functions ln (1 + x), 1/ (ax + b) and $(1 + x)^n$.

Book Recommended:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Publishing Co., Chapters:6(6.1-6.9),7(7.1-7.7),

Books for References:

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
3. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
4. S.R. Ghorpade and BV Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

CORE PAPER - VI

Group Theory (Algebra-II)

Total Marks:l00 Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week)

Objective: Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of group theory and examples of groups and their properties. This course will lead to future basic courses in advanced mathematics, such as Group theory-II and ring theory.

Expected Outcomes: A student learning this course gets idea on concept and examples of groups and their properties. He understands cyclic groups, permutation groups, normal subgroups and related results. After this course he can opt for courses in ring theory, field theory, commutative algebras, linear classical groups etc. and can be apply this knowledge to problems in physics, computer science, economics and engineering.

Unit - I

Definitions and examples of groups including permutation groups. Elementary properties of groups. Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

Unit - II

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, properties of cosets, Lagranges theorem and consequences including Fermats Little theorem.

Unit - III

Normal subgroups, factor groups, Cauchys theorem for finite abelian groups.

Unit – IV

Group homomorphisms, properties of homomorphisms, Cayleys theorem, properties of isomorphisms, First, Second and Third isomorphism theorems (Statement only)

Book Recommended:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.Ch-2(2.1-2.7,2.9, 2.10)

Books for References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.
4. Joseph A. Gallian, Contemporary Abstract Algebra(4th Edn.), Narosa Publishing House, New Delhi

CORE PAPER - VII
Partial Differential Equations and Systems of Ordinary Differential Equations
(Total Marks : 100)

Part - I(Marks:75)
Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures (per week)

Objective: The objective of this course is to understand basic methods for solving Partial Differential Equations of first order and second order. In the process, students will be exposed to Charpit's Method, Jacobi Method and solve wave equation, heat equation, Laplace Equation etc. They will also learn classification of Partial Differential Equations and system of ordinary differential equations.

Expected Outcomes: After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, non linear evolution equations etc. All these courses are important in engineering and industrial applications for solving boundary value problem.

Unit-I

Simultaneous linear first order equations in three variables, methods of solution, Pfaffian differential equations, methods of solutions of Pfaffian differential equations in three variables.

Unit-II

Formation of first order partial differential equations. Linear and non-linear partial differential equations of first order, special types of first-order equations, Solutions of partial differential equations of first order satisfying given conditions.

Unit-III

Linear partial differential equations with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients, Partial differential equations with variable coefficients.

Unit-IV

Monge's method of integrating Rr+Ss+ Tt =V.Laplace equation, Solution of Laplace equation by separation of variables.

Part-II (Practical: Marks:25)

List of Practicals (Using any Software) Practical/Lab work to be performed on a Computer.

1. To find the general solution of the non-homogeneous system of the form: $\frac{dx}{dt} = a1x + b1y + f1(t); \frac{dy}{dt} = a2x + b2y + f2(t)$ with given conditions.
2. Plotting the integral surfaces of a given first order PDE with initial data.
3. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - C^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

   (a) $u(x, 0) = \phi$, $u_t(x, 0) = \Psi(x)$, $x \varepsilon R$, $t > 0$. *(b)* $u(x, 0) = \phi(x)$, $u_t(x, 0) = \Psi(x)$, $u_x(0, t) = 0$ $x \varepsilon (0, \infty)$, $t > 0$, *(c)* $u(x, 0) = \phi(x)$, $u_t(x, 0) = \Psi(x)$, $u(0,t) = 0$, $x \varepsilon (0, \infty)$, $t > 0$. *(d)* $u(x,) = \phi(x)$, $u_t(x,) = \Psi(x)$, $u(0, t) = 0$, $u(l, t) = 0$, $0 < x < l$, $t > 0$.
4. Solution of Diffusion equation $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

   (a) $u(x, 0) = \phi(x)$, $u(0, t) = a$, $u(l, t) = b$, $0 < x < l$, $t > 0$

   (b) $u(x, 0) = \phi(x)$, $x \varepsilon R$, $0 < t < T$.

