

UNDERGRADUATE CURRICULUM FRAMEWORK -2022
BASED ON
NATIONAL EDUCATION POLICY 2020

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

August 2022

COURSE STRUCTURE FOR FOUR-YEAR UNDERGRADUATE PROGRAMMES

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)

Credit Scheme

Semester	Core course(14) (DSC)(4)	Discipline Specific Elective (DSE)(4)	Generic Elective (GE)(4)	Ability Enhancement Compulsory Course (AECC)(2)	Skill Enhancement Course (SEC)(2)	Internship/Apprenticeship /Academic project	VAC (Value added course)	Total Credits
I			GMA(select any one) GMA-101:Calculus GMA-102: Analytic Geometry GMA-103:Probability Theory and Statistics					
L+T/P			3+1=4					22
II			GMA(select any one) GMA-204: Vector analysis and Solid Geometry GMA-205:Differential Equation GMA-206:Linear Programming and game theory					
L+T/P			3+1=4					
III			GMA(select any one) GMA-307:Transportation and Network problems					

			GMA-308:Algebra GMA309:Graph Theory					
L+T/P			3+1=4					22
IV			GMA(select any one) GMA-410:Inventory systems and Marketing management GMA-411:Group Theory GMA-412:Graph theory					
L+T/P			4					
V			GMA(select any one) GMA-509:Network analysis GMA-510:Number theory 511: Mathematical logic and Boolean Algebra					
L+T/P			3+1=4,					
VI			GMA(select any one) GMA-611:Cryptography and Network Security GMA-612:Partial differential Equations GMA-613:C++ C++ programming for Mathematics					
L+T/P			3+1=4					

VII							
L+T/P							
VIII							
L+T/P							
	EXIT OPTION WITH BACHELOR'S DEGREE WITH HONOURS IN A DISCIPLINE ON COMPLETION OF COURSES EQUAL TO A MINIMUM OF 176 CREDITS						

Note -1: L: Lecture Class; T: Tutorial Class; P: Practical Class

Note-2: 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: Analytic Geometry

GE-1: Calculus

GMA-101: Semester1

[Probability Theory and Statistics]

Total Marks: 100 Workload:

4 Lectures (per week), Credits: 4 Duration: 14 Weeks (56 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 Functions ⊗(30 marks)

(Lectures: 18)

Sample Space, Axiomatic definition of Probability, Random Variables- Discrete and Continuous, Cumulative distribution function, Probability mass/density functions, Mathematical expectation, Moments, Moment generating function, Characteristic function.

Unit 2: Discrete and Continuous Distributions (Univariate and Bivariate): (40marks)

(Lectures: 20)

Discrete distributions -Uniform, Geometric and poisson, Continuous distributions -Uniform, Exponential, Gamma, Beta and Normal; Bivariate distributions – Joint cumulative distribution, joint probability density functions, Marginal distributions, Expectation of two random variables, joint moment generating Function.

Unit 3: Correlation, Regression and Central Limit Theorem: (30 marks)

(Lectures: 18)

The Correlation coefficient, Covariance, Linear regression of two variables, The method of Least square, Chebyshev's theorems, Strong law of large numbers, Central limit theorems and Weak law of large numbers

Books recommended:

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

References:

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.
6. Kai Lai Chung, A Course in Probability Theory, Academic Press, 2001.
7. Sheldon Ross, A first course in Probability, Prentice Hall, New Jersey, 2002.

GMA102: SEMESTER-I

[Analytical Geometry]

Total Marks: 100 Workload:

4 Lectures (per week) ,Credits: 4 Duration: 14 Weeks (56 Hrs.) Examination: 3 Hrs.

Course Objectives: The goal of this paper is to acquaint students with certain ideas about conic sections, polar equation of Conics.

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

- i) Transformation of Co-ordinates, pair of straight lines.
- ii) Classify different types of conic sections – the circle, the ellipse, the hyperbola and the parabola – in Cartesian and polar coordinates.

