

**DIBRUGARH UNIVERSITY**  
**DIBRUGARH**  
**SYLLABUS FOR THREE YEAR DEGREE COURSE IN**  
**MATHEMATICS**  
**UNDER SEMESTER SYSTEM**  
(General Programme and Major Programme)

**COURSE STRUCTURE OF THREE YEAR DEGREE B.A/B. Sc. PROGRAMME**  
**IN MATHEMATICS UNDER SEMESTER SYSTEM OF**  
**DIBRUGARH UNIVERSITY**  
**(GENERAL PROGRAMME)**

Course	Number of Classes : 50	Marks
<b>SEMESTER – I</b>		
<b>1. Course Code : NM 101</b>		<b>100</b>
(A) Classical Algebra	25 Classes	40
(B) Trigonometry	16 Classes	25
(C) Vector Calculus	9 Classes	15
Internal Assessment	...	20
<b>SEMESTER – II</b>		
<b>1. Course Code : NM 201</b>		<b>100</b>
(A) Matrices	11 Classes	20
(B) Ordinary Differential Equations	21 Classes	30
(C) Numerical Analysis	18 Classes	30
Internal Assessment	...	20
<b>SEMESTER – III</b>		
<b>1. Course Code : NM 301</b>		<b>100</b>
(A) Co-ordinate Geometry	25 Classes	45
(B) Analysis – I (Real Analysis)	25 Classes	35
Internal Assessment	...	20
<b>SEMESTER – IV</b>		
<b>1. Course Code : NM 401</b>		<b>100</b>
(A) Linear Programming Problem	29 Classes	50
(B) Computer Lab (Matlab, Mathematica)	21 Classes	30
Internal Assessment	...	20
<b>SEMESTER – V</b>		
<b>1. Course Code : NM 501</b>		<b>100</b>
(A) Analysis – II (Complex Analysis)	23 Classes	35
(B) Mechanics	27 Classes	45
Internal Assessment	...	20
<b>SEMESTER – VI</b>		
<b>1. Course Code : NM 601 (Optional Paper)</b>		<b>100</b>
Group ( A) or Group (B)		
Group (A): (a) Abstract Algebra	29 Classes	45
(b) Elementary Statistics	21 Classes	35
Group (B): (a) Discrete Mathematics	29 Classes	45
(b) Metric Space	21 Classes	35
Internal Assessment	...	20

**COURSE STRUCTURE OF THREE YEAR DEGREE B.A/B. Sc. PROGRAMME  
IN MATHEMATICS UNDER SEMESTER SYSTEM OF  
DIBRUGARH UNIVERSITY**

**(MAJOR PROGRAMME)**

Course	Number of Classes : 50	Marks
<b>SEMESTER – I</b>		
<b>1. Course Code : MM 101</b>		<b>100</b>
(A) Classical Algebra	25 Classes	40
(B) Trigonometry	16 Classes	25
(C) Vector Calculus	9 Classes	15
Internal Assessment	...	20
<b>SEMESTER – II</b>		
<b>1. Course Code : MM 201</b>		<b>100</b>
(A) Matrices	11 Classes	20
(B) Ordinary Differential Equations	21 Classes	30
(C) Numerical Analysis	18 Classes	30
Internal Assessment	...	20
<b>SEMESTER – III</b>		
<b>1. Course Code : MM 301</b>		<b>100</b>
(A) Analysis I (Real Analysis)	50 Classes	80
Internal Assessment	...	20
<b>2. Course Code : MM 302</b>		<b>100</b>
(A) Co-Ordinate Geometry	25 Classes	45
(B) Algebra I	25 Classes	35
Internal Assessment	...	20
<b>SEMESTER – IV</b>		
<b>1. Course Code : MM 401</b>		<b>100</b>
(A) Computer Programming(C-Programming)	29 Classes	50
(B) Computer Lab		
(C - Programming, Matlab)	21 Classes	30
Internal Assessment	...	20
<b>2. Course Code : MM 402</b>		<b>100</b>
(A) Linear Programming Problem	25 Classes	45
(B) Analysis II (Multiple Integral)	25 Classes	35
Internal Assessment	...	20
<b>SEMESTER – V</b>		
<b>1. Course Code : MM 501</b>		<b>100</b>
(A) Logic and Combinatorics	23 Classes	35
(B) Analysis III (Complex Analysis)	27 Classes	45
Internal Assessment	...	20
<b>2. Course Code: MM 502</b>		<b>100</b>
(A) Linear Algebra	25 Classes	40
(B) Number Theory	25 Classes	40
Internal Assessment	...	20
<b>3. Course Code: MM 503</b>		<b>100</b>
(A) Fluid Mechanics	50 Classes	80
Internal Assessment	...	20
<b>4. Course Code: MM 504</b>		<b>100</b>
(A) Mechanics	29 Classes	50
(B) Integral Transformation	21 Classes	30
Internal Assessment	...	20
<b>SEMESTER – VI</b>		