   (c) $u(x, 0) = \phi(x)$, $u(0,t) = a$, $x \varepsilon (0, \infty)$, $t \geq 0$

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi, Ludhiana, 2012.Chapters:11, 12, 13(13.1-13.5,13.7), 15(15.1,15.5 (excluding 15.5.1)).

Books for References:

1. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.

Semester - IV

CORE PAPER - VIII

Numerical Methods (Total Marks:100)

Part-I (Marks:75)

Theory: 60 Marks+Mid-Sem:15 Marks

04 Lectures (per week)

Objective: Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of systems of linear equations and differential equations, interpolation, differentiation, evaluating integration.

Expected Outcome: Students can handle physical problems to find an approximated solution. After getting trained a student can opt for advance courses in Numerical analysis in higher mathematics. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance.

Unit-I

Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newtons method, Secant method. Rate of convergence of these methods.

Unit-II

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods.

Unit-III

Interpolation: Lagrange and Newtons methods. Error bounds. Finite difference operators.

Unit-IV

Numerical Integration: Trapezoidal rule, Simpsons rule, Simpsons 3/8th rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpsons rule. Or.dinary Differential Equations: Eulers method.

Part-II (Practical: Marks:25)

List of Practicals (Using any Software) Practical/Lab work to be performed on a Computer.

1. Bisection Method.
2. Regulai Falsi Method.
3. Secant Method.
4. Newton Raphson Method.
5. Lagrange Interpolation Method.
6. Newton Interpolation Method.
7. Compound Trapezoidal rule.
8. Compound Simpson's rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, looical.operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

Book Recommended:

1. B.P. Acharya and R.N. Das, A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 0 (0.2), 1 (1.8), 2(2.1 - 2.4, 2.6-2.9), 3(3.1 - 3.4, 3.6 - 3.9), 6(6.1-6.5), 7(7.1- 7.4),8(8.1- 8.3)

Books for References:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
2. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
3. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
4. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited,2012 .

CORE PAPER - IX

Riemann Integration and Series of Functions (Analysis-III)

Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week)

Objective : The objective of the course is to have knowledge of Riemann Integration, Improper Integrates, convergence of sequence and series of functions & power series.

Expected Outcome : On the completion of the course students will have working knowledge on the concept and theorems of elementary calculus of functions of one variable. This knowledge is basic and students can take all other analysis courses after learning the course.

Unit-I

Riemann integration; inequalities of upper and lower sums; Riemann conditions of inerrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann inerrability of monotone and continuous functions, Properties of the Riemann integral; definition and inerrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

Unit-II

Improper integrals; Convergence of Beta and Gamma functions.

Unit-III

Point wise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit-IV

Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abels Theorem; Weierstrass Approximation Theorem.

Book Recommended:

1. G. Das and S. Pattanayak-Fundamentals of Mathematics Analysis, TMH Publishing Co., Chapters: 4(4.14), 8(8.1 - 8.6) 9(9.1 - 9.6, 9.8)

Books for References:

1. KA Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
2. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.
4. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Ltd., New Delhi.
5. Shanti Narayan and M.D. Raisinghania-Elements of Real Analysis, S. Chand & Co. Pvt. Ltd.

CORE PAPER - X

Ring Theory and Linear Algebra (Algebra-III)

Total Marks : 100

Theory : 80 Marks+Mid-Sem:20

Marks 5 Lectures, 1 Tutorial (per week)

Objective: This is a second course in modern algebra which deals with ring theory. Some basics of ring theory like rings, subrings, ideals, ring homomorphisms and their properties and. This course is an integral part of any course on Modern algebra the others being Group theory and Field Theory.

Expected Outcomes: After completing this course, this will help students to continue more courses in advanced Ring theory modules, Galois groups.

Unit-I

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Unit-II

Ring homomorphisms, properties of ring homomorphisms, field of quotients of an integral domain.