Course Contents:

Unit-I: Transformation of Co-ordinates and Pair of Straight lines⊗(35 marks)

(Lectures: 20)

Transformation of axes: Change of Origin without changing the direction of axes, Rotation of axes: Change of Direction of axes of co-ordinates without changing the origin, Invariants, removal of the xy -term. Pair of straight lines: Homogeneous equation of second degree, Angle between pair of lines given by the 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-II: Systems of conics⊗(40 marks)

(Lectures: 25)

To find the equation of the tangent to the Circle, to find the equation of the chord of the circle, Chord of contact, pole and polar, to find the pole of straight line, to find the equation of the pair of tangents drawn from a given point to the circle, orthogonal circles, System of conics: Parabola, Ellipse and Hyperbola. Every general equation of second degree in two variables always represents a conic section, Centre of a conic, Reduction of the general equation of second degree into central and non- central conics, Equation of tangent at a point on a conic, Condition that a line be a tangent to a conic, pair of tangents, Chord of contact, Co-normal points, pole and polar, Chord in terms of its middle point, Diameters and Conjugate diameters, Intersection of two conics, Conics through the points of intersection of two given conics, pair of tangents, Director circle,

Unit-III: Polar equation of conics: (Mark:25)

(Lectures: 12)

Polar equation of conics: Polar equation of a conic with respect to focus as pole, Equation of chord, tangent and normal, Confocal conics: Equations and properties of confocal conics.

Recommended Books:

B Das, Analytical Geometry with Vector Analysis, Orient Book Company, Kolkata.

Reference Books:

- 1 J.G.Chakravorty, P.R. Ghosh, Analytical Geometry and vector Analysis.
- 2 Shanti Narayan and P K Mittal, Analytical Solid Geometry, S Chand & Co.
- 3 S L Loney, Co-Ordinate Geometry of Two Dimensions, Macmillan and Co.

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

GMA-103: Semester-1

[CALCULUS]

Total Marks: 100 Workload:

4 Lectures (per week) ,Credits: 4 Duration: 14 Weeks (56 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:

Unit-I: Successive Differentiation (30 marks)

(Lectures:15)

Successive differentiation, Leibnitz theorem. Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax + b)^n\sin x$, $(ax + b)^n\cos x$, 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 , $\sin x$, $\cos x$, $\log(1+x)$, $(1+x)^n$, $\tan^{-1}x$, Indeterminate forms and L. Hospital's Rule,[1-Ch 8, 9, 11]

Unit -II: Derivatives and its applications (40 marks)

(Lectures: 25)

Function of Two and three variables, Limit and Continuity for functions of two and three variables[2-Ch11], Partial differentiation, successive partial differentiations, Euler's theorem on Homogeneous functions of two and three variables,[1-Ch 12] Maxima and Minima of functions of two variables.[1-Ch 13]

Curvature, Radius of curvature for the Cartesian equation, parametric equation, implicit equation and polar equation,[1-Ch 15] Asymptotes[1-Ch 16]. 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, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves.[1-Ch 19]

Unit –III: Reduction, Volume and Area of Surfaces (30 marks) (Lectures: 16)

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int (\log x)^n dx$, $\int \sin^n x \cos^m x dx$. [3-Ch7]
Evaluation of double integrals[3-Ch21], Change of the order of integration, Change of variables in double integrals [4-Ch12], Areas and lengths of curves in the plane, Volumes and Surface areas of solid of revolution [3-Ch 10,11,12 and 4-Ch 8,9,10] .

Books Recommended:

1. Das and Mukherjee - Differential Calculus, U.N. Dhur and Sons Pvt. Ltd, Kolkata.
2. Shanti Narayan and PK Mittal - Differential Calculus, S.Chand and Company Ltd.
3. Das and Mukherjee-Integral Calculus, U.N. Dhur and Sons Pvt. Ltd, Kolkata.
4. Shanti Narayan and PK Mittal - Integral Calculus, S.Chand and Company Ltd.

References:

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.

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

Any one of the following:

GE-2: Linear Programming and Applications

GE-2: Vector analysis and Solid Geometry

GE-2: Differential equation

GMA-204: Semester-II

[Linear Programming and Applications]

Total Marks: 100 Workload:

4 Lectures (per week) ,Credits: 4 Duration: 14 Weeks (56 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.

Course Contents:

Unit 1: Introduction to Linear Programming (30 marks) (Lectures: 18)

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 (40marks) (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 (30 marks) (Lectures:18)

Motivation and Formulation of Dual problem; Primal-Dual relationships; Fundamental Theorem of Duality; Complimentary Slackness. Game Theory and solve by Simplex method.

Books recommended: P.K Gupta and Man Mohan, Linear Programming and Theory of Games

Reference Books:

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.

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

GMA-205: Semester-II

[Vector analysis and Solid Geometry]

Total Marks: 100 Workload:

4 Lectures (per week) ,Credits: 4 Duration: 14 Weeks (56 Hrs.) Examination: 3 Hrs.

Course Objectives: The goal of this paper is to acquaint students with certain ideas about three dimensional geometry and vectors in coordinate system.