<b>1. Course Code : MM 601</b>		<b>100</b>
(A) Metric Space	25 Classes	40
(B) Statistics	25 Classes	40
<b>Internal Assessment</b>	...	20
<b>2. Course Code : MM 602</b>		<b>100</b>
(A) Discrete Mathematics	29 Classes	45
(B) Graph Theory	21 Classes	35
<b>Internal Assessment</b>	...	20
<b>3. Course Code: MM 603</b>		<b>100</b>
(A) Algebra II	25 Classes	40
(B) Partial Differential Equation	25 Classes	40
<b>Internal Assessment</b>	...	20
<b>4. Course Code: MM 604 (Optional Paper)</b>		<b>100</b>
<b>Group (A) or Group (B)</b>		
<b>Group (A): (a) Financial Mathematics</b>	<b>29 Classes</b>	<b>45</b>
<b>(b) Operations Research</b>	<b>21 Classes</b>	<b>35</b>
<b>Group (B): (a) Space Dynamics</b>	<b>25 Classes</b>	<b>40</b>
<b>(b) Relativity</b>	<b>25 Classes</b>	<b>40</b>
<b>Internal Assessment</b>	...	20

## GENERAL PROGRAMME

SEMESTER – I  
Course Code: NM 101

**Objective :** To infuse the classical ideas of algebraic and analytic structures. The students can have a deeper insight of the developments of the generalized notions of Trigonometry. The students will have an orientation towards the vectorial notations of multivariable calculi.

**(A) Classical Algebra**

**25 Classes    Marks : 40**

**Unit I:** Real sequences: Definition, bounds of a sequence, convergence of sequences and related theorems, limit of a sequence, Bolzano Weierstrass theorem, Definitions of limit inferior and superior with simple examples, Convergent sequences and statements of related theorems, non convergent sequences, Cauchy's General Principle of convergence and Cauchy sequence, monotonic sequences (Th. 29).  
9 Classes    Marks : 10

[1] Chapter – 3 (Section: 1 – 6, 9).

**Unit II:** Infinite Series and its convergence: Introduction, Necessary condition for convergence, Cauchy's general principle of convergence for series, Statements of preliminary theorems, positive series and its necessary condition of convergence, Geometric series, Comparison series, Statements of comparison test (first and second types), Cauchy's Root Test, D'Alembert's Ratio Test, and Raabe's Test, Leibnitz's Test for convergence of an alternating Series.  
Chapter – 4 (Section: 1 – 6, 10(10.1 only)).  
7 Classes    Marks : 15

**Unit III:** Theory of Polynomial equations: Definitions. Division algorithm, Remainder theorem, factor theorem and theorems on Existence of real roots (statements only) with examples, Descartes' rule of sign., Fundamental Theorem of Algebra, Existence of complex roots, Relation between roots and coefficients and related problems, Transformation of equation, Cardon's method of solution of cubic equation.  
9 Classes    Marks : 15

[2] Chapters – 5, 6, 7, 8, 9.

**(B) Trigonometry:**

**16 Classes    Marks : 25**

**Unit I:** De Moivre's theorem and important deductions from De Moivre's theorem

[3] Chapters – VII and VIII.

4 Classes    Marks : 8

**Unit II:** Trigonometrical and exponential functions of complex arguments.

[3] Chapter – IX .

4 Classes    Marks : 5

**Unit III:** Gregory's series and evaluation of  $\pi$  .

[3] Chapter – X.

3 Classes    Marks : 4

**Unit IV:** Summation of trigonometric series and hyperbolic functions.

[3] Chapters – XI and XII.

5 Classes    Marks : 8

**(C) Vector Calculus**

**9 Classes    Marks : 15**

**Unit – I:** Ordinary derivatives of vectors, Space curves, Continuity and differentiability, Differentiation formulae, Partial derivatives of vectors and related problems, Vector differential operator  $\nabla$ , Gradient, Directional derivative, Divergence and Curl, Laplacian operator  $\nabla^2$ , Vector identities and related problems.  
9 Classes    Marks : 15

[4] Chapters – 3, 4.

**Text Books :**

- [1] Mathematical Analysis; S. C. Malik & S. Arora, New age International (P) Ltd. New Delhi, 3<sup>rd</sup> revised edition, 2008.
- [2] Higher Algebra; B. Das & S.R. Maity, Ashoke Prakashan, Calcutta
- [3] Higher Trigonometry; B.C. Das, B.N. Mukherjee, U.N. Dhur and Sons, Calcutta.
- [4] Theory and Problems of Vector Analysis, Murray R. Spiegel, Schaum's outline series, McGraw Hill Book Company.

### Reference Books :

1. A text book of vector calculus; Shanti Narayan, J. N. Kapur, S. Chand and company, N. Delhi
2. A Text Book of Higher Algebra; M.Ray, H. S. Sarma, S. Chand and Company, New Delhi
3. Mathematics for Degree Students; Dr. P.K. Mittal, S. Chand and Company, 2010

## SEMESTER – II Course Code: NM 201

**Objective :** Students will be able to use matrix methods for solving linear equations, have ideas on the basics of differential equations and also about the numerical methods of obtaining results where complexity of obtaining analytical solutions is sufficiently high.

### (A) Matrices

**11 Classes    Marks : 20**

**Unit I:** Rank of a matrix, Elementary operations on a matrix, Determination of rank by reduction into echelon form & normal form, elementary matrices. 4 Classes    Marks : 8

**Unit II:** Solution of homogeneous & non homogeneous linear equations, Characteristic polynomial, characteristic equation, Eigen values and Eigen vectors, Cayley-Hamilton theorem.

[1] Chapters – 6, 11. 7 Classes    Marks : 12

### (B) Ordinary Differential Equations

**21 Classes    Marks : 30**

**Unit I:** Differential equation of the type  $\frac{dy}{dx} + Py = Q$ , Exact differential equations of first order, Equations of first order higher degree, Clairaut's form, wronskian, its properties and application.

