Proposed Syllabus and Scheme of Examination

for

GENERIC ELECTIVE (GE) COURSES OFFERED TO B.Sc. (Hons.) / B.A. (Hons.) / B.Com (Hons.) (Other than B.Sc./B.A/B.Com (Hons.) Mathematics)

Submitted to

Dhanamanjuri University

Manipur

under the

Choice Based Credit System

May 2020

DHANAMANJURI UNIVERSITY, IMPHAL

DEPARTMET OF MATHEMATICS

UNDERGRADUATE SYLLABUS IN MATHEMATICS

GENERIC ELECTIVE (GE) COURSES OFFERED TO B.Sc. (Hons.) / B.A. (Hons.) / B.Com (Hons.) (Other than B.Sc./B.A/B.Com (Hons.) Mathematics)

Semester wise Details of B.Sc./B.A (Hons.) Mathematics Course & Credit Scheme

Semester	Core course(14)	Ability Enhancement Compulsory Course (AECC)(2)	Skill Enhancement Course (SEC)(2)	Discipline Specific Elective (DSE)(4)	Generic Elective (GE)(4)	Total Credits
I					GE-1:Probability Theory and Statistics GE-1: Vector analysis and Analytic Geometry GE-1:Calculus	
L+T/P					5+1=6	6
II					GE-2: Transportation and Network problems GE-2:Discrete Mathematics GE-2 :Differential equations	
L+T/P					5+1=6	6
III					GE-3:Algebra GE-3: Inventory systems and Marketing management GE-3 : Linear Programming and applications	
L+T/P					5+1=6	6
IV					GE-4:Cryptography and Network Security GE-4: Mathematical Modelling and Graph Theory GE-4: Group theory	
L+T/P					5+1=6	6
V						
VI						
					Total Credits	= 24

Note: L: Lecture Class; T: Tutorial Class; P: Practical Class Note: One-hour lecture per week equals 1 Credit; 2 Hours practical class per week equals 1 credit. 'Generic Elective (GE)' Course is an elective course may be chosen generally from an unrelated discipline/subject, with an intention to seek exposure to other disciplines.

Semester-I: Generic Elective (GE) Course -Mathematics

Any one of the following:

GE-1: Probability Theory and Statistics

GE-1: Vector analysis and Analytic Geometry

GE-1: Calculus

MATGE-1(i): 101Probability Theory and Statistics

Total Marks: 100 (Theory: 75 + Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: To make the students familiar with the basic statistical concepts and tools which are needed to study situations involving uncertainty or randomness.

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

i) Distributions to study the joint behaviour of two random variables.
ii) To establish correlation and linear regression.
iii) Central limit theorem, which helps to understand the remarkable fact that: the empirical frequencies of so many natural populations, exhibit a bell shaped curve.

Course Contents:

Unit 1: Probability Functions and Moment Generating Function (Lectures: 20)

Sample space, Probability set function, Real random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions, Transformations, Mathematical expectation, Moments, Moment generating function, Characteristic function.

Unit 2: Univariate Discrete and Continuous Distributions (Lectures: 20)

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 3: Bivariate Distribution (Lectures: 10)

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 4: Correlation, Regression and Central Limit Theorem (Lectures: 20)

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, Central limit theorem and weak law of large numbers.

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

2. Miller, Irwin & Miller, Marylees. (2014).John E. Freund's Mathematical Statistics with Applications (8th ed.). Pearson. Dorling Kindersley (India).

3. Ross, Sheldon M. (2014). Introduction to Probability Models (11th ed.). Elsevier Inc.

4. B.R Bhatt, Modern Probability theory, Wiley 1989.

5.P. Mukhopadhyay, Theory of Probability, New Central Book Agency, Kolkata.

6Kai Lai Chung, A Course in Probability Theory, Academic Press, 2001.

