FYUGP

# MATHEMATICS HONOURS/ RESEARCH

FOR UNDER GRADUATE COURSES UNDER N.P. UNIVERSITY

Implemented from
Academic Session 2022-2026

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# SEMESTER I

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## I. MAJOR COURSE –MJ 1: (Credits: Theory-06)

| Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100 | Pass Marks: Th (SIE + ESE) = 40 |
|---|---|

***Instruction to Question Setter for***

*Semester Internal Examination (SIE 20+5=25 marks):*
*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

*The Semester Internal Examination shall have two components. (a) One Semester Internal Assessment Test (SIA) of 10 Marks, (b) Class Attendance Score (CAS) of 5 marks. Conversion of Attendance into score may be as follows:*

*(Attendance Upto 45%, 1mark; 45<Attd.<55, 2 marks; 55<Attd.<65, 3 marks; 65<Attd.<75, 4 marks; 75<Attd, 5 marks)*

*End Semester Examination (ESE 75 marks):*
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

## CALCULUS & GEOMETRY

**Theory: 75 Lectures; Tutorial: 15 Lectures**

**Course Objectives & Learning Outcomes:**
This course will enable the students to:

1. Understand the consequences of various mean value theorems for differentiable functions.
2. Sketch curves in Cartesian and polar coordinate systems.
3. Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.
4. Evaluate integrals of different rational and irrational functions
5. Evaluate nth order integration by means of reduction formulae
6. Explain the properties of three dimensional shapes.

**Course Content:**

**Unit-I: Differentiation** **15 Lectures**

Limits and Continuity, Differentiation of a real valued function, Geometrical interpretation of differentiation, Relation between differentiation 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-II: Expansions of Functions** **8 Lectures**

Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange and Cauchy Schlomilch forms of remainder; Maxima and minima.

**Unit-III: Curvature, Asymptotes and Curve Tracing** **15 Lectures**

Curvature; Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes; 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: Integral Calculus** **12 Lectures**

Integration of rational and irrational functions. Evaluation of definite integrals, Special integrals, differentiation and integration under the sign of integration (Beta and Gamma functions are excluded), reduction formulae.

**Unit-V: Geometry of Integral Calculus** **10 Lectures**

Length of plane curve and area bounded by plane curves. Volumeand surface area of solid of revolution, Centroid and Moment of Inertia.

**Unit-VI: Planes, Straight Lines and Spheres** **17 Lectures**

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; Spheres: Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal, Radical plane, Radical line, Coaxial system of spheres, Pole, Polar and Conjugacy.

**Reference Books:**

1. Howard Anton, I. Bivens & Stephan Davis (2016). Calculus (10th edition). Wiley India.
2. Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag.
3. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd.
4. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). Thomas' Calculus (14th edition). Pearson Education.
5. Integral Calculus – Lalji Prasad.
6. Higher Engineering Mathematics – B S Grewal
7. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
8. Rama Shanker & Ravi Shanker (2014). Introduction to Calculus for Business and Economics: GRD Prakashan Uttam Nagar, Delhi – 59
9. Lalji Prasad. Degree Level Mathematics (2022): Paramount Publication

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# SEMESTER II

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## I. MAJOR COURSE- MJ 2: (Credits: Theory-06)

| Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100 | Pass Marks: Th (SIE + E |
|---|---|

***Instruction to Question Setter for***

*Semester Internal Examination (SIE 20+5=25 marks):*
*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

*The Semester Internal Examination shall have two components. (a) One Semester Internal Assessment Test (SIA) of 10 Marks, (b) Class Attendance Score (CAS) of 5 marks. Conversion of Attendance into score may be as follows: (Attendance Upto 45%, 1mark; 45<Attd.<55, 2 marks; 55<Attd.<65, 3 marks; 65<Attd.<75, 4 marks; 75<Attd, 5 marks)*

*End Semester Examination (ESE 75 marks):*
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

## MULTIVARIATE CALCULUS

**Theory: 75 Lectures; Tutorial: 15 Lectures**

**Course Objectives & Learning Outcomes:**
This course will enable the students to:

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

**Course Content:**

**Unit-I: Partial Differentiation** **13 Lectures**

Functions of several variables, Level curves and surfaces, Partial differentiation, Tangent planes, Chain rule, Directional derivatives, The gradient, Maximal andnormal properties of the gradient, Tangent planes and normal lines.