[2] Chapter – 1. 7 Classes    Marks : 10

**Unit II:** Linear differential equation of higher order with constant coefficients, linear homogeneous equations. 7 Classes    Marks : 10

[2] Chapter – 2.

**Unit III:** Linear equation of second order with variable coefficients: Removal of first order derivative, Change of independent variables, Method of variation of parameters.

[3] Chapter – 4 (section: 4.6 – 4.15). 7 Classes    Marks : 10

### (C) Numerical Analysis

**18 Classes    Marks : 30**

**Unit I:** Solution of algebraic and transcendental equation: Bisection method, Regula-falsi method, Iteration method, Newton-Raphson method and its geometrical interpretation.

Solution of system of equations: Gauss elimination method, Gauss Seidal Method, Gauss Jordan method. 7 Classes Marks : 15

[4] Chapters – 2 (Section: 2.1 – 2.5), 6 (Section: 6.3.1 – 6.3.3).

**Unit II:** Diagonal and horizontal difference tables, finite difference operators, Newton's forward, backward and general interpolation formulae, Lagrange's interpolation formula, Quadrature: Trapezoidal rule, Simpson's quadrature (1/3 and 3/8 rule). 11 Classes Marks : 15

[5] Chapters – II, III, VIII (Section: 52).

### Text Books :

[1] A Text Book of Matrices; Shanti Narayan and P.K.Mittal, S. Chand and Company Ltd.

[2] Differential Equations; S L Ross, John Wiley and sons, India ,2004.

[3] Advance Differential Equation; M D Raisinghanian, S Chand Company

[4] Introductory Method of Numerical Analysis; S.S. Sastry, Prentice Hall India Pvt. Ltd.

[5] Numerical Mathematical Analysis; J B Scarborough, Oxford &IBH Publishing Co.

### Reference Books :

1. Introductory Method of ordinary Differential Equations; E.A. Coddington, Prentice Hall India Pvt. Ltd. 2004

2. Mathematics for Degree Students; Dr. P.K. Mittal, S. Chand and Company, New Delhi.

3. Elementary Numerical Analysis, An algorithmic approach; S.D. Conte & Carl De Boor, McGraw Hill International.

4. Numerical Analysis; G. Shanker Rao, New Age International Publisher

## SEMESTER – III

### Course Code : NM 301

**Objective :** The students will be have a deeper understanding of Co-ordinate geometry and a broader insight towards the analytical aspects of Mathematics.

**(A) Co-ordinate Geometry** 25 Classes Marks : 45

**(a) 2 - Dimension** 16 Classes Marks : 27

**Unit I:** Transformation of coordinates: Translation of axes, Rotation of axes, Invariants, Removal of  $xy$ -term. 3 Classes Marks : 5

[1] Chapter – 5 (Section: 39 – 42).

**Unit II:** Pair of straight lines: Pair of straight lines through origin, Angle and Bisectors of the angle between the lines given by homogenous equation of 2nd degree, Condition for the general equation of second degree to represent a pair of straight lines, Pair of intersecting straight lines, Pair of parallel straight lines. 6 Classes Marks : 12

[1] Chapter – 6 (Section: 44 – 49).

**Unit III:** General Equation of second degree: Equation to the conic sections, Centre of a conic, Reduction to central and non central conic, Tangent to the conic and condition of tangency, Chord of contact, Pole and Polar, conjugate diameter, 7 Classes Marks : 10

[1] Chapter – 11 (Section: 139 – 141, 143 – 147, 153, 154).

**(b) 3- Dimension****9 Classes    Marks : 18****Unit I:** Equation of planes, straight lines.

5 Classes    Marks : 10

[1] Chapters – 2 (Section: 21 – 31), 3 (Section: 32 – 38).

**Unit II:** Shortest distance between two lines, Skew lines.

4 Classes    Marks : 8

[1] Chapter – 3 (Section: 39 – 42), Appendix – 2.

**(B) Analysis –I (Real Analysis)****25 Classes    Marks : 35****Unit I:** Successive differentiation, Leibnitz's theorem, indeterminate forms, Sub tangent, sub normal, curvature and radius of curvature.

6 Classes    Marks : 10

[2] Chapters – 8, 11, 14 (Section: 14.7), 15 (Section: 15.1, 15.2).

**Unit II:** Function of one variable: Functions continuous on closed intervals, Differentiability, Darboux's theorem, Rolle's theorem, Lagrange mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Taylor's series, Maclaurin's series.

8 Classes    Marks : 10

[3] Chapters – 5 (Section: 3(theorems 5 – 10)), 6 (Section: 1, 2, 4 – 8).

**Unit III:** Partial Derivatives, Euler's theorem on homogeneous function.

[2] Chapter – 12.

4 Classes    Marks : 5

**Unit IV:** Evaluation of definite integrals by using properties only, Reduction formula of the integrands  $\sin^n \theta$ ,  $\cos^n \theta$ ,  $\tan^n \theta$  and  $\sin^m \theta \cos^n \theta$ , Rectification of plane curves.

[4] Chapters – 8 (Section: 8.13 – 8.15), 11 (Section: 11.1, 11.3).    7 Classes    Marks : 10

**Text Books :**

[1] Analytical Geometry and Vector Analysis; B. Das, Orient Book Company, Calcutta.

