Parishkar College of Global Excellence

(Autonomous), Jaipur

CHOICE BASED CREDIT SYSTEM (CBCS)

B. Sc. Honours (3 year Program)

MATHEMATICS

Faculty Members

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Title of the Program: B. Sc.(Hons.) Mathematics

Welcome to the Department of Mathematics which joins in

Parishkar College of Global Excellence (Autonomous), Jaipur

1. Introduction

The current focus in higher education is to shift from teacher-centric approach to learner centric approach. For this as one of the aims, UGC has introduced the learning outcomes based curriculum framework for undergraduate education. The learning outcomes-based curriculum framework for B.Sc.(Hons.) Mathematics is prepared keeping this in view. The framework is expected to provide a student with knowledge and skills in mathematics along with generic and transferable skills in other areas that help in personal development, employment and higher education in the global world.

About the Mathematics

Mathematics is a powerful tool for global understanding and communication that organizes our lives and prevents chaos. Mathematics helps us understand the world and provides an effective way of building mental discipline. Mathematics encourages logical reasoning, critical thinking, creative thinking, abstract or spatial thinking, problem-solving ability, and even effective communication skills. Mathematics is necessary to understand the other branches of knowledge. All depend on mathematics in one way or another. There is no science, art, or specialty except mathematics was the key to it. The discipline and mastery of any other science or art are very much related to the size of mathematics.

Introduction to CBCS (Choice Based Credit System)

Choice Based Credit System:

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations enables the student to move across institutions of higher learning. The uniformity in evaluation system also enable the potential employers in assessing the performance of the candidates.

Key words:

- **'Academic Program'** means an entire course of study comprising its program structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more thanone such Department/Centre.
- **'Course'** means a segment of a subject that is part of an Academic Program.
- **'Program Structure'** means a list of courses (Core, Elective, Open Elective)that makes up an Academic Program, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the program etc.
- **'Core Course'** means a course that a student admitted to a particular programmust successfully complete to receive the degree and which cannot be substituted by any other course.
- **'Elective Course'** means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre.
- **'Discipline Specific Elective (DSE)'** Course is the domain specific elective course offered by the main discipline/subject of study.
- **'Dissertation/Project'** is an elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member. Project work/Dissertation is considered as a special course involving application of knowledge in solving /analyzing /exploring a real life situation/difficult problem.
- **'Generic Elective (GE)'** Course is an elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure to other disciplines.

Objective of Bachelor's degree (Hons.) program in Mathematics

The overall objective of B.Sc. (Hons.) Mathematics Program are to inculcate strong interest in learning mathematics.

• Evolve broad and balanced knowledge and understanding of definitions, key concepts, principles and theorems in Mathematics

• Enable learners/students to apply the knowledge and skills acquired by them during the program to solve specific theoretical and applied problems in mathematics.

• Develop in students the ability to apply relevant tools developed in mathematical theory to handle issues and problems in social and natural sciences.

• Provide students with sufficient knowledge and skills that enable them to undertake further studies in mathematics and related disciplines.

• Enable students to develop a range of generic skills which will be helpful in wage employment, self-employment and entrepreneurship.

Graduate Attributes in Mathematics

Some of the graduate attributes in mathematics are listed below:

- **Disciplinary knowledge:**
  Capability of demonstrating comprehensive knowledge of basic concepts and ideas in mathematics and its subfields, and its applications to other disciplines.

- **Communications skills:**
  Ability to communicate various concepts of mathematics in effective and coherent manner both in writing and orally, ability to present the complex mathematical ideas in clear, precise and confident way, ability to explain the development and importance of mathematics and ability to express thoughts and views in mathematically or logically correct statements.

- **Critical thinking and analytical reasoning:**
  Ability to apply critical thinking in understanding the concepts in mathematicsand allied areas; identify relevant assumptions, hypothesis, implications or conclusions; formulate mathematically correct arguments; ability to analyses and generalize specific arguments or empirical data to get broader concepts.

- **Problem solving:**
  Capacity to use the gained knowledge to solve different kinds of non-familiar problems and apply the learning to real world situations; Capability to solve problems in computer graphics using concepts of linear algebra; Capability to apply the knowledge gained in differential equations to solve specific problemsor models in operations research, physics, chemistry, electronics, medicine, economics, finance etc.