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

- i) Visualize three dimensional objects – spheres and cylinders.
- ii) Having Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola by using software say Mathematica/MATLAB.

Unit 1 : Vector Analysis⊗(30 marks)

(Lectures: 18)

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: Sphere, Cone and Cylinder⊗(40 marks)

(Lectures: 23)

Sphere: To find the Equation of sphere, Condition for the general equation of second degree to represent a sphere, section of a sphere by a plane, Intersection of two spheres, Equation of a tangent plane, Condition for a plane to be a tangent plane to a sphere. To find the equation of the sphere described on the join of two points as diameter, Cone: Equation of a cone with a conic as guiding curve, To find the equation of a cone with its vertex as origin is homogeneous of second degree, 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.

Unit 2: Cylinder⊗(30 marks)

(Lectures: 15)

Cylinder: Equation of cylinder, Enveloping cylinder, Right circular cylinder. To find the equation of the right circular cylinder whose axis is the line. Central Conicoids, Ellipsoid,

The hyperboloid of one sheet, the hyperboloid of two sheets, condition for tangent planes, Enveloping cone, Enveloping cylinder: Paraboloids, Elliptic paraboloid, Hyperbolic paraboloid, Equations and their properties.

Recommended Books:

- I) B Das, Analytical Geometry with Vector Analysis, Orient Book Company, Kolkata.
- II) Ghosh and Maity, Vector Analysis, New Central Book Agency.

Reference Books:

- III) Shanti Narayan and P K Mittal, Analytical Solid Geometry, S Chand & Co.
- IV) S L Loney, Co-Ordinate Geometry of Three Dimensions, Macmillan and Co.
- V) R J T Bell, An Elementary Treatise on Co-Ordinate Geometry of Three Dimensions, Macmillan and Co.

GMA-206: Semester-II

[Differential Equations]

Total Marks: 100 Workload:

4 Lectures (per week) ,Credits: 4 Duration: 14 Weeks (56 Hrs.) Examination: 3 Hrs.

Course Objectives: The main objectives of this course are to introduce the students to the exciting world of Differential Equations, Mathematical Modeling and their applications.

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

- i) Formulate Differential Equations for various Mathematical models.
- ii) Solve first order non-linear differential equation and linear differential equations of higher order using various techniques.
- iii) Apply these techniques to solve and analyse various mathematical models.

Course Contents:

Unit – I: First order and First degree differential equations (30 Marks)

(Lecture - 18)

Order and degree of a differential equations; Exact differential equation and integrating factors of first order differential equations; Linear equations and equations reducible to linear form; Equations of first order and first degree; Linear equations and equations reducible to linear form; 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 geometric interpretations; Orthogonal trajectories.

Unit – II: Mathematical Modelling with Differential Equations (40 Marks)

(Lecture - 20)

Equations of first order but not of first degree: Equations solvable for x , y and p ; Clairaut's equations and the singular solutions. Application of first order differential equations to equations to acceleration-velocity model; Growth and decay model; Introduction to compartmental models; Drug assimilation into the blood (case of a single cold pill, case of alcohol in the bloodstream); Exponential growth of population; Limited growth of population.

Unit – III: Second Order and Higher Order Differential Equations (30 Marks)

(Lecture - 18)

General solution of homogeneous equation of second order, Wronskian, its properties and applications; Linear homogeneous and non-homogeneous equations of higher order with constant coefficients; Euler's equation, Method of undetermined coefficients, Method of variation of parameters.

Books Recommended:

1. Arup Mukherjee & Naba Kumar Bej (Reprint 2017): Ordinary & Partial Differential Equations. Shreedhar Prakashani, Publishers & Book Selles; 203/4D Bidhan Sarani, Kolkata.

References:

1. Barnes, Belinda & Fulford, Glenn R. (2015). Mathematical Modelling with Case Studies, Using Maple and MATLAB (3rd ed.). CRC Press, Taylor & Francis Group.
2. Edwards, C. Henry, Penney, David E., & Calvis, David T. (2015). Differential Equation and Boundary Value Problems: Computing and Modeling (5th ed.). Pearson Education.
3. Piaggio – *An Elementary Treatise on Differential Equation and Their Applications*, C.B.S.Publishers & Distributors, New Delhi
4. M.D. Raisinghanian- Ordinary and Partial Differential Equations, S.Chand, New Delhi
5. R.K.Gosh and K.C. Maity-An introduction to Differential Equations NCBA (P) Ltd Kolkata
6. D.A.Murray - *Introductory Course in Differential Equations*, Orient Longman (India).