[2] Differential Calculus; B C Das and B N Mukherjee, U.N. Dhar and Sons, Calcutta

[3] Mathematical Analysis; S.C. Malik, S. Arora, New Age International, New Delhi

[4] Integral Calculus; B. C. Das and B. N. Mukherjee, U.N. Dhar and Sons, Calcutta

**Reference Books :**

1. Analytical Geometry of two and three dimensions; R.M. Khan, New Central Book Agency, Calcutta

2. Analytical Geometry of two dimensions; P K Jain &amp; K. Ahmed, Wiley Eastern Ltd.

3. Analytical Geometry of three dimensions; P K Jain &amp; K. Ahmed, Wiley Eastern Ltd.

**SEMESTER – IV  
Course Code: NM 401****Objective :** The students will be able to formulate and solve various practical models using Linear Programming techniques and also by using Computer Laboratory they will attain computational proficiency in dealing with Mathematical Software.



**(A) Linear Programming (LP)****29 Classes    Marks : 50**

**Unit I:** LP Model formulation & Graphical Method: Introduction, General structure and assumption of LP model, Mathematical formulation of a linear programming problem, Example of LP model Formulation, Feasible solution, basic solution, graphical method for the solution of a linear programming problem, convex set. 8 Classes    Marks : 12

[1] Chapter – 2 (2.1, 2.2, 2.6, 2.8), 3 (3.2 – 3.4).

[2] Chapter – 5 (5.1, 5.2 Th 5.1.1, Th 5.2.2, Th 5.1.3, Th 5.2.4).

**Unit II:** Theory of simplex algorithm and simplex method: Standard form of an LP Problem, Simplex Algorithm, Solutions of unique optimal solution, alternative optimal solution, unbounded solution, artificial variable technique (Charnes' M-technique, two phase method), Degeneracy. 8 Classes    Marks : 18

[1] Chapter – 4 (4.2, 4.3, 4.4, 4.5.2, 4.5.3, 4.6).

**Unit III:** Duality Theory: Concept of duality, Types of primal dual problem, Standard form, Rules for constructing the dual from primal, Simple and mixed type problems, Theorem on duality, Fundamental duality theorem (Statement only). 5 Classes    Marks : 8

[2] Chapter –12 (12.1 –12.4, 12.6, 12.7, 12.9 Th12.5.1, Th12.6.1, Th12.6.2, Th12.9.1, Th12.9.2).

**Unit IV:** Transportation Problem: Definition, Transportation Table, Loops in transportation tables and their properties, Determination of an initial basic feasible solution by North West corner method, Matrix minima or least cost method and Vogel approximation method, unbalanced transportation problem, optimization by Modi method. 8 Classes    Marks : 12

[2] Chapter – 13 (13.1 – 13.3, 13.4.10, Th.13.1.1, Th.13.1.3).

**(B) Computer Laboratory (Practical)****21 Classes    Marks : 30**

Matlab / Mathematica: Evaluation of arithmetic expression, exponential and logarithms, trigonometric functions, computation of complex numbers, Plotting of curves (Algebraic function, trigonometric function, and exponential function), Operations in matrices, Plotting of three 3D curves and shapes, Solution of algebraic equation, simultaneous linear equations.

(Reference [3] and [4]).

**Note:** There will be one internal examiner for the practical examination. The duration of the practical examination will be 3 Classes .:

Marks : distribution: 20 Marks : for practical,

5 Marks : for viva-voce,

5 Marks : for laboratory note book.

All materials related to examination have to be sent to the controller of examinations by the colleges after the examination is over.

**Text Books :**

[1] Operation Research – Theory and Application; J.K.Sharma, McMillan India Ltd. New Delhi.

[2] Linear programming and Theory of Game ; P. M. Karak, New Central Book Agency(P) Ltd

[3] Getting started with Mat lab, A quick introduction for scientist and Engineers; Rudrapratap, Oxford University Press.

[4] The Mathematica; Stephen Wolfram, Cambridge University Press.

### Reference Books :

1. Linear Programming and Game Theory; Dipak Chatterjee, Prentice Hall of India (P) Ltd
2. Linear Programming; G. Hadley, Narosa Publishing House.

## SEMESTER – V Course Code: NM 501

**Objective :** The students will be able to understand the analytical perspective of the complex number system. The students will be able to identify the applicable domain of Mathematics in Physical Sciences.

### (A) Analysis – II (Complex Analysis) 23 Classes    Marks : 35

**Unit I:** Analytic Function: Limit, Continuity and differentiability, Analytic functions, Cauchy-Riemann equations. Necessary and sufficient condition for a function to be analytic, polar form of C.R. equation, Harmonic functions, Construction of analytic function.

- [1] Chapter – 3 (Solved Problems 1 – 8). 6 Classes    Marks : 10  
 [2] Chapter – 5 (Section: 5.2, 5.4, 5.6 – 5.9).

**Unit II:** Complex Integrals: Definite integral, arc, contour, line integrals, simply and multi connected domains, Cauchy's theorem, Cauchy's integral formula, Derivative of Cauchy's integral formula. 8 Classes    Marks : 12

- [1] Chapters – 4 (Solved Problems 1 – 3), 5 (Solved Problems 1 – 6).  
 [2] Chapters – 8 (Section: 8.2, 8.3, 8.4, 8.6), 9 (Section: 9.3, 9.4, 9.5.1, 9.5.3, 9.6, 9.7).