Program Learning Outcomes in B.Sc. (Hons.) Mathematics

- The completion of the B.Sc. (Hons.) Mathematics Program willenable a student to:
- Communicate mathematics effectively by written, computational andgraphic means.
- Create mathematical ideas from basic axioms.
- Gauge the hypothesis, theories, techniques and proofs provisionally.
- Utilize mathematics to solve theoretical and applied problems by criticalunderstanding, analysis and synthesis.
- Identify applications of mathematics in other disciplines and in the real-world, leading to enhancement of career prospects in a plethora of fieldsand research.

PROGRAM HIGHLIGHTS

Salient Features

- Approaching the subject from theoretical and practical points of view.
- Opportunity to attend seminars, workshops etc.
- Extra-curricular activities for peer interaction, growth of organizational skills and personality development.
- Well-equipped and spacious laboratories.
- Well qualified and experienced staff.
- Industrial collaboration/training.
- Placement opportunities.
- Good library and internet facilities.
- Industrial /Institutional projects.
- Guest lectures by experts from the field.

Total Teaching Hours:

For each Theory Paper: 60 Hours

for each Practical Paper: 30 Hours

Assessment Pattern:

Evaluation will be done on the basis of

1. Continuous internal assessment (CIA)
    - Group discussion
    - Assignments
    - Seminar
    - Presentation
    - Practical
    - Open Book Test
    - Quiz
    - Class Test
2. Mid Semester Examination (MSE)
3. Attendance
4. End Semester Examination (ESE)

Credits:

For each Theory Paper: 4

for each Practical Paper: 2

- **AECC**- Ability Enhancement Compulsory Course
- **CC**- Core course
- **GE**- Generic Elective
- **SEC**- Skill Enhancement Course
- **DSE**-Discipline Specific Elective

B.Sc. Honours Proposed scheme for choice based credit System							
Semester	**Core Course**			**Ability Enhancement (Credit-4)**	**Skill Enhancement(Credit-4)**	**Elective Course**	
	Paper (Credit-6)	**Paper (Credit-6)**	**Paper (Credit-6)**			**DSE Paper(Credit-6)**	**GE Paper (Credit -6)**
I	Calculus	Algebra & Geometry		English Communication	Introductive computer skills / General inter disciplinary awareness-I / Logical aptitude		
II	Multivariable calculus	Probability and Statistics			Mathematical & computational thinking / General inter disciplinary awareness-II / Quantitative aptitude-1	DSE-1- Mathematics	GE-1
III	Real Analysis	Ordinary Differential Equations			Professional &leadership and management skills / General inter disciplinary awareness-III/Quantitative aptitude-II	DSE-2- Mathematics	GE-2
IV	Linear Algebra	Group Theory	Set theoryand Metricspace		Industry exposure / General inter disciplinary awareness-IV/ Quantitative aptitude-III		GE-3
V	PDE and calculus ofvariation	Mechanics				DSE-3- Mathematics	GE-4
VI	AdvancedAlgebra	Complex Analysis	Numerical Analysis	EVS		DSE-4- Mathematics / Project / Internship	

Note: -

- Switch Dissertation with either of the Elective Paper (Only One).
- Freedom of selection of various subjects for industrial exposure.
- Student can opt any SEC offered by any Department

Credit Scheme For B.Sc. Mathematics Honours

S. No.	Course	Credit		Total Credits	
		Theory	Practical/ Tutorial		
1.	Core Course– 14	4	2	14 × 6	84
2.	Ability Enhancement Course 2	4		2 × 4	8
3.	Skill Enhancement Course 4	4		4× 4	16
4.	Discipline Specific Elective Course – Paper 4	4	2	4 × 6	24
5.	Generic Elective Course – Paper 4	4	2	4 × 6	24
Total Credits					156

Discipline Specific Elective Papers: (Credit: 04 each)

(4 papers to be selected)

DSE: 1-4

S. No.	Discipline Specific Elective Papers (DSECP) Name
	DSE: 1
1.	**Mathematical logic**
2.	**Graph Theory**
3.	**Optimization theory**
	DSE: 2
4.	**Vector Calculus**
5.	**Integral calculus**
6.	**Theory of equation**
	DSE: 3
7.	**Mathematical Modelling**
8.	**Number Theory**
9.	**Differential Geometry**
	DSE: 4
10.	**Boolean Algebra**
11.	**Information Theory of Coding**

Generic Course (GE1-GE4)

S. No.	Paper	Credits	
		Theory	Practical
1.	**Calculus**	4	2
2.	**Differential Equations**	4	2
3.	**Real Analysis & Metric Space**	4	2
4.	**Algebra**	4	2