7. Sheldon Ross, A first course in Probability, Prentice Hall, New Jersey, 2002.

8. Probability & Statistics (Vol. I), D. Biswas, New Central Book Agency (P) Ltd.

MATGE-1(ii): 101Vector analysis and Analytic Geometry

Total Marks: 100 (Theory: 75, Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: The goal of this paper is to acquaint students with certain ideas about conic sections, vectors in coordinate system.

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

i) Classify different types of conic sections – the circle, the ellipse, the hyperbola and the parabola – in Cartesian and polar coordinates.
ii) Visualize three dimensional objects – spheres and cylinders.

Unit 1 : Vector Analysis: (Lectures: 20)

Scalar product of three vectors and four vectors. Vector product of three vectors, and four vectors, Reciprocal vectors, Differentiation of Vectors, Gradient, Divergence and Curl of a vector, Vector integration, Ordinary integrals of vectors. Line integrals, Surface integrals and Volume integrals,

Unit 2: Two Dimensional Geometry: (Lectures: 15)

Change of axes: Change of Origin without changing the direction of axes, Change of Direction of axes of co-ordinates without changing the origin. Pair of straight lines: Homogeneous equation of second degree, Angle between pair of lines given by homogeneous equation, Bisectors of angles between the pair of lines, Condition for the general equation of second degree to represent a pair of straight lines, Point of intersection, Equation of the pair of straight lines joining the origin to the point of intersection of lines and a curve.

Unit 3: Conic Sections, Parametrized Curves, and Polar Coordinates (20 Lectures)

Conic sections and quadratic equations: Circle, Parabola, Ellipse, and hyperbola; Techniques for sketching: Parabola, Ellipse, and Hyperbola; Reflection properties of parabola, ellipse, and hyperbola, Classifying conic sections by eccentricity, Classification of quadratic equations representing lines, parabola, ellipse, and hyperbola; Parameterization of plane curves, Conic sections in polar coordinates and their sketching.

Unit 4: Sphere, Cone and Cylinder: (Lectures: 15)

Sphere: Equations of sphere, Condition for the general equation of second degree to represent a sphere, Plane section of a sphere, Intersection of two spheres, Equation of a tangent plane, Condition for a plane to be a tangent plane to a sphere.Cone: Equation of a cone with a conic as guiding curve, Enveloping cone of a sphere, Quadratic cones with vertex at origin, Condition for the general equation of second degree to represent a cone, Reciprocal cone, Right circular cone. Cylinder: Equation of cylinder, Enveloping cylinder, Right circular cylinder.Paraboloids & Central Conicoids: Equations and their properties.

Recommened Books:

1. B Das, Analytical Geometry with Vector Analysis, Orient Book Company, Kolkata.
2. Ghosh and Maity, Vector Analysis, New Central Book Agency.
3. Shanti Narayan and P K Mittal, Analytical Solid Geometry, S Chand & Co.

4. S L Loney, Co-Ordinate Geometry of Two Dimensions, Macmillan and Co.
5. S L Loney, Co-Ordinate Geometry of Three Dimensions, Macmillan and Co.
6. R J T Bell, An Elementary Treatise on Co-Ordinate Geometry of Three Dimensions, Macmillan and Co.

GE-1(iii): 101Calculus

Total Marks: 100 (Theory: 75, Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) ,Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful to the real-world problems. .

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

i) Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference.
ii) Apply derivatives in Optimization, Social sciences, Physical sciences and Life sciences etc.
iii) Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.

Course Contents:

Unit1: Successive Differentiation (Lectures: 15)

Successive differentiation, Indeterminate forms and L. Hospital's Rule, Leibnitz theorem. Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type e^{ax+b}sinx, e^{ax+b}cosx, $(ax+b)^n$sinx, $(ax+b)^n$cosx, Rolle's theorem, Lagrange's and Cauchy's mean value theorems, Taylor's and Maclaurin's theorems with Lagrange's and Cauchy's forms of remainder, Expansion of standard functions: e^x, sin*x*, cos*x*, log(1+x), $(1+x)^n$, $\tan^{-1}x$.