**Unit III:** Taylor and Laurent theorem (statements only) and related problems, Definition and statement of the related theorems of isolated singularity, removable singularity and poles, Cauchy's residue theorem, Contour Integration (Integration round the unit circle)

- [1] Chapter – 6 (Solved Problems 22 – 27). 9 Classes    Marks : 13  
 [2] Chapters – 10 (Section: 10.3, 10.4, 10.6, 10.7, 10.9, 10.10), 11 (Section: 11.2).

### (B) Mechanics 27 Classes    Marks : 45

#### (a) Statics 11 Classes    Marks : 20

**Unit I:** Reduction of a system of forces on a rigid body, Change of base point, Conditions of equilibrium, Point's central axis, wrench, pitch, screw, Invariants, Equations of central axis.

- [3] Chapter – 6 (Section 6.4, 6.5, 6.9 – 6.14). 7 Classes    Marks : 10

**Unit II:** Virtual work, Common catenary, 4 Classes    Marks : 10

- [3] Chapters – 3 (Section: 3.3 – 3.7), 4 (Section: 4.1 – 4.7).

#### (b) Dynamics 16 Classes    Marks : 25

**Unit I:** Motion in a straight line and plane, Radial and transverse velocities and acceleration, angular velocity and angular acceleration, tangential and normal acceleration, Simple Harmonic Motion. 5 Classes    Marks : 8

- [4] Chapters – 1 (Section: 1.1 – 1.6), 2 (Section: 2.3).

**Unit II:** Central forces, Motion under resistance.  
[4] Chapters – 8, 9.

5 Classes    Marks : 7

**Unit III:** Dynamics of Rigid Body: Moments of inertia, Theorems of parallel and perpendicular axes, Moment of inertia about a line, Moment and product of inertia of a plane lamina, Momental ellipsoid and Momental ellipse.  
[5] Chapters – 1(Section: 1.1 – 1.13), 2(section: 2.2 – 2.7).

6 Classes    Marks : 10

**Text Books :**

[1] Complex Variables; Murray R. Spiegel: McGraw Hill.

[2] Theory of Functions of a Complex Variable; Shanti Narayan & P.K. Mittal, S. Chand & Company(Revised Edition)

[3] Statics; Dr Md Motiur Rahman, New Central Book Agency (P) Ltd 2007

[4] A Text Book on Dynamics; M. Ray & G.C. Sharma, S. Chand and Company Ltd.

[5] Rigid Dynamics; by Dr Md Motiur Rahman, New Central Book Agency (P) Ltd 2009

**Reference Books :**

1. Dynamic of a Particle and of Rigid Bodies; S.L. Loney, S. Chand and Company Ltd.

2. An Elementary Treatise on Statics; S.L. Loney, Cambridge University Press.

3. A Text Book on Statics; M. Ray. R.D. Manglik, G.C. Sharma, S. Chand and Company Ltd.

**SEMESTER – VI**

**Course Code: NM 601**

**(Any one of the following Groups)**

**Group –A (Abstract Algebra & Statistics)**

**50 Classes    Marks : 80**

**Objective :** Students will be able to identify the characteristics of Abstract Algebraic Structures and also can obtain insights of statistical tools for solving various practical problems.

**(a) Abstract Algebra**

**29 Classes    Marks : 45**

**Unit I:** Binary composition, Definition and Examples of Group, Elementary properties of Group, Subgroups, Normal subgroup, Lagranges' theorem, Cyclic group.    12 Classes    Marks : 17

[1] Chapters – 1 (Section: 3), 2 (Section: 2.1 – 2.5, 2.7, 2.14 – 2.17, 2.20, 2.23 – 2.42).

**Unit II:** Quotient group, Homomorphism and Natural homomorphism, First theorem of Isomorphism.    5 Classes    Marks : 8

[1] Chapter – 3 (Section: 3.1 – 3.12).

**Unit III:** Permutation Group, Cayley's theorem, Automorphism of Group

[1] Chapter – 3 (Section: 3.15, 3.17 – 3.21, 3.25 – 3.30, 3.35 – 3.39).    6 Classes    Marks : 10

**Unit IV:** Definition and examples of Ring, Special kinds of rings, fields, sub rings and ideals, algebra of ideals.    6 Classes    Marks : 10

[1] Chapter – 7 (Section: 7.1 – 7.16, 7.19 – 7.35).

**(b) Statistics**

**21 Classes    Marks : 35**

**Unit I:** Probability: Basic terminology, Mathematical probability, Statistical probability, Axiomatic approach to probability. Some theorems on probability, Conditional probability, Multiplication theorem of probability, Independent events, Multiplication theorem of probability for independent events, Extension of multiplication theorem of probability, Baye's theorem.

[2] Chapters – 3 (Section: 3.1 – 3.5, 3.8 – 3.14), 4 (Section: 4.2). 7 Classes Marks : 11

**Unit II:** Measures of Dispersion: Standard deviation, Quartile deviation, co-efficient of variation.

4 Classes Marks : 5

[2] Chapter – 2 (2.12, 2.13, 2.14).

**Unit IV:** Correlation and regression: Karl Pearson's co-efficient of correlation, Spearman Rank correlation co-efficient, regression lines and equation.

4 Classes Marks : 7

[2] Chapters – 10 (10.1 – 10.4, 10.7), 11 (11.1 – 11.2.3).