Unit-III

Vector spaces, subspaces, algebra of subspaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit-IV

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations.

Book Recommended:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.Ch-3(3.1-3.6)
2. V. Krishnamurty, V. P. Mainra, J. L. Arora-An introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi.Ch-3(ex-3.4),4(4.1-4.3),5(5.1-5.2)

Books for References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
4. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning India Pvt. Ltd.
5. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
6. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
7. Joseph A. Gallian, Contemporary Abstract Algebra(4th Edn.), Narosa Publishing House, New Delhi. Chapters : 12, 13, 14, 15.

Semester-V

CORE PAPER – XI

Multivariate Calculus (Calculus-II)

Total Marks : 100 Theory : 80 Marks + Mid - Sem : 20 Marks

5 Lectures, 1 Tutorial (per week)

Objective: The objective of this course to introduce functions of several variable to a student after he has taken a course in one variable calculus. The course will introduce partial derivatives and several of its consequences and will introduce double and triple integrals along with line integrals which are fundamental to all streams where calculus can be used.

Expected Outcomes: After reading this course a student will be able to calculate partial derivatives, directional derivatives, extremum values and can calculate double, triple and line integrals. He will have idea of basic vector calculus including green's theorem, divergence theorem and stokes theorem. He can take courses in calculus on manifolds, Differential geometry and can help in numerical computations involving several variables.

Unit-I

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property or the gradient, tangent planes.

Unit-II

Extreme of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl.

Unit-III

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals.

Unit-IV

Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. Greens theorem surface integrals, integrals over parametrically defined surfaces. Stokes theorem, The Divergence theorem(only statement).

Books Recommended:

1. Advanced Higher Calculus by G. Samal, S.C. Jena, T. Biswal & D. K. Dalai, Vidyapuri Publication (12, 13, 14, 16, 17, 20)

Books for References :

1. M.J. Strauss, G.L. Bradley and K.J. Smith: Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007. Chapters: 11(11.1 (Pages: 541-543), 11.2-11.6, 11.7 (Pages: 598-605), 11.8 (Pages : 610-614), 12 (12.1-12.3, 12.4 (Pages : 652-660), 12.5, 12.6), 13 (13.1-13.3, 13.4 (Pages 712-716, 718-720), 13.5 (Pages : 723-726; 729-730), 13.6 (Pages : 733-737), 13.7 (Pages : 742-745))
2. G.B. Thomas and R.L. Finney : Calculus, 9th Ed., Pearson Education, Delhi, 2005.

CORE PAPER – XII

Programming in C++

Part-I (Marks:75)

(Theory:60 Marks+Mid-Sem:15 Marks)

Objective: The objective of this course is to provide the student with all the basic concepts of C++ Programming Language.

Expected Outcomes: After reading this course a student will be able to develop programs in C++ for all areas of mathematics and will be very useful for pursuing higher courses in mathematics.

Unit - I

Introduction to structured programming: data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operators precedence, variables and constant declarations, expressions.

Unit - II

Input using the extraction operator n and cin, output using the insertion operator and cout, preprocessor directives, increment(++) and decrement(-) operations, creating a C++ program, input, output, relational operators, logical operators and logical expressions.

Unit - III

If and if-else statement, switch and break statements. for, while and do-while loops and continue statement, nested control statement.

UNIT - IV

Value returning functions, value versus reference parameters, local and global variables, one dimensional array, two dimensional array, pointer data and pointer variables.

Book Recommended:

1. Baluja, object Oriented Programming using C++ Chapters 1, 2 (Excluding 2.9, 2.14 & 2.20), 3, 4, 5 (5.1 – 5.7, 5.9, 5.10 & 5.13)

Books for References:

1. E. Balaguruswami: Object oriented programming with C++, fifth edition, Tata McGraw Hill Education Pvt. Ltd.
2. R. Johnsonbaugh and M. Kalin-Applications Programming in ANSI C, Pearson Education.
3. S. B. Lippman and J. Lajoie, C++ Primer, 3rd Ed., Addison Wesley, 2000.
4. Bjarne Stroustrup , The C++ Programming Language, 3rd Ed., Addison Welsley.