Skill Enhancement Course (Credit: 04 each) - SEC 1 to SEC 4

S. No.	Paper Code	Core Papers (CP) Name
1.	SEC//MAT-3001	**Logical Aptitude**
2.	SEC//MAT-3002	**Quantitative Aptitude-I**
3.	SEC//MAT-3003	**Quantitative Aptitude-II**
4.	SEC//MAT-3004	**Quantitative Aptitude-III**

Practical/Tutorial (Credit: 02 each) :

Sem.	Paper Code	Course Name (Computer Software)
I	CP/MAT-102(A)	SCILAB-I
I	CP/MAT-102(B)	SCILAB-II
II	CP/MAT-202(A)	C Programming-I
II	CP/MAT-202(B)	C Programming-II
II	DSE/MAT-202(C)	Tutorial
III	CP/MAT-302(A)	C ++ Programming-I
III	CP/MAT-302(B)	C ++ Programming-II
III	DSE/MAT-302(C)	Tutorial
IV	CP/MAT-402(A)	Wolfram Mathematica-I
IV	CP/MAT-402(B)	Wolfram Mathematica-II
IV	CP/MAT-402(C)	Tutorial
V	CP/MAT-502(A)	Power BI-I
V	CP/MAT-502(B)	Power BI-II
V	DSE/MAT-502(C)	Tutorial
VI	CP/MAT-602(A)	Tableau-I
VI	CP/MAT-602(B)	Tableau-II
VI	CP/MAT-602(C)	Tutorial
VI	DSE/MAT-602(D)	Tutorial

SYLLABUS

SEMESTER-I

Core Paper-1

Calculus

Credit: 4 **Hours-60**

Course Objectives:

This course will enable the students to:

- Assimilate the notions of limit of a sequence and convergence of a series of real numbers.
- Calculate the limit and examine the continuity of a function at a point.
- Understand the consequences of various mean value theorems for differentiable functions.
- Sketch curves in Cartesian and polar coordinate systems.
- Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Course Learning Outcomes:

- Explore the solution of problems from a mathematical perspective and help to prepare student to succeed in upper level math, science, engineering and other courses that require calculus.
- Determine if an infinite series is convergent or divergent.
- Acquaint the students with fundamental concepts of single variable calculus.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students: Self-learning, peer learning,

Assignments, effective questions, presentation.

Assessment Strategies: Quiz, Poster presentation, PPT, open book

Test, End Semester exams.

Syllabus Content:

Unit-I:

Limit and Continuity

ε-δ definition of limit of a real valued function, Limit at infinity and infinite limits; Continuity of a real valued function, Properties of continuous functions, Intermediate value theorem, Geometrical interpretation of continuity, Types of discontinuity; Uniform continuity.

Unit-II:

Differentiability

Differentiability of a real valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Differentiability and monotonicity, Chain rule of differentiation; Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Geometrical interpretation of mean value theorems; Successive differentiation, Leibnitz's theorem.

Unit-III:

Curvature, Asymptotes and Curve Tracing Curvature

Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes and Symmetry, Concavity and convexity, Points of inflection, Tangents at origin, Multiple points, Position and nature of double points; Tracing of Cartesian, polar and parametric curves.

Unit-IV:

Expansions of Functions & Sequences

Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange's remainder¸Derivative of an arc, pedal equation (Cartesian and polar form); Maxima and minima. **Real numbers, Sequences of real numbers, Convergence of sequences and series, Bounded and monotonic sequences;**

Suggested Readings:

1. Howard Anton, I. Bivens & Stephan Davis (2016). Calculus (10th edition). Wiley India.
2. Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag.
3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). Calculus with Maple Labs. Narosa.
4. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd.
5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). Thomas' Calculus (14th edition). Pearson Education.

Core Paper-2

Algebra and Geometry

Credit : 4 **Hours-60**

Course Objectives:

This course will enable the students to:

- Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots.
- Familiarize with relations, equivalence relations and partitions.
- Employ De Moivre's theorem in a number of applications to solve numerical problems.
- Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
- Find eigenvalues and corresponding eigenvectors for a square matrix.
- Explain the properties of three-dimensional shapes

Course Learning Outcomes:

Understand the Algebraic number system.

- Develop the idea about set and binary operations.
- Understand the concept of group and its properties.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students: Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies: Quiz, Poster presentation, PPT, open book test, End Semester exams.

Syllabus Content

Unit-I: Relations and Basic Number Theory Relations,

Equivalence relations, Equivalence classes; Functions, Composition of functions, Inverse of a function; Finite, countable and uncountable sets; The division algorithm, Divisibility and the Euclidean algorithm, The fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences;.