Unit 2: Derivatives and its applications (Lectures: 20)

Curvature, Radius of curvature for the Cartesian equation, parametric equation, implicit equation and polar equation, Asymptotes.

The first-derivative test for relative extrema, Concavity and inflection points, Second derivative test for relative extrema, Curve sketching using first and second derivative tests, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves,

Unit 3: Partial Derivatives (Lectures: 15)

Function of Two and three variables, Limit and Continuity for functions of two and three variables, Partial differentiation, successive partial differentiations, Euler's theorem on Homogeneous functions of two and three variables, Maxima and Minima of functions of two variables.

Unit 4: Volume and Area of Surfaces (Lectures: 20)

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int sinnxdx, \int cosnxdx$, $\int tannxdx, \int secnxdx$, $\int (logx)^n dx$, $\int sin^n x sin^m x dx$. Evaluation of double integrals, Change of the order of integration, Change of variables in double integrals, Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution.

Books Recommended:

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

2. Prasad, Gorakh (2016). Differential Calculus (19th ed.). Pothishala Pvt. Ltd. Allahabad.

3. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). Calculus (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.

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

References:

1. Das and Mukherjee - Differential Calculus, U.N. Dhur and Sons Pvt. Ltd, Kolkata.
2. Das and Mukherjee-Integral Calculus, U.N. Dhur and Sons Pvt. Ltd, Kolkata.
3. B Das, Analytical Geometry with Vector Analysis, Orient Book Company, Kolkata.
4. Ghosh and Maity, Vector Analysis, New Central Book Agency.

Semester-II: Generic Elective (GE) Course -Mathematics

Any one of the following:

GE-2: Transportation and Network problems

GE-2: Discrete Mathematics

GE-2:Differential equation

MATGE-2(i): 201Transportation and Network problems

Total Marks: 100 (Theory: 75, Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) ,Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: The main objective of this course is to teach students how to model physical problems.

Course Learning Outcomes: The course will enable the students to learn the following:

The basic concepts of graph theory, Network flows, Transportation problems and assignment problems.

Unit1: Transportation problems (Lectures: 20)

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

Unit2: Graphs Theory (Lectures: 15)

Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Unit3: **Network Problems** (Lectures: 20)

Flows in networks. Maximal flow. Shortest path and travelling salesman problem. Construction of minimal spanning tree and its applications. Project management through PERT/CPM, Updating of PERT Charts.

Unit4: Game Theory (Lectures: 15)

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure.

Books Recommended:

1. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.

2. Rudolf Lidl and Günter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate

4. G. Hadley, Nonlinear and Dynamic Programming, Addison-Wesley, 1964.

5. A. Ravindran, D.T. Phillips and James J. Solberg, Operations Research- Principles and Practice, John Wiley and Sons, 2005.

6. R.K. Ahuja T. L. Magnanti, B. Orlin, Network Flows-Theory, Algorithm and Applications, Prentice Hall, NJ, 1993. 4. J.D. Wist, F.K. Levy, A Management Guide to PERT/CPM, 2nd Ed., PHI, 1967 (Reprint 2007).

Referrence: i. Rosen, Kenneth H. (2012). Discrete Mathematics and its Applications, with Combinatorics and Graph Theory. (7th ed.). McGraw-Hill Education. Indian Reprint.

ii. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.

MATGE-2(ii): 201Discrete Mathematics

Total Marks: 100 (Theory: 75, Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives:

The course introduces formal logic notation, methods of proof, mathematical induction, set theory, permutations and combinations and counting principles.

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

i) Understand the basic principles of logic, set theory.
ii) Understand the ideas of mathematical induction and basic counting techniques.
iii) Basic concepts of Fuzzy set.

Unit 1: Logical Mathematics (20 Lectures)

Compound statements (and, or, implication, negation, contrapositive, quantifiers), Truth tables, Basic logical equivalences and its consequences, Logical arguments, Set theory, Operation on sets, Types of binary relations, Equivalence relations, Congruences and its properties, Partial and total ordering, Lattices, Properties of integers, Division algorithm, Divisibility and Euclidean algorithm, GCD, LCM, Relatively prime.