Part-II (Practical, Marks:25)

List of Practicals (Using any software) Practical/Lab work to be performed on a Computer.

1. Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ... + 1 /N.
2. Calculate the factorial of any natural number.
3. Read floating numbers and compute two averages : the average of negative numbers and the average of positive numbers.
4. Write a program that prompts the user to input a positive integer. It should then output a message indicating whether the number is a prime number.
5. Write a program that prompts the user to input the value of a, band c involved in the equation $ax^2 + bx + c = 0$ and outputs the type of the roots of the equation. Also the program should outputs all the roots of the equation.
6. Write a programme that generates random integer between 0 and 99. Given that first two Fibonacci numbers are 0 and 1, generate all Fibonacci numbers less than or equal to generated number.
7. Write a program that prompts the user to input five decimal numbers. The program should then add the five decimal numbers, convert the sum to the nearest integer, and print the result.
8. Write a program that prompts the user to enter the lengths of three sides of a triangle and then outputs a message indicating whether the triangle is a right triangle or a scalene triangle.

9. Write a function that takes as a parameter an integer (as a long. value) and returns the number of odd, even, and zero digits. Also write a program to test your function.
10. Enter 100 integers into an array and short them in an ascending/ descending order and print the Larges / smallest integers.
11. Enter 10 integers into an array and then search for a particular integer in the array.
12. Multiplication/ Addition of two matrices using two dimensional arrays.

Semester- VI

CORE PAPER - XIII

Metric Spaces and Complex Analysis (Analysis-IV)

Total Marks: 100 Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week)

Objective: This is an introductory course in topology of metric spaces and complex analysis. The objective of this course is to impart knowledge on open sets, closed sets, continuous functions, connectedness and compactness in metric spaces and complex analysis.

Expected Outcomes: On successful completion of the course students will learn to work with abstract topological spaces. This is a foundation course for all analysis courses in future.

Unit-I

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighborhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantors theorem.

Unit-II

Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit-III

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Unit-IV

Liouvilles theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples. Laurent series and its examples, absolute and uniform convergence of power series.

Books Recommended:

1. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publicatfons.Ch-19 – 1, 2, 3 (Upto Theorem 11)
2. Complex analysis Dr. S Arumugam. Ch- 1, 2 (2.1 - 2.8), 4 (4.4), 6, 7 (7.1 - 7.2)

Books for References:

1. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
2. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
3. S. Ponnusamy-Foundations of Complex Analysis, Alpha Science International Ltd.
4. J.B. Conway-Functions of one complex variable, Springer.
5. N. Oas- Complex Function Theory, Allied Publishers Pvt. Ltd., Mumbai.

CORE PAPER – XIV

Linear Programming

Total Marks : 100 Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week)

Objective: The objective of this course is to familiarize industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications. Also, students will know the application of linear Programming method in Game Theory.

Expected Outcomes: More knowledge on this topic in higher studies will help students to deal industrial models. This is also prerequisite for studying advanced courses in Nonlinear Programming Problems, Inventory Control Problem and Queuing Theory etc.

Unit-I

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two phase method, Big M method.

Unit-II

Duality, formulation of the dual problem, primal-dual relationships.

Unit-III

Transportation problem and its mathematical formulation, northwest corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem,

Unit-IV

Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Recommended Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt. Ltd. Ch-4 (4.1-4.4), 5(5.1-5.4), 10(10.1-10.3, 10.5, 10.9) 11. (11.1-11.3)

Books for Reference:

1. F.S. HiHier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009. Chapter: 14
2. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice Hall India, 2006. Chap- ter:5(5.1, 5.3, *5A).*
3. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
4. NVR. Naidu, G. Rajendra and T. Krishna Rao-Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
5. R. Veerachamy and V. Ravi Kumar-Operations Research- I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.