**Unit-II: Differentiability** **12 Lectures**

Higher order partial derivatives, Total differential and differentiability, Jacobians, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem for functions of two and more variables, Envelopes and evolutes.

**Unit-III: Differentiation of a vector function** **07 Lectures**

Vector point function, Scalar point function, Differentiation of a vector function. Derivatives of a sum of vectors. Derivatives of a product of vectors (both scalar and vector products)

**Unit-IV: Extrema of Functions and Vector Field** **13 Lectures**

Extrema of functions of two and more variables, Method of Lagrange multipliers, Constrained optimization problems, Definition of vector field, Divergence, curl, gradient and vector identities.

**Unit-V: Double and Triple Integrals** **15 Lectures**

Double integration over rectangular and nonrectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals, Dirichlet integral.

**Unit-VI: Green's, Stokes' and Gauss Divergence Theorem** **15 Lectures**

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, The Gauss divergence theorem.

**Reference Books:**

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.
5. Vector Calculus – Dasgupta.
6. Rama Shanker & Ravi Shanker (2014). Introduction to calculus for Business and Economics; GRD Prakashan Uttam Nagar Delhi – 59.
7. Lalji Prasad. Degree Level Mathematics (2022): Paramount Publication

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COURSES OF STUDY FOR **INTRODUCTORY/ MINOR ELECTIVE** FYUGP IN **"MATHEMATICS"**

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**SEMESTER I/ II/ III INTRODUCTORY REGULAR COURSE 1 Paper**

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# I. INTRODUCTORY REGULAR COURSE (IRC)

(Credits: Theory-03)

- All Four Introductory & Minor Papers of Mathematics to be studied by the Students of **Other than Mathematics Honours.**

- Students of **Mathematics Honours** must Refer Content from the **Syllabus of Opted Introductory & Minor Elective Subject**.

| **Marks: 100 (ESE: 3Hrs) = 100** | **Pass Marks: Th (ESE) = 40** |
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***Instruction to Question Setter for***

*End Semester Examination (ESE 100 marks):*

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of twenty marks each, out of which any four are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

## INTRODUCTORY MATHEMATICS

**Theory: 30 Lectures; Tutorials: 15 Lectures**

**Course Objectives & Learning Outcomes:**

1. This course will enable the students to:
2. Be familiar with the upcoming concepts of Differential calculus, Integral calculus, Vector calculus, Analytical Geometry 2D, Set theory and Trigonometry in minor paper

**Course Content:**

**Unit-I: Differential Calculus** **10 Lectures**

Successive Differentiation. $n^{th}$ order derivatives of standard functions. Partial derivatives

**Unit-II: Integral Calculus** **10 Lectures**

Integration of rational & irrational functions. Partial fractions.

**Unit-III: Vector Calculus** **08 Lectures**

Scalar point functions. vector point functions. Differentiation of a vector of scalar variables.

**Unit-IV: Analytical Geometry 2D** **05 Lectures**

Change of rectangular axes. Rotation & shifting of origin.

**Unit-V: Set Theory** **05 Lectures**

Indexed family of sets. Generalized set operations. DeMorgan's Law.

**Unit-VI: Trigonometry** **07 Lectures**

DeMoivre's theorem & its Applications.

**Reference Books:**

1. Differential Calculus: Lalji Prasad
2. Integral Calculus: Dasgupta & Prasad.
3. Vector Calculus: Dasgupta& Prasad
4. Coordinate Geometry: A Das Gupta
5. Set Theory: K K Jha
6. Trigonometry: Dasgupta& Prasad
7. Rama Shanker & Ravi Shanker (2014): Introduction to Calculus for Business and Economics GRD Prakashan Uttam Nagar Delhi – 59

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