Unit 2: Applications of numbers (15 Lectures)

Prime numbers, Statement of fundamental theorem of arithmetic, Fermat primes, Mathematical induction, Recursive relations and its solution (characteristics polynomial and generating function), Principles of counting (inclusion/exclusion, pigeon-hole), Permutation and combinations (with and without repetition).

Unit 3: Graph Theory **(Lectures: 20)**

Introduction to graphs, Konigsberg Bridge problem, Instant insanity game; Definition, examples and basic properties of graphs, Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs, Paths and circuits, Eulerian circuits, Hamiltonian cycles, Adjacency matrix, Weighted graph, Travelling salesman problem, Shortest path, Dijkstra's algorithm.

Unit 4: Fuzzy sets (Lectures: 15)

Fuzzy sets, Fuzzy relations, classical logic and fuzzy logic, Linguistic variable, Fuzzy truth qualifier

Books Recommended:

1. Davey, B A., & Priestley, H. A. (2002). Introduction to Lattices and Order (2nd ed.). Cambridge University Press. Cambridge. 7th Printing 2012.

2. Goodaire, Edgar G., & Parmenter, Michael M. (2003). Discrete Mathematics with Graph Theory (2nd ed.). Pearson Education (Singapore) Pte. Ltd. Indian Reprint.

3. Lidl, Rudolf & Pilz, Günter. (1998). Applied Abstract Algebra (2nd ed.). Undergraduate Texts in Mathematics. Springer (SIE). Indian Reprint 2004.

4.Rajjan Shinghal (2013), Introduction to Fuzzy logic, PhI learning private limited, Delhi

References:

Rosen, Kenneth H. (2012) Discrete Mathematics and its Applications (7th ed.). McGraw-Hill Education (India) Pvt. Ltd.

MATGE-2(iii): 201Differential Equations

Total Marks: 100 (Theory: 75, Internal Assessment: 25,) Workload: 5 Lectures,1 Tutorial, Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: This course includes a variety of methods to solve ordinary and partial differential equations with basic applications to real life problems.

Course Learning Outcomes: The student will be able to:

i) Solve the exact, linear and Bernoulli equations and find orthogonal trajectories.
ii) Apply the method of variation of parameters to solve linear differential equations.
iii) Formulate and solve various types of first and second order partial differential equations.

Unit 1: Ordinary Differential Equations and Applications (Lectures: 10)

Exact equations and integrating factors (Rules), Linear equations and equations reducible to linear form, Equations solvable for x, y, p and Clairaut's equation, Singular solutions

Unit 2: Solving of Higher-Order Linear Differential Equations (Lectures: 30)

Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. Second order linear differential equations with constant coefficients, Homogeneous linear equations, Complementary functions and particular integrals, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Solutions of simultaneous equations of the form $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$, total differential equations of the form: $Pdx+Qdy+Rdz=0$, method of solutions and their geometrical interpretations, orthogonal trajectory

Unit 3: First and Second Order Partial Differential Equations (Lectures: 20)

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations,Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit 4: Application of Partial differential equation (Lectures: 10)

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Recommended books:

1. Piaggio – *An Elementary Treatise on Differential Equation and Their Applications,* C.B.S.Publishers & Distributors, New Delhi

2. M.D. Raisinghania- Ordinary and Partial Differential Equations, S.Chand, New Delhi

3. R.K.Gosh and K.C. Maity-An introduction to Differential Equations NCBA (P) Ltd Kolkata

4. Coddington - *An Introduction to Ordinary Differential Equations and their Applications,* Prentice Hall of India., New Delhi

5. G.F.Simmons - *Differential Equations,* Tata McGraw Hill

6. D.A.Murray - *Introductory Course in Differential Equations,* Orient Longman (India).

Semester-3: Generic Elective (GE) Course -Mathematics

Any one of the following:

GE-3: Algebra

GE-3: Inventory systems and Marketing management

GE-3: Linear Programming and Applications

MATGE-3(i): 301Algebra

Total Marks: 100 (Theory: 75, Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: The primary objective of this course is to introduce the basic tools of theory of equations, complex numbers, number theory and matrices to understand their linkage to the real-world problems.