Discipline Specific Elective Paper - I

DSE - I

2. Discrete Mathematics

Objective : This is a preliminary course for the basic courses in mathematics and all its applications. The objective is to acquaint students with basic counting principles, set theory and logic, matrix theory and graph theory

Expected Outcomes : The acquired knowledge will help students in simple mathematical modeling. They can study advance courses in mathematical modeling, computer science, statistics, physics, chemistry etc.

Unit-I

Logic, proportional equivalence, predicates and quantifiers, nested quantifiers, methods of proof. The basic counting, the Pigeon-hole principle, Generalized Permutations and Combinations.

Unit-II

Recurrence relations, Counting using recurrence relations, Solving linear homogeneous recurrence relations with constant coefficients, Generating functions, Solving recurrence relations using generating functions.

Unit-III

Relations and their properties, n-ary relation and their applications. Partially ordered sets, Hasse diagram of partially ordered sets, maps between ordered sets, duality principle,

Unit-IV

Graphs: Basic concepts and graph terminology, representing graphs and graph isomorphism. Distance in a graph, Cut-vertices and Cut-edges, Connectivity, Euler and Hamiltonian path.

Book Recommended:

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Tata McGraw Hill Publications, 7th Edition, Chapters: 1(1.1 - 1.4, 1.6), 4 (4.1), 5 (5.1, 5.2, 5.5), 6 (6.1, 6.2, 6.4), 7 (7.1, 7.2, 7.6), 8 (8.1-8.5), 10 (10.1,10.2).

Books for References:

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Gnter Pilz, Applied Abstract Algebra (2nd Edition), Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. D.S. Malik-Discrete Mathematics: Theory & Applications, Cengage Learning India Pvt. Ltd.
5. Kevin Ferland-Discrete Mathematical Structures, Cengage Learning India Pvt. Ltd .

Discipline Specific Elective Paper - II

DSE-II

Number Theory

Objective: The main objective of this course is to build up the basic theory of the integers, prime numbers and their primitive roots, the theory of congruence, quadratic reciprocity law and number theoretic functions, Fermat's last theorem, to acquire knowledge in cryptography specially in RSA encryption and decryption.

Expected Outcomes: Upon successful completion of this course students will able to know the basic definitions and theorems in number theory, to identify order of an integer, primitive roots, Euler's criterion, the Legendre symbol, Jacobi symbol and their properties, to understand modular arithmetic number-theoretic functions and apply them to cryptography.

Unit-I

Divisibity theorem in integers, Primes and their distributions, Fundamental theorem of arithmetic, Greatest common divisor, Euclidean algorithms, Modular arithmetic,

Unit-II

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture.

Unit-III

Introduction to congruences, Linear Congruences, Chinese Remainder theorem, Polynomial congruences, System of linear congruences, complete set of residues.

Unit-IV

Fermats little theorem, Wilsons theorm. Eulers phifunction, Eulers theorem, reduced set of residues, some properties of Eulers phi-funciton.

Book Recommended :

1. D.M. Burton-Elementary Number Theory, McGraw Hill, Chapters : 2(2.1 to 2.5), 3(3.1 to 3.3), 4 (4.1 to 4.4), 5(5.1 to 5.3), 7 (7.1 to 7.4).

Book for References :

1. K.H. Rosen-Elementary Number Theory & its Applications, Pearson Addition Wesley.
2. I. Niven and H.S. Zuckerman-An Introduction to Theory of Numbers, Wiley Eastern Pvt. Ltd.

Discipline Specific Elective Paper - III

DSE-III

Differential Geometry

Total Marks:100 Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week)

(Anyone of the following)

Objective: After learning methods on curve tracing andAnalytic Geometry, the objective of this course is to teach Differential geometry of curves and surfaces which trains a student using tools in calculus to derive intrinsic properties of plain curves and space curves.