**Unit V:** Theoretical Probability Distribution: Binomial, Poisson and Normal Distribution and their applications to simple problems.

6 Classes Marks : 12

[2] Chapters – 8 (8.1 – 8.4.1, 8.5, 8.5.2), 9 (9.1 – 9.2.2).

### **Text Books :**

[1] Abstract Algebra; Surjit Singh and Quazi Zamiruddin, Vikas Publishing House Pvt. Ltd., Seventh Revised Edition, 1990, Reprint 2003.

[2] Fundamentals of Mathematical Statistics; V.K. Kapoor, S. C. Gupta, Sultan Chand & Sons.

### **Reference Books :**

1. Basic Abstract Algebra, P.B. Bhattacharyya; S.K. Jain, S.R. Nagpaul, 2<sup>nd</sup> Edition, Cambridge University Press, Indian Edition.

2. Probability and Statistics ; A.M. Mathai and P.N. Rathie, MacMillan India Ltd.

## **Group – B ( Discrete Mathematics & Metric Spaces )**

**50 Classes Marks : 80**

**Objective :** The students will be able to identify the relations between Mathematics and Theoretical Computer Science and also have a detailed idea on Metric Spaces as a prelude to the Topological concepts.

### **(a) Discrete Mathematics**

**29 Classes Marks : 45**

**Unit I:** Logic: The Statement Calculus: Introduction, Sentential Connectives ,Truth tables, Truth value, Validity, truth function, tautology and related theorems, arithmetic representation of sentential connectives.

6 Classes Marks : 10

[1] Chapter – 4 (Section: 1, 2, 3).

**Unit II:** Logic: Theory of Inference: Consequence, rule of inference and applications. Predicate calculus: symbolizing language.

6 Classes Marks : 10

[1] Chapter – 4 (Section: 4, 5, 6).

**Unit II:** Lattice: Definition and examples, Hasse diagram, Properties of Lattice, Lattice as an Algebraic systems, Sub lattice and lattice isomorphism, Special Classes : of lattice, Distributive lattice and Boolean algebras. 7 Classes Marks : 10

[2] Chapter – 8 (Section: 8.1 – 8.6).

**Unit III:** Boolean Algebra: Boolean algebra as lattice, Boolean algebra as an algebraic system, Properties of Boolean algebra , Sub-algebra and homomorphism of Boolean algebra, Boolean expressions, sum-of-products canonical form, values of Boolean expression and Boolean functions, representation by Karnaugh Maps, minimization of Boolean functions using Karnaugh Maps. 10 Classes Marks : 15

[2] Chapter – 9 (Section: 9.1 – 9.4, 9.5.1 – 9.5.3, 9.6.1, 9.6.2).

### **(b) Metric Spaces**

**21 Classes Marks : 35**

**Unit I:** Definition and examples of metric spaces, Open spheres and closed spheres, Neighborhoods, Open sets, Equivalent metrics, Interior points, Closed sets, Limit points and isolated points, Closure of a set, Boundary points, Distance between sets and diameter of a set, Subspace of metric space, Product metric spaces (definition only), Bases.

[3] Chapter – 2 (2.1 – 2.12, 2.13.1, 2.14).

9 Classes Marks : 15

**Unit II:** Convergent sequences, Cauchy sequences, complete spaces, dense sets and separable spaces.

[3] Chapter – 3 (3.1 – 3.4).

7 Classes Marks : 12

**Unit III:** Continuous functions: Definition and characterizations, Extension theorem, Uniform continuity (definition only), Homeomorphism.

[3] Chapter – 4 (4.1, 4.2, 4.3.1, 4.3.2, 4.4).

5 Classes Marks : 8

### **Text Books :**

[1] Set Theory and Logic; Robert R. Stoll, Eurasia Publishing House (P) Ltd.

[2] Discrete Mathematics; N. Chandrasekaran & M. Umavathi Prentice Hall of India, New Delhi, 2010.

[3] Metric Space, P.K.Jain and Khalil Ahmed, Narosa Publication House, New Delhi 2010.

### **Reference Books :**

1. Principles of Mathematical Analysis; Walter Rudin, McGraw Hill International.

2. Introduction to Topology and Modern Analysis; G.F. Simmon, Tata Mc Graw Hill.

3. Discrete Mathematics; Schaum Outline Series, Tata Mc Graw Hill Pub. – 1999.

4. Discrete Mathematical Structures; G. Shanker Rao, New International Publishers.

5. Introduction to Logic ; Patrick Suppes. East West Pvt Ltd. New Delhi.

## **MAJOR PROGRAMME**

### **SEMESTER – I**

**Course Code: MM 101**

**Objective :** To infuse the classical ideas of algebraic and analytic structures. The students can have a deeper insight of the developments of the generalized notions of Trigonometry. The students will have an orientation towards the vectorial notations of multivariable calculi.