Unit-II: Theory of Equations and Complex Numbers

Relations between the roots and the coefficients of polynomial equations, some properties of algebraic equations; Synthetic division, Factored form of a polynomial, Elementary theorems on the roots of an equations including Cardan's method; Polar representation of complex numbers,The remainder and factor theorems, The nth roots of unity, De Moivre's theorem for integer and rational indices

Unit-III: Row Echelon Form of Matrices and Applications

Systems of linear equations, Row reduction and echelon forms, Linear independence, The rank of a matrix and applications; Introduction to linear transformations, The matrix of a linear transformation, Matrix operations, Determinants, The inverse of a matrix, Characterizations of invertible matrices; Applications to Computer Graphics; Eigenvalues and eigenvectors, The characteristic equation and the Cayley–Hamilton theorem..

Unit-IV: Planes, Straight Lines:

Planes: Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes;

Straight lines: Equations of straight lines, Distance of a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane

Suggested Reading:

1. Titu Andreescu, & Dorin Andrica (2014). Complex Numbers from A to...Z. (2nd edition). Birkhäuser.
2. Robert J. T. Bell (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.
3. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
4. Leonard Eugene Dickson (2009). First Course in the Theory of Equations. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785)
5. Edgar G. Goodaire & Michael M. Parmenter (2015). Discrete Mathematics with Graph Theory (3rd edition). Pearson Education Pvt. Ltd. India.
6. Bernard Kolman & David R. Hill (2003). Introductory Linear Algebra with Applications (7th edition). Pearson Education Pvt. Ltd. India.

Practical- 1
SCILAB-I

Credit- 2 **Hours-30**

Objectives:

This Course will enable be students to:

1. Families with software SCILAB for numerical computations of the fundamental arithmetic operations.
2. Demonstrate plotting of 2D and 3D curves.
3. To study constructions of a vector/ matrix and operations.
4. Compute the Fundamental Concept of single variable and multivariable calculus.
5. Demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential, logarithm and trigonometric functions.
6. Produce and interpret graphs of basic functions of these types.
7. Solve equations and inequalities in both algebraically and graphically.

Learning Outcomes:-

1. Develop programs in SCILAB.
2. Evaluate analyses and plot results.
3. Good understanding of Linear algebra and signal processing concepts.

Learning and Teaching Strategies:-

Interactive lectures, Discussion, PPT presentations, Informative videos.

Assessment:

1. Performance in the Lab.
2. Practical Record
3. Viva

Syllabus content

1. Introduction of SCILAB.
2. Commands for managing a session input and output commands.
3. Some Primary Mathematical functions(Arithmetic functions ,trigonometric, logarithms, exponentfunction)
4. Commonly used operators and special characters.
5. Vector, Metrix and Array commands.
6. Constructions of a vector with operations on vectors.
7. Metrix representations and some of operations of Metrix.
8. Special Metrix and element operations on Metrix.

Reading Suggestions:

Open Source of SCILAB: http//:www.scilab.org

Scilab-6.0.2(64 bit)/scilab-6.0.2 (32-bit)

Practical- 2
SCILAB-II

Credit- 2 **Hours-30**

Course Objectives:

This Course will enable be students to:

1. Families with software SCILAB for numerical computations of the fundamental arithmetic operations.
2. Demonstrate plotting of 2D and 3D curves.
3. To study constructions of a vector/ matrix and operations.
4. Compute the Fundamental Concept of single variable and multivariable calculus.
5. Demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential,logarithm and trigonometric functions.
6. Produce and interpret graphs of basic functions of these types.
7. Solve equations and inequalities in both algebraically and graphically.

Learning Outcomes:-

1. Develop programs in SCILAB.
2. Evaluate analysis and plot results.
3. Good understanding of Linear algebra and signal processing concepts.

Learning and Teaching Strategies:-

Interactive lectures, Discussion, PPT presentations, Informative videos.

Assessment:

1. Performance in the Lab.
2. Practical Record
3. Viva

Syllabus content

1. Eigen values Eigen vectors.
2. Plotting Commands.
3. Create 2D graphs and customized line, plot multiple graphs.
4. Scaling and colouring the line, styles in 2D graphs.
5. Add title axis, labels and legend to graph.
6. 3D graph Plotting, Scaling and colouring and line style in 3D graphs
7. Add title axis labels and legend to graphs.