Expected Outcome: After completing this course a student will learn on serret-Frenet formulae, relation between tangent, normal and binormals, first and second fundamental forms and ideas on various curvatures. He has scope to take more advanced courses in surface theory and geometry.

1-Differential Geometry

Unit-I

Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae.

Unit-II

Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Unit-III

Developables: Developable associated with space curves and curveson surfaces, Minimal surfaces.

Unit-IV

Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Eulers theorem. Rodrigues formula.

Book Recommended:

1. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003. Chapters.1(1-4, 7,8,10,11),2(13,14,16,17),3,4(29-31,35)

Books for References

1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.
2. S. Lang, Fundamentals of Differential Geometry, Springer, 1999,
3. B. O'Neill, Elementary Differential Geometry, 2nd Ed" Academic Press, 2006.
4. A.N, Pressley-Elementary Differential Geometry, Springer,
5. B.P, Acharya and R.N. Das-Fundamentals of Differential Geometry, Kalyani Publishers, Ludhiana, New Delhi.

Discipline Specific Elective Paper-IV

PROJECT

DSE-IV Project Work (Compulsory)

Total Marks : 100 (Project : 75 Marks + Viva Voice : 25 Marks)

Guidelines for +3(CBCS) Under Graduate(B.A./B.Sc.) Mathematics(Honours) Project

1. Any student registering for doing project is required to inform the HOD, Mathematics the name of his/her project supervisor(s) at the time of pre-registration.
2. By the last date of add and drop, the student must submit the "Project Registration Form", appended as Annexure-I to this document, to the HOD, Mathematics. This form requires a project title, the signature of the student, signature(s) of the supervisor(s) and the signature of the HOD, Mathematics of the college/university.

3. The project supervisor(s) should normally be a faculty member(s) of the Department of Mathematics and the topic of the project should be relevant to Mathematical Sciences. If a student desires to have a Project Supervisor from another department of the institute, the prior approval for the same should be sought from the HOD, Mathematics.
4. A student may have at the most two Project Supervisors. If a student desires to have two supervisors, at least one of these should be from the Department of Mathematics.
5. The student(s) will be required to submit one progress report and a final report of the Project to the HOD, Mathematics. The progress report is to be submitted in the sixth week of the semester in which the project is undertaken. The hard copy and an electronic version of the final report of the project should be submitted two weeks before the end semester examination of the sixth semester. In addition the student will be required to make an oral presentation in front of a committee (Under Graduate (B.A./B.Sc.) Mathematics (Honours) Project committee of the college in which supervisor is one of the members) constituted for this purpose by the Department of Mathematics of the college.
6. The student is expected to devote about 100 hours. The project will be evaluated by a committee of faculty members at the end of the sixth semester. The committee will be constituted by the Under Graduate (B.A./B.Sc.) Mathematics (Honours) Project committee of the college keeping in mind the areas of project they will cover.
7. In each semester the grade of a student will be awarded by the committee in consultation with his/her project supervisor(s). The project is evaluated on the basis of the following components: First Progress Reports: 20%; second/Final Report: 30%; Presentation: 30%; Viva:20%.
8. Project progress reports should normally be no longer than 250 words and final report should not be longer than 40 A4 size pages in double spacing. Each final project report need to contain the following: (i) Abstract (ii) Table of contents (iii)Review of literature (iv) Main text(v) List of references. It may be desirable to arrange the main text as an introduction, the main body and conclusions.

GUIDELINES FOR STRUCTURING CONTENTS

Sequence of Contents:

The following sequence for the thesis organization should be followed:

(i) Preliminaries	Title Page Certificate Abstract/Synopsis Acknowledgement and/ or Dedication Table of Contents List of Figures, Tables, Illustrations, Symbols, etc (wherever applicable)
(ii) Text of Thesis	Introduction The body of the thesis, summary and conclusions
(iii) Reference Material	List of References, Bibliography
(iv) Appendices	

NOTE:

1. Synopsis/Abstract should be self-complete and contain no citations for which the thesis has to be referred.
2. The Text of the Thesis

(a) Introduction:

Introduction may be the first chapter or its first major division. In either case, it should contain a brief statement of the problem investigated. It should outline the scope, aim, general character of the research and the reasons for the student's interest in the problem.