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

i) Employ De Moivre's theorem in a number of applications to solve numerical problems.
ii) Apply Euclid's algorithm and backwards substitution to find greatest common divisor.
iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
iv) Find eigenvalues and corresponding eigenvectors for a square matrix.

Course Contents:

Unit 1: De Moivre's theorem and its application (Lectures: 15)

Polar representation of complex numbers, The nth roots of unity, De Moivre's theorem for integer and rational indices and its applications. Expansion of trigonometric functions, Exponential values for circular functions, Complex argument, Gregory's series, Hyperbolic functions, Summation of series including C+iS method.

Unit 2: Theory of Equations (Lectures:15)

Arithmetic mean, Geometric mean, Harmonic mean, Cauchy-Schwartz inequality, Holder's inequality, Minkowski's inequality. Elementary theorems on the roots of an equation, Polynomials, The remainder and factor theorem, Synthetic division, Factored form of a polynomial, The Fundamental theorem of algebra, Relations between the roots and the coefficients of polynomial equations, Imaginary roots occur in pairs, Integral and

rational roots; Equivalence relations, The division algorithm, Divisibility and the Euclidean algorithm, The fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruence; Congruence relation between integers, Principles of mathematical induction and well ordering principle.

Unit 3: Convergence of series (Lectures: 20)

Infinite series-Definitions, Geometric series, Theorems on series of positive terms, Comparison test of convergence, Convergence and Divergence of p-series, Cauchy's root test, D' Alembert's ratio test, Raabe's test, Logarithmic test, Leibnitz's test for alternating series, Conditional and Absolute convergence. Descartes rule of signs, Fundamental theorem of Algebra (Statement only). Transformation of equations,

Unit 4: Theory of Matrices and its Applications (Lectures: 20)

Systems of linear equations, Row reduction and echelon forms, Vector equations, The matrix equation Ax = b, Solution sets of linear systems, Linear independence, The rank of a matrix and applications; Introduction to linear transformations, The matrix of a linear transformation; Matrix operations, The inverse of a matrix, Characterizations of invertible matrices, Eigenvectors and eigenvalues, The characteristic equation and the Cayley-Hamilton theorem.

Books Recommended:

1. Andreescu, Titu & Andrica Dorin. (2014). Complex Numbers from A to...Z. (2nd ed.). Birkhäuser.

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

3. Goodaire, Edgar G., & Parmenter, Michael M. (2005). Discrete Mathematics with Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint 2015.

4. Kolman, Bernard, & Hill, David R. (2001). Introductory Linear Algebra with Applications (7th ed.). Pearson Education, Delhi. First Indian Reprint 2003.

5. Lay, David C., Lay, Steven R., & McDonald, Judi J. (2016). Linear Algebra and its Applications (5th ed.). Pearson Education.

References:

1. Chandrika Prasad- Algebra and Theory of Equations, Pothisala Private Limited.
2. Shanti Narayan and P.K. Mittal- A text Book of Matrices, S. Chand and Co. New Delh
3. Bhattacharya, Jain and Nagpaul-First Course in Linear Algebra, Wiley Eastern, N. Delhi
4. Das and Mukherjee-Higher Trigonometry, U.N. Dhur and Sons Pvt. Ltd. Kolkata.

MATGE-3(ii):301 Inventory systems and Marketing management

Total Marks: 100 (Theory: 75 + Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: This course aims at introducing the concepts of Inventory systems and marketing management.

Course Learning outcomes: After the course, the student will be able to understand the concepts of:

i) Different Inventory models

ii) Applications of the models in real life situations.

Course Contents:

Unit 1: Inventory systems (Lectures: 15)

Concepts and problems in Inventory Systems, Objectives of Scientific Inventory Control, classification of Inventory Systems, different costs in Inventory Systems and method of their estimation. The concept of EOQ

Unit 2: Deterministic Inventory models (Lectures: 20)

Deterministic Inventory models with and without lead time. Deterministic Inventory models with and without shortages.