Reading Suggestions:

Open Source of SCILAB: http//:www.scilab.orgScilab-

6.0.2(64 bit)/scilab-6.0.2 (32-bit)

SEMESTER-II

Core Paper-3

Multivariable Calculus

Credit: 4 **Hours-60**

Course Objectives:

To understand the extension of the studies of

Single variable differential and integral calculus to functions of two or more independent variables. Also, the emphasis will be on the use of Computer Algebra Systems by which these concepts may be analyzed and visualized to have a better understanding. This course will facilitate to become aware of applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

Course Learning Outcomes: This course will enable the students to:

- Learn conceptual variations while advancing from one variable to several variables in calculus.
- Apply multivariable calculus in optimization problems.
- Inter-relationship amongst the line integral, double and triple integral formulation
- Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.
- Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students: Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies: Quiz, Poster presentation, PPT, open book test, End Semester exams.

Syllabus Content

Unit 1: **Calculus of Functions of Several Variables**

Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Higher order partial derivative, Tangent planes, Total differential and differentiability, Chain rule, Directional derivatives, The gradient, Maximal and normal property of the gradient, Tangent planes and normal lines.

Unit-II: Differentiation Higher order partial derivatives

Envelopes and evolutes, Jacobians, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem for functions of two variables and more variables

Unit-III: Extrema of Functions and Vector Field

Extrema of functions of two and more variables, Method of Lagrange multipliers, constrained optimization problems, Definition of vector field, Divergence, curl, gradient and vector identity

Unit IV: Green's, Stokes' and Gauss Divergence Theorem

Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, Gauss divergence theorem variables in double and triple integrals.

Suggested Readings:

1. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). Basic Multivariable Calculus, Springer India Pvt. Limited.

2. James Stewart (2012). Multivariable Calculus (7th edition). Brooks/Cole. Cengage.

3. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). Calculus (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

4. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). Thomas' Calculus (14th edition). Pearson Education.

Core Paper-4

Probability and Statistics

Credit:4

Hours-30

Course Objectives:

To make the students familiar with the basic statistical concepts and tools which are needed to study situations involving uncertainty or randomness. The course intends to render the students to several examples and exercises that blend their everyday experiences with their scientific interests.

Course Learning Outcomes:

This course will enable the students to:

i) Understand distributions in the study of the joint behavior of two random variables.
ii) Establish a formulation helping to predict one variable in terms of the other that is, correlation and linear regression.
iii) Understand central limit theorem, which establish the remarkable fact that the empirical frequencies of so many natural populations, exhibit a bell shaped curve.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students: Self-learning, peer learning, assignments, effectivequestions, presentation.

Assessment Strategies: Quiz, Poster presentation, PPT, open book test, End Semester exams.

Syllabus Content

Unit-I: Probability Functions and Moment Generating Function

Basic notions of probability, Conditional probability and independence, Baye's theorem; Random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions; Transformations, Mathematical expectation, Moments, Moment generating function, Characteristic function.

Unit-II: Univariate Discrete and Continuous Distributions

Discrete distributions: Uniform, Bernoulli, Binomial, Negative binomial, Geometric and Poisson; **Continuous distributions: Uniform, Gamma, Exponential, Chi-square, Beta and normal; Normal approximation to the binomial distribution.**

Unit-III: Bivariate Distribution

Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions and expectations.

Unit-IV: Correlation, Regression and Central Limit Theorem

The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Independent random variables, Linear regression for two variables, The method of least squares, Bivariate normal distribution, Chebyshev's theorem, Strong law of large numbers.

Suggested Readings:

1. Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). Introduction to Mathematical Statistics (7th edition), Pearson Education.

2. Irwin Miller &Marylees Miller(2014). John E. Freund's Mathematical Statistics with Applications (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.

3. Jim Pitman (1993). Probability, Springer-Verlag.

4. Sheldon M. Ross (2014). Introduction to Probability Models (11th edition). Elsevier.A. M. Yaglom and I. M. Yaglom (1983). Probability and Information. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi

lective Course (DSE)

DSE-2.1: Mathematical Logic

Course Objectives:-

Mathematical logic is the study of formal logic within mathematics. Major subareas include model theory, proof theory, set theory, and recursion theory. Research in mathematical logic commonly addresses the mathematical properties of formal systems of logic such as their expressive or deductive power. However, it can also include uses of logic to characterize correct mathematical reasoning or to establish foundations of mathematics.

Learning Outcomes:-This course will enable the students to:

i) Learn the syntax of first-order logic and semantics of first-order languages.

ii) Understand the propositional logic and basic theorems like compactness theorem, meta theorem and post-tautology theorem.

iii) Assimilate the concept of completeness interpretations and their applications with special emphasis on applications in algebra.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students: Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies: Quiz, Poster presentation, PPT, open book test, End Semester exams.

Syllabus Content

Unit-I: Syntax of First-order Logic

First-order languages, Terms of language, Formulas of language, First order theory.