(b) The body of Thesis

This is the substance of the dissertation inclusive of all divisions, subdivisions, tables, figures, etc.

(c) Summary and conclusions

If required, these are given as the last major division (chapter) of the text. A further and final subdivision titled "Scope for Further Work" may follow.

(d) Reference material

The list of references should appear as a consolidated list with references listed either alphabetically or sequentially as they appear in the text of the thesis.

For referencing an article in a scientific journal the suggested format should contain the following information: authors, title, name of journal, volume number, page numbers and year. For referencing an article published in a book, the suggested format should contain, authors, the title of the book, editors, publisher, year, page number of the article in the book being referred to. For referencing a thesis the suggested format should contain, author, the title of thesis, where thesis was submitted or awarded, year.

ANNEXURE-I

Department of Mathematics

Project Registration Form

Name of the college/university:

Name of the student:

Roll No. :

e-mail :

Name of the supervisor(s):

Department(s):

e-mail(s):

Title of the Project:

Signature of the Student:

Signature of supervisor(s): (i)

(ii)

Signature of HOD, Mathematics:

GENERIC ELECTIVES (TWO PAPER CHOICE)

Generic Electives/Interdisciplinary (04 Papers, 02 papers each from two Allied disciplines)

(Credit: 06 each, Marks:l00) GE-I to GE-IV

GE-I: Calculus and Ordinary Differential Equations

Objective: Calculus invented by Newton and Leibnitz is a powerful analytical tool to solve mathematical problems which arise in all branches of science and engineering. The main emphasis of this course is to equip the student with necessary analytic and technical skills to handle problems of a mathematical nature as well as practical problems using calculus and differential equation. The aim should be to expose the students to basic ideas quickly without much theoretical emphasis with importance on applications.

Excepted Outcomes: After completing the course, students are expected to be able to apply knowledge of calculus and differential equations in the areas of their own interest.

Unit-I

Curvature, Asymptotes, Rectification, Quardrature, Volume and Surface area of solids of revolution.

Unit-II

Explicit and Implicit functions, Limit and Continuity of functions of several variables, Partial derivatives. Partial derivatives of higher orders, Homogeneous functions, Change of variables, Mean value theorem, Taylors theorem and Maciaurins theorem for functions of two variables.

Unit-III

Ordinary Differential Equations of 1st order and 1st degree (Variables separable, homogenous, exact and linear). Equations of 1st order but higher degree.

Unit-IV

Second order linear equations with constant coefficients, homogeneous forms.

Books Recommended:

1. Shantinarayan-Text Book of Calculus, Part-II, S. Chand and Co., Chapter-8 (Art. 24, 25, 26)
2. Shantinarayan-Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art 1,2), 4(Art. 10 to 12 omitting Simpsons Rule), 5(Art-13), 6 (15, 16)
3. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.Ch-15 (1 - 9)
4. J. Sinharoy and S. Padhy-A Course of Ordinary and Partial Differential Equations, Kalyani Publishers. Chapters: 2(2.1 to 2.7),3,4(4.1 to 4.4)

Books for References:

1. Shanti Narayan and P.K. Mittal-Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.
2. David V. Weider-Advanced Calculus, Dover Publications.
3. Martin Braun-Differential Equations and their Applications-Martin Braun, Springer International.
4. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
5. G. Dennis Zill-A First Course in Differential Equations with Modelling Applications, Cengage Learning India Pvt. Ltd.

Generic Elective Paper - II

GE-II : Linear Algebra and Advanced Algebra

Objective: This is a preliminary course for the basic courses in mathematics like, abstract algebra and linear algebra. The objective is to acquaint students with the properties of natural numbers i.e. Euclidean algorithm, congruence relation, fundamental theorem of arithmetic, etc. The basics of linear algebra i.e. vector spaces, matrices are introduced here.