**(A) Classical Algebra**

**25 Classes    Marks : 40**

**Unit I:** Real sequences: Definition, bounds of a sequence, convergence of sequences and related theorems, limit of a sequence, Bolzano Weierstrass theorem, Definitions of limit inferior and superior with simple examples, Convergent sequences and statements of related theorems, non convergent sequences, Cauchy's General Principle of convergence and Cauchy sequence, monotonic sequences (Th. 29).  
[1] Chapter – 3 (Section: 1 – 6, 9).  
9 Classes    Marks : 10

**Unit II:** Infinite Series and its convergence: Introduction, Necessary condition for convergence, Cauchy's general principle of convergence for series, Statements of preliminary theorems, positive series and its necessary condition of convergence, Geometric series, Comparison series, Statements of comparison test (first and second types), Cauchy's Root Test, D'Alembert's Ratio Test, and Raabe's Test, Leibnitz's Test for convergence of an alternating Series.  
[1] Chapter – 4 (Section: 1 – 6, 10(10.1 only)).  
7 Classes    Marks : 15

**Unit III:** Theory of Polynomial equations: Definitions. Division algorithm, Remainder theorem, factor theorem and theorems on Existence of real roots (statements only) with examples, Descartes' rule of sign., Fundamental Theorem of Algebra, Existence of complex roots, Relation between roots and coefficients and related problems, Transformation of equation, Cardon's method of solution of cubic equation.  
[2] Chapters – 5, 6, 7, 8, 9.  
9 Classes    Marks : 15

**(B) Trigonometry:**

**16 Classes    Marks : 25**

**Unit I:** De Moivre's theorem and important deductions from De Moivre's theorem  
[3] Chapters – VII and VIII.  
4 Classes    Marks : 8

**Unit II:** Trigonometrical and exponential functions of complex arguments.  
[3] Chapter – IX.  
4 Classes    Marks : 5

**Unit III :** Gregory's series and evaluation of  $\pi$ .  
[3] Chapter – X.  
3 Classes    Marks : 4

**Unit IV:** Summation of trigonometric series and hyperbolic functions.  
[3] Chapters – XI and XII.  
5 Classes    Marks : 8

**(C) Vector Calculus**

**9 Classes    Marks : 15**

**Unit – I:** Ordinary derivatives of vectors, Space curves, Continuity and differentiability, Differentiation formulae, Partial derivatives of vectors and related problems, Vector differential operator  $\text{del}$ , Gradient, Directional derivative, Divergence and Curl, Laplacian operator  $\nabla^2$ , Vector identities and related problems.  
[4] Chapters – 3, 4.  
9 Classes    Marks : 15

**Text Books :**



[4] Chapters – 2 (Section 2.1 – 2.5), 6 (Section: 6.3.1 – 6.3.3).

**Unit II:** Diagonal and horizontal difference tables, finite difference operators, Newton's forward, backward and general interpolation formulae, Lagrange's interpolation formula, Quadrature: Trapezoidal rule, Simpson's quadrature (1/3 and 3/8 rule). 11 Classes Marks : 15

[5] Chapters - II, III, VIII (Section: 52).

### Text Books :

[1] A Text Book of Matrices; Shanti Narayan and P.K.Mittal, S. Chand and Company Ltd.

[2] Differential Equations; S. L. Ross, John Wiley and sons, India ,2004.

[3] Advanced Differential Equation; M D Raisinghania, S Chand Company.

[4] Introductory Method of Numerical Analysis; S.S. Sastry, Prentice Hall of India Pvt. Ltd.

[5] Numerical Mathematical Analysis; J B Scarborough, Oxford &IBH Publishing Co.

### Reference Books :

1. Introductory Method of ordinary Differential Equations; E.A. Coddington, Prentice Hall of India Pvt. Ltd. 2004.

2. Mathematics for Degree Students; Dr. P.K. Mittal, S. Chand and Company, New Delhi. 2010.

3. Elementary Numerical Analysis, an algorithmic approach; S.D. Conte & Carl De Boor, McGraw Hill International.

4. Numerical Analysis; G. Shanker Rao, New Age International Publisher.

## SEMESTER – III Course Code: MM 301

**Objective :** Students will be able to identify the analytical aspects of Mathematical concepts.

**Analysis I (Real Analysis)** **50 Classes Marks : 80**

**(A) Differential Calculus** **23 Classes Marks : 35**

**Unit I:** Successive differentiation, Leibnitz's theorem, Indeterminate forms, Sub tangent, sub normal, derivative of arc length (Cartesian and polar forms), values of  $\sin \phi, \cos \phi$ , angle between radius vector and tangent, polar sub tangent and polar subnormal, curvature and radius of curvature. 6 Classes Marks : 10

[1] Chapters – 8, 11, 14 (Section: 14.7 – 14.15), 15 (Section: 15.1, 15.2).

**Unit II:** Function of one variable: Functions continuous on closed intervals, Differentiability, Darboux's theorem, Rolle's theorem, Lagrange mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Taylor's series, Maclaurin's series. 6 Classes Marks : 10

[2] Chapters – 5 (Section: 3 (theorems 5 – 10)), 6 (Section: 1, 2, 4 – 8).

**Unit III:** Partial derivatives, Euler's theorem on homogeneous function.

[1] Chapter – 12. 3 Classes Marks : 5

**Unit IV:** Function of several variable : Explicit and implicit functions, continuity, partial derivatives, definition of Jacobian, partial derivatives of higher order, Young's and Schwarz's



theorems (without proof), change of variables, Taylor's theorem, extreme values.  
[2] Chapters – 15 (Section: 1, 2, 3, 5, 8, 9, 10), 16 (Section: 2). 8 Classes Marks : 10

**(B) Integral Calculus** 10 Classes Marks : 20

**Unit I:** Evaluation of definite integrals by using properties only, Reduction formula of the integrands  $\sin^n \theta$ ,  $\cos^n \theta$ ,  $\tan^n \theta$  and  $\sin^m \theta \cos^n \theta$ . 6 Classes Marks : 10  
[3] Chapter – 8 (Section: 8.13 – 8.15).