Unit-II: Semantics of First-order Languages

Structures of first order languages, Truth in a structure, Model of a theory, Embeddings and isomorphism.

Unit-III: Propositional Logics

Syntax of propositional logic, Semantics of propositional logic, Compactness theorem for propositional logic, Proof in propositional logic, Meta theorem in propositional logic, Post tautology theorem.

Unit-IV: Proof and Meta Theorems in First-order Logic

Proof in first-order logic, Meta theorems in first-order logic, Some meta theorem in arithmetic, Consistency and completeness.

sEssential Readings:

1. Richard E. Hodel (2013). An Introduction to Mathematical Logic. Dover Publications.
2. Yu I. Manin (2010). A Course in Mathematical Logic for Mathematicians (2nd edition). Springer.
3. Elliott Mendelson (2015). Introduction to Mathematical Logic (6th edition). Chapman & Hall/CRC.
4. Shashi Mohan Srivastava (2013). A Course on Mathematical Logic (2nd edition).

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Discipline Specific Elective (DSE)

DSE 2.2: Graph Theory

Course Objectives:-

- Understand the basic concept of **Graphs, Walk, Path and Circuit**.
- Demonstrate the ideas of **the vertices and edges and degree of vertex.**
- Basic idea of some standard type of graphs and **Euler and Hamiltonian graph.**
- Understand the knowledge of **Euler's formula, Kuratowski theorem and shortest path problem**.

Learning Outcomes:-

- Compute the **degree of vertex** in directed as well as undirected graph.
- Understand the **Handshaking theorem** for degree of verices.
- Realize importance of **Planar graph and its application, four color theorem, homomorphism and complementary of graphs**.
- Use **Adjacency and incidence matrix** for plotting graph.

Learning Activities for the Students :-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Assessment Strategies:-

Quiz, Poster presentation, PPT, open book test, End Semester exams, Seminars, Data Collection.

Syllabus Content:

Unit-I

Introduction: Graph, **finite and infinite graph, simple graph, multigraph, pseudo graphs, directed graph, simple directed graph, directed multigraphs , underlying undirected graph, mixed graph ,regular graph, complete bipartite graphs.**

Unit-II

Subgraphs, union of two graphs, intersection of two graphs, disjoint graph, Ring sum of two graphs, product of two graphs, complementary graph, decomposition of graph, detection, fusion.

Unit-III

Representing graphs and graph isomorphism, **representation of a graph by adjacency matrix, incidence matrices, self-complementary graphs.**

Unit-IV

Walk, path, trail, closed walk, circuit, terminology path, **connectedness in directed and undirected graphs, cut vertex, bridges and block**, **path and isomorphism, Euler line and Euler graph, Euler path, Dirac's theorem.**

Essential Readings:

1. Dr. Gokhroo: Discrete Mathematics.
2. E.G. Goodaire & M.M. Parmenter: Discrete Mathematics with Graph theory.
3. JPH Publication- Discrete Mathematics

Discipline Specific Elective Course (DSE)

DSE-2.3: Optimization Theory

Course Objectives:-

- Understand the **Optimization and Optimization Techniques**, **L.P.P. and its solutions**, **Transportation and Assignment Problems.**
- Explore the solution of **Linear Programming Problems** and help to prepare students to succeed in higher level mathematics, Science, Engineering and other courses that require Optimization Techniques.
- Develop the ideas about **Transportation and Assignments Techniques.**

Learning Outcomes:-

- Students will describe **Simplex method, Big-M method, Two phase method,** Related Problems and theorems.
- Students will describe **L.P.P, Transportation and Assignment Problems.**
- Evaluate various **Optimal solutions of L.P.P, Transportation and Assignment Problems.**
- Students will use the **Graphical method, North West Corner method, Least Cost method, Vogel's approximation method, Hungarian method** in industry & Research.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students: Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies: Quiz, Poster presentation, PPT, open book test, End Semester exams.

Syllabus Content:

Unit-I

Introduction of Optimization Techniques:
Introduction of O.T., Scope and Advantages of O.T., convex set, concave set , convex combination, Extreme points of a convex set , line segment.
Definitions of (i) Solution, (ii) Feasible solution (FS), (iii) Infeasible solution (IFS), (iv) Basic solution (BS) , (v) Basic feasible solution (BFS), (vi) Degenerate solution , (vii) Non Degenerate solution, (viii) Optimum Basic feasible solution, (ix) Unbounded solution.

Unit-II

L.P.P. , Mathematical formulation of L.P.P, Graphical method, slack and surplus variables, Standard form of L.P.P, Fundamental theorem of L.P.P.