Expected Outcomes: The acquired knowledge will help students to study further courses in mathematics like, group theory, ring theory and field theory and linear algebra. It has applications not only in higher mathematics but also in other science subjects like computer science, statistics, physics, chemistry etc.

Unit - I

Vector space, Subspace, Span of a set, Linear dependence and Independence, Dimensions and Basis. Linear transformations.

Unit - II

Matrices and linear maps, Rank and Nullity of a matrix, Transpose of a matrix, Elementary row operations, System of linear equations, Matrix inversion using row operations, Determinant and Rank of matrices, Eigen values, Eigen vectors.

Unit - III

Group Theory: Definition and examples, Subgroups, Normal subgroups

Unit - IV

Cyclic Groups, Cosets, Quotient Groups, Permutation Groups, Homomorphism.

Books Recommended:

1. V. Krishnamurty, V. P. Mainra, J. L. Arora-An introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi, Chapters: 3, 5 (5.1, 5.2. 5.5 - 5.9), 6 (6.5 to 6.8)
2. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.Ch-2 (2.1 to 2.6,2.7(ex application)

Books for References:

1. S. Kumaresan-Linear Algebra: A Geometric Approach, Prentice Hall of India.
2. Rao and Bhimasankaran-Linear Algebra, Hindustan Publishing House.
3. S. Singh-Linear Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.
4. Gilbert Strang-Linear Algebra & its Applications, Cengage Learning India Pvt. Ltd.
5. Gallian-Contemporary Abstract Algebra, Narosa publishing House.
6. Artin-Algebra, Prentice Hall of India.

OR

GENERIC ELECTIVES (FOR FOUR PAPERS CHOICE)
Generic Elective Paper III

Linear Programming

Total Marks : 100 Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week)

Objective: The objective of this course is to familiarize industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications. Also, students will know the application of linear Programming method in Game Theory.

Expected Outcomes: More knowledge on this topic in higher studies will help students to deal industrial models. This is also prerequisite for studying advanced courses in Nonlinear Programming Problems, Inventory Control Problem and Queuing Theory etc.

Unit-I

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two phase method, Big M method.

Unit-II

Duality, formulation of the dual problem, primal-dual relationships.

Unit-III

Transportation problem and its mathematical formulation, northwest corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem,

Unit-IV

Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Recommended Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt. Ltd. Ch-4 (4.1-4.5), 5(5.1-5.4), 10(10.1-10.3, 10.5, 10.9) 11 (11.1-11.3)

Books for Reference:

1. F.S. HiHier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009. Chapter: 14
2. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice Hall India, 2006. Chap- ter:5(5.1, 5.3, 5A).
3. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
4. NVR. Naidu, G. Rajendra and T. Krishna Rao-Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
5. R. Veerachamy and V. Ravi Kumar-Operations Research- I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.

GENERIC ELECTIVE PAPER IV

Numerical Methods

Total Marks : 100 Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week)

Objective: Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of systems of linear equations and differential equations, interpolation, differentiation, evaluating integration.

Expected Outcome: Students can handle physical problems to find an approximated solution. After getting trained a student can opt for advance courses in Numerical analysis in higher mathematics. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance.

Unit-I

Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newtons method, Secant method. Rate of convergence of these methods.

Unit-II

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods.

Unit-III

Interpolation: Lagrange and Newtons methods. Error bounds. Finite difference operators.

Unit-IV

Numerical Integration: Trapezoidal rule, Simpsons rule, Simpsons 3/8th rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpsons rule. Or.dinary Differential Equations: Eulers method.

Book Recommended:

2. B.P. Acharya and R.N. Das, A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 1, 2(2.1 to 2.4, 2.6, 2.8, 2.9), 3(3.1 to 3.4, 3.6 to 3.9), 6(6.1-6.5), 7(7.3, 7.4),8(8.1,8.2)

Books for References:

5. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
6. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
7. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
8. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited,2012 .