Unit 3: Concepts of marketing management and related models (Lectures: 20)

Concept of marketing and its role in organization. Marketing decisions, scientific marketing analysis. Uses and limitations of mathematical models in marketing , classification of market structure in competitive conditions.

Unit 4: Concepts of joint optimization of price (Lectures: 15)

Demand elasticity, joint optimization of price, quality and promotional efforts. Pricing decisions, media allocation for advertisement. Brand switching analysis.

Books Recommended 1. G. Hadley, T.M. Whitin, Analysis of Inventory Systems, D.B. Taraporevala and Sons, Published by arrangement with Prentice Hall Inc., 1979.

2. Zipkin, Foundations of Inventory Management, McGraw Hall Inc., 2000.

3. Donald Waters, Inventory Control, John Wiley, 2003.

4. Philip Kotler, Marketing Management, 13th Ed., Prentice Hall of India, 2008.

5. Tony Curtis, Marketing for Engineers, Scientists and Technologists, John Wiley & Sons Inc., 2008.

6. Graham J. Hooley and Michael K. Hassey, Quantitative Methods in Marketing, 2nd Ed., International Thomson Business Press, 1999.

7. Grahame R. Dowling, The Art and Science of Marketing –Marketing for Marketing Managers, Oxford University press, 2005.

8. Gary L. Lilien, Philip Kotler, K. Sridhar Moorthy, Marketing Models, Prentice Hall of India, 2003

MATGE-3(iii): 301Linear Programming and Applications

Total Marks: 100 (Theory: 75 and Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: This course develops the ideas underlying the Simplex Method for Linear Programming Problem, as an important branch of Operations Research. The course covers Linear Programming with applications to Transportation, and Assignment.

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

i) Solve linear programming models of real life situations.
ii) Simplex method for solution of LPP.
iii) Transportation and Assignment problems

Course Contents:

Unit 1: Introduction to Linear Programming (Lectures: 15)

The Linear Programming Problem: Standard, Canonical and matrix forms, Graphical solution. Hyperplanes, Extreme points, Convex and polyhedral sets. Basic solutions; Basic Feasible Solutions; Reduction of any feasible solution to a basic feasible solution; Correspondence between basic feasible solutions and extreme points.

Unit 2: Methods of Solving Linear Programming Problem (Lectures: 20)

Simplex Method: Optimal solution, Termination criteria for optimal solution of the Linear Programming Problem, Unique and alternate optimal solutions, Unboundedness; Simplex Algorithm and its Tableau Format; Artificial variables, Two-phase method, Big-M method.

Unit 3: Duality Theory of Linear Programming (Lectures: 15)

Motivation and Formulation of Dual problem; Primal-Dual relationships; Fundamental Theorem of Duality; Complimentary Slackness.

Unit 4: Applications **(Lectures: 20)**

Transportation Problem: Definition and formulation; Methods of finding initial basic feasible solutions; North West corner rule. Least cost method; Vogel's Approximation method; Algorithm for solving Transportation Problem. Assignment Problem: Mathematical formulation and Hungarian method of solving.

Books recommended: 1. Bazaraa, Mokhtar S., Jarvis, John J., & Sherali, Hanif D. (2010). Linear Programming and Network Flows (4th ed.). John Wiley and Sons.