Unit-III

Reduction of feasible solution to a Basic feasible solution (BFS) , Improving a Basic feasible solution (BFS) , Alternative optimal solution , unbounded solutions ,Optimality conditions , Unrestricted variables, Degeneracy and its resolution ,The Simplex algorithm ,Artificial variable.

Unit-IV

Big-M method, Two phase method, Dual and Primal, Formation of dual from standard primal problem , Primal - Dual relationship, solution of L.P.P. by solving its dual by simplex method.

Essential Readings:

- Kanti Swaroop, P.K. Gupta and Manmohan, Operation Research, Sultan Chand and Sons,2002.
- G.C. Sharma and Madhu Jain, Operation Research,Students and Co. Agra.
- S.D. Sharma, Operation Research Theory, Methods and Applications, Kedarnath and Ramnath Co. Meerut.
- Bhargav, Sharma and Bhati , Optimization theory , JPH Jaipur.
- Gokhroo , Optimization Techniques, Navkar Publication, Ajmer

Practical : 3

C-Programming-I

Credit:2 **Hours-30**

Practicals with Computer Programming in C Language.

Programming Languages and Problem solving on computer. Algorithm, Flow chart, Programming in C Constant, Variables , Arithmetic and logical expressions , input/output conditional statements , Implementing loops in Programs, Defining and Manipulation Array and functions.

Practical's list:

1. **Printing n terms of Fibonacci sequence.**
2. **Finding $n!$, $\sum n$, $\sum n^2$**
3. **Defining a function and findings sum of n terms of a series / sequence whose general term is given by $a_n = \left(\frac{n^2+3}{n+1}\right)$.**
4. **Printing Pascal Triangle.**
5. **Finding GCD and LCM. of two numbers by Euclid's Algorithm.**
6. **Checking Prime/Composite Numbers.**
7. **Finding number of Primes less then n, $n \in$Z.**
8. **Finding mean, Standard deviation and n_{p_r} , n_{c_r} for different n and r .**

Suggested Readings:

C++ Software: Emulated Turbo C++ Turbo

Practical -4
C- Programming-II

Credit:2 **Hours-30**

Practicals with Computer Programming in C Language.

Programming Languages and Problem solving on computer. Algorithm, Flow chart, Programming in C Constant, Variables , Arithmetic and logical expressions , input/output conditional statements , Implementing loops in Programs, Defining and Manipulation Array and functions.

Practical's list:

1. **WAP in C to create a pyramids and patterns.**
2. **WAP in C to Print "HELLO WORLD".**
3. **WAP in C to find largest and Smallest number.**
4. **WAP in C to add two given matrix of order $3x3$**
5. **WAP in C to Multiply two given matrix of order $3x3$.**
6. **WAP in C to transpose of a Square matrix.**
7. **WAP in C to Subtract two given matrix of order $3x3$.**
8. **WAP in C to calculate the median.**

Suggested Readings:

C++ Software: Emulated Turbo C++ Turbo

Course Name: B.Sc. (Hons.)
Generic Paper-I – Calculus

Paper Code: GE/MAT-101 **Credits: 04**

Total Teaching Hours: 60

Course Objectives:-

- Explore the solution of problems from a mathematical perspective and help to prepare studentto succeed in upper level math, science, engineering and other courses that require calculus.
- Determine if an infinite series is convergent or divergent.
- Acquaint the students with fundamental concepts of single variable calculus.

Learning Outcomes:-

- Apply the concept and principles of differential and Integral calculus to solve geometric and physical problems.
- Evaluate various limit problems both algebraically and applicable in real life situation.
- Interpret the geometric meaning of differential and Integral calculus.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students:-

Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies:-

Quiz, Poster presentation, PPT, open book test, End Semester

Syllabus Content:

UNIT-I

Basic: Limits, Functions, Derivatives, Roll theorem, Langrage's mean value theorem, Cauchy's mean value theorem**, General mean value theorem, Second mean value theorem,** Generalized mean value theorem, Taylor and McLaurin's theorem with different reminder**,** expansion of sin(x), cos(x) , **Log (1+x), $(1+x)^m$, Derivative of an arc, Pedal equation (Cartesian andPolar curves).**

UNIT-II

Infinite series, Infinite series of non-negative terms, definition of convergence, test of convergence without proof, comparison test, Cauchy root test, D'Alembert's ratio test, Rabbe test, D'Morgan test, Cauchy condensation test, Logarithm ratio test, Gauss test, Alternating series-Leibnitz test.

UNIT-III

Partial differentiation, total derivative, Euler theorem for Homogeneous function, **Maxima and Minima of Functions of two variables, Lagrange's method of undetermined multipliers**.

Radius, Centre and chord of curvature, Asymptotes (Cartesian and polar curves).

UNIT-IV

Multiple points, Classification of double points, Node, Cusp and point ofinflexion, tracing of Cartesian and polar curves. Beta and Gamma Function and its Applications. Double and Triple Integrals. Application of Double and Triple Integrals.

Suggested Books:

1. Differential calculus: Shanti Narayan & P.K. Mittal.
2. Differential calculus :Gorakh Prasad.
3. H. Anton, I. Bivens and S. Davis: Calculus.
4. G. Kalambauer: Aspects of calculus.
5. G.B .Thomas, Jr. J. Hass, C. Heil: Thomas's Calculus.
6. Lalji Prasad: Differential Calculus.
7. J.L. Bansal & H.S. Dhami: Differential Calculus.

Practical
SCILAB-I

Credit- 2 **Hours-30**

Objectives:

This Course will enable be students to:

1. Families with software SCILAB for numerical computations of the fundamental arithmetic operations.
2. Demonstrate plotting of 2D and 3D curves.
3. To study constructions of a vector/ matrix and operations.
4. Compute the Fundamental Concept of single variable and multivariable calculus.
5. Demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential, logarithm and trigonometric functions.
6. Produce and interpret graphs of basic functions of these types.
7. Solve equations and inequalities in both algebraically and graphically.

Learning Outcomes:-

4. Develop programs in SCILAB.
5. Evaluate analyses and plot results.
6. Good understanding of Linear algebra and signal processing concepts.

Learning and Teaching Strategies:-

Interactive lectures, Discussion, PPT presentations, Informative videos.

Assessment:

1. Performance in the Lab.
2. Practical Record
3. Viva

Syllabus content

1. Introduction of SCILAB.
2. Commands for managing a session input and output commands.
3. Some Primary Mathematical functions(Arithmetic functions ,trigonometric, logarithms, exponent function)
4. Commonly used operators and special characters.
5. Vector, Metrix and Array commands.
6. Constructions of a vector with operations on vectors.
7. Metrix representations and some of operations of Metrix.
8. Special Metrix and element operations on Metrix.

Reading Suggestions:

Introduction to SCILAB: JPH Publication.

Open Source of SCILAB: http//:www.scilab.org
Scilab-6.0.2(64 bit)/scilab-6.0.2 (32-bit)

Skill Enhancement Course: 1

(LOGICAL APTITUDE)

- Semantic Analogy
- Symbolic/Number Analogy
- Figural Analogy
- Semantic Classification
- Symbolic/Number Classification
- Figural Classification
- Semantic Series
- Number Series
- Figural Series
- Problem Solving
- Word Building
- Coding & de-coding
- Numerical Operations
- Symbolic Operations
- Trends
- Space Orientation
- Space Visualization
- Venn Diagrams
- Drawing ingerences
- Punched hole/pattern-folding & un-folding
- Figural Pattern-folding and completion
- Indexing
- Address matching
- Date & city matching
- Classification of centre codes/roll numbers
- Small & Capital letters/numbers coding
- decoding and classification
- Embedded Figures
- Critical thinking
- Emotional Intelligence
- Social Intelligence

Skill Enhancement Course: 2

(Quantitative Aptitude-1)

- whole numbers
- decimals
- fractions and relationships between numbers
- Percentage
- Ratio & Proportion
- Square roots
- Averages
- Interest
- Profit and Loss
- Discount
- Partnership Business
- Mixture and Alligation
- Time and distance
- Time & Work

Skill Enhancement Course: 3

(Quantitative Aptitude-2)

- Basic algebraic identities of School Algebra &Elementary surds
- Graphs of Linear Equations
- Triangle and its various kinds of centres
- Congruence and similarity of triangles
- Circle and its chords
- tangents
- angles subtended by chords of a circle
- common tangents to two or more circles
- Triangle
- Quadrilaterals
- Regular Polygons
- Circle
- Right Prism
- Right Circular Cone
- Right Circular Cylinder
- Sphere
- Hemispheres
- Rectangular Parallelepiped
- Regular Right Pyramid with triangular or square base

Skill Enhancement Course: 4

(Quantitative Aptitude-3)

- Trigonometric ratio
- Degree and Radian Measures
- Standard Identities
- Complementary angles
- Heights and Distances
- Histogram
- Frequency polygon
- Bar diagram & Pie chart