2. Hadley, G. (1997). Linear Programming. Narosa Publishing House. New Delhi.

3. Taha, Hamdy A. (2010). Operations Research: An Introduction (9th ed.). Pearson.

Referrences: i. Hillier, Frederick S. & Lieberman, Gerald J. (2015). Introduction to Operations Research (10th ed.). McGraw-Hill Education (India) Pvt. Ltd.

ii. Thie, Paul R., & Keough, G. E. (2014). An Introduction to Linear Programming and Game Theory. (3rd ed.). Wiley India Pvt. Ltd.

iii.. Kanti Swarup, P.k. Gupta and Man Mohan(2020), Operations research, Sultan chand & Sons, New Delhi

Semester-4 Generic Elective (GE) Course -Mathematics

Any one of the following:

GE-4: Cryptography and Network Security

GE-4: Mathematical Modelling and Graph Theory

GE-4: Group theory

MATGE-4(i): 401Cryptography and Network Security

Total Marks: 100 (Theory: 75 + Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: This course helps the students to develop skills and knowledge of standard concepts in cryptography and demonstrates how cryptography plays an important role in the present digital world by knowing encryption and decryption techniques and secure data in transit across data networks.

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

Understand the fundamentals of Cryptography and Network Security, including data and advanced encryption standard (DES & AES), RSA and elliptic curve cryptography.

Course Contents:

Unit 1: Cryptography and Data Encryption Standard (DES) (Lectures: 20)

Overview of Cryptography, Computer security concepts, Security attacks, Symmetric cipher model, Cryptanalysis and brute-force attack, Substitution techniques, Caesar cipher, Monoalphabetic ciphers, Playfair cipher, Hill cipher, Polyalphabetic ciphers, One-time pad, Transposition techniques, Binary and ASCII, Pseudo-random bit generation, Stream ciphers and Block ciphers, The Feistal cipher, The data encryption standard (DES), DES example.

Unit 2: Algorithms and Advanced Encryption Standard (AES) (Lectures: 20)

Review of basic concepts in Number theory and Finite Fields: Divisibility, Polynomial and modular arithmetic, Fermat's and Euler's theorems, The Chinese remainder theorem, Discrete logarithm., Finite fields of the form GF(p) and GF(2n). Advanced encryption standard (AES), AES transformation functions, AES key expansion, AES example.

Unit 3: Public-key Cryptography (Lectures: 15)

Principles of public-key cryptosystems, The RSA algorithm and security of RSA, Elliptic curve arithmetic, Elliptic curve cryptography, Cryptographic Hash functions, Secure Hash algorithm.

Unit 4: Digital Signatures and Network Security (Lectures: 15)

Digital signatures, Elgamal and Schnorr digital signature schemes, Digital signature algorithm. Wireless network and mobile device security, Email architecture, formats, threats and security, Secure/Multipurpose Internet Mail Extension (S/MIME) and Pretty Good Privacy (PGP).

Books rercommended: 1. Stallings, William (2017). Cryptography and Network Security, Principles and Practice (7th ed.). Pearson Education Limited. England.

2. Trappe, Wade & Washington, Lawrence C. (2006). Introduction to Cryptography with Coding Theory (2nd ed.). Pearson Education International.

Referrence: 1. Stinson, Douglas R. (2005). Cryptography Theory and Practice (3rd ed.). CRC Press.

2. Hans Delfs and Helmut Knebl: Introduction to cryptography, (Principles & Applications), Springer verlag, revised 3rd Edition, 2002.
3. David M Burton : Elementary Number Theory, Tata McGraw Hill Educational Pvt. Ltd., New Delhi, Sevent Reprint, 2009.
4. Abraham Robinson: Numbers & Ideals; Yale University, Reprinted, 1965.

MATGE-4(ii): 401Mathematical Modelling and Graph Theory

Total Marks: 100 (Theory: 75 + Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: The main objective of this course is to teach students how to model physical problems.

Course Learning Outcomes: The course will enable the students to learn the following:

The basic concepts of graph theory, simulation and formation of mathematical models.

Course Contents:

Unit 1: Overview of optimization modelling (Lectures: 25)

Overview of optimization modelling; Linear Programming Model: Geometric solution, Algebraic solution, Simplex method, Sensitivity analysis.

Unit 2: Graph Theory (Lectures: 20)

Introduction to graphs,; Definition, examples and basic properties of graphs, Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs, Paths and circuits, connected graphs, tree, binary trees and algorithms,, Cayley's theorem, Spanning trees, Eulerian circuits, Hamiltonian paths and circuits, Konigsberg Bridges problem, Instant insanity game, Adjacency and incidence matrix, Path matrix, Circuit matrix, Directed graphs, Digraph, Euler's Digraphs, Matrix representation of Digraphs, Weighted graph, Travelling salesman problem, Shortest path, Dijkstra's algorithm.

Unit 3: Network Analysis and Sequencing (Lectures: 15)

Flows in networks. Maximal flow. Shortest path and travelling salesman problem. Construction of minimal spanning tree and its applications. Project management through PERT/CPM, Updating of PERT Charts.

Unit 4: Monte Carlo Simulation (Lectures: 10)

Monte Carlo Simulation Modeling: Simulating deterministic behaviour (area under a curve, volume under a surface); Generating Random Numbers: Middle square method, Linear congruence;

Books recommended: 1. Aldous, Joan M., & Wilson, Robin J. (2007). Graphs and Applications: An Introductory Approach. Springer. Indian Reprint.

2. Giordano, Frank R., Fox, William P., & Horton, Steven B. (2014). A First Course in Mathematical Modeling (5th ed.). Brooks/Cole, Cengage Learning.

3. R.K. Ahuja T. L. Magnanti, B. Orlin, Network Flows-Theory, Algorithm and Applications, Prentice Hall, NJ, 1993. 4. J.D. Wist, F.K. Levy, A Management Guide to PERT/CPM, 2nd Ed., PHI, 1967 (Reprint 2007).

4. A. Ravindran, D.T. Phillips and James J. Solberg, Operations Research- Principles and Practice, John Wiley and Sons, 2005.

5. Kanti Swarup, P.k. Gupta and Man Mohan(2020), Operations research, Sultan chand & Sons, New Delhi

MATGE-4(iii): 401Group theory

Total Marks: 100 (Theory: 75 and Internal Assessment: 25) Workload: 5 Lectures, 1 Tutorial (per week) Credits: 6 (5+1) Duration: 14 Weeks (70 Hrs.) Examination: 3 Hrs.

Course Objectives: The objective of the course is to introduce the fundamental theory of groups.

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

i) understand the mathematical concepts about the groups, and classify them as abelian, cyclic and permutation groups, etc;
ii) Explain the significance of the notion of subgroups, cyclic groups, cosets, normal subgroups, and factor groups.

Course Contents:

Unit 1: Groups and its Elementary Properties (Lectures: 15)

Symmetries of a square, The Dihedral groups, Definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups.

Unit 2: Subgroups and Cyclic Groups (Lectures:15)

Subgroups and examples of subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups; Properties of cyclic groups, Classification of subgroups of cyclic groups.

Unit 3: Permutation Groups and Lagrange's Theorem (Lectures: 20)

Cycle notation for permutations, Properties of permutations, Even and odd permutations, alternating groups; Properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem; Normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Unit 4: Group Homomorphisms (Lectures: 20)

Group homomorphisms, Properties of homomorphisms, Group isomorphisms, Cayley's theorem, Properties of isomorphisms, First, Second and Third isomorphism theorems for groups.

Books recommended: 1. Gallian, Joseph. A. (2013). Contemporary Abstract Algebra (8th ed.). Cengage Learning India Private Limited, Delhi. Fourth impression, 2015.

Referrence: i.Rotman, Joseph J. (1995). An Introduction to The Theory of Groups (4th ed.). Springer Verlag, New York

ii.I.N.Herstein, Topics in Algebra, John Wiley & Sons, New Delhi.

iii.K. Khanna & S.K. Bhambri, A Course in Abstract Algebra, Vikas Publishing House, New Delhi.

iv.Joseph A. Gallan, Contemporary Algebra, Narosa Publishing House, New Delhi.

v.Surjeet Singh and QaziZameerudin, Modern Algebra, Vikas Publishing House.

vi.P.B. Bhattacharya, S.K. Jain and S. R. Nagpaul: Basic Abstract Algebra, CUP.