**Unit II:** Rectification of plane curves, surface and volume of solids of revolution.  
[3] Chapters – 11 (Section: 11.1, 11.3), 12 (Section: 12.1). 4 Classes Marks : 10

**(C) Riemann integral** 17 Classes Marks : 25

**Unit I:** Definitions and existence of R-integrals, inequalities of R-integrals, refinement and related theorems, Darboux's theorem, conditions of integrability (both the forms). Integral as a limit of sum (Riemann sums) and its relationship with Darboux's condition of integrability, some applications, integrability of continuous and monotonic functions, functions with finite and infinite number of discontinuities, related examples. 5 Classes Marks : 8  
[2] Chapter – 9 (Section: 1– 4, 6, 7).

**Unit II:** Primitive, fundamental theorem (1<sup>st</sup> & 2<sup>nd</sup>) of integral calculus, first mean value theorem and generalized first mean value theorem, related examples, Integration by parts & change of variable on an integral, second mean value theorem (statement only), particular case of second Mean Value theorem. 4 Classes Marks : 7  
[2] Chapter – 9 (Section: 8 – 12, Th. 23, 13.1(Th. 24)).

**Unit III:** Improper integrals: Introduction and their convergence, Statements of Comparison test, Cauchy's test, Abel's test, Dirichlet's test and their applications. 5 Classes Marks : 6  
[2] Chapter – 11 (Section: 1 – 4.6, 5.2).

**Unit IV:** Beta and Gamma functions and their relationship. 3 Classes Marks : 4  
[3] Chapter – 9 (Section 9.18, 9.19).

**Text Books :**

- [1] Differential Calculus; B C Das and B N Mukherjee, U N Dhur & Sons, Private Ltd, Calcutta. 51st edition.
- [2] Mathematical Analysis; S C Malik & Savita Arora, New Age International (P) Ltd, Third Edition 2007 (reprint) New Delhi.
- [3] Integral Calculus including Differential equations; B C Das & B N Mukherjee, U N Dhur & Sons Pvt. Ltd, Calcutta. 53rd Edition.

**Reference Books :**

1. Introduction to Real Analysis; R G Bartle and D R Sherbert (3<sup>rd</sup> Edition), John Wiley and Sons (Asia) Pvt. Ltd, Singapore, 2002.
2. Principals of Mathematical Analysis; Walter Rudin; Mc Graw Hill International.
3. Mathematical Analysis; Tom M Apostol, Narosa Publishing House.

**Course Code: MM 302**

**Objective :** The students will have a deeper understanding of Co-ordinate geometry and a broader insight towards the analytical aspects of Mathematics.

**(A) Co-ordinate Geometry** **25 Classes** **Marks : 45****(a) 2 - Dimension** **16 Classes** **Marks : 27**

**Unit I:** Transformation of coordinates: Translation of axes, Rotation of axes, Invariants, Removal of xy-term. **3 Classes** **Marks : 5**

[1] Chapter – 5 (Section: 39 – 42).

**Unit II:** Pair of straight lines: Pair of straight lines through origin, Angle and Bisectors of the angle between the lines given by homogeneous equation of 2nd degree, Condition for the general equation of second degree to represent a pair of straight lines, Pair of intersecting straight lines, Pair of parallel straight lines. **6 Classes** **Marks : 12**

[1] Chapter – 6 (Section: 44 – 49).

**Unit III:** General Equation of second degree: Equation to the conic sections, Centre of a conic, Reduction to central and non central conic, Tangent to the conic and condition of tangency, Chord of contact, Pole and Polar, conjugate diameter, **7 Classes** **Marks : 10**

[1] Chapter – 11 (Section: 139 – 141, 143 – 147, 153, 154).

**(b) 3- Dimension** **9 Classes** **Marks : 18**

**Unit I:** Equation of planes, straight lines. **5 Classes** **Marks : 10**

[1] Chapters – 2 (Section: 21 – 31), 3 (Section: 32 – 38).

**Unit II:** Shortest distance between two lines, Skew lines. **4 Classes** **Marks : 8**

[1] Chapter – 3 (Section: 39 – 42), Appendix – 2.

**(B) Algebra I** **25 Classes** **Marks : 35**

**Unit I:** Binary Composition, Definition and Examples of Group, Elementary properties and theorem of Group, Subgroups, Lagrange's theorem, cyclic groups. **12 Classes** **Marks : 20**

[2] Chapters – 1 (Page 12), 2 (Page: 42 – 83, Th. 1 – Th. 29).

**Unit II:** Normal subgroups, Quotient groups, Homomorphisms – Isomorphisms, permutations, cyclic permutations, cycles of a permutation, disjoint permutations, Permutation Group, Cayley's theorem. **13 Classes** **Marks : 15**

[2] Chapters – 1 (Page: 14 – 24), 3 (Page: 91 – 129, Th. 1 – Th. 14).

**Text Books :**

[1] Analytical Geometry and Vector Analysis; B. Das Orient book Company, Calcutta.

[2] A course in Abstract algebra; V.K.Khanna & S.K.Bhambri, Vikas Publishing House Pvt. Ltd. Third Edition, 2008.

**Reference Books :**

1. Text Book of Analytical Geometry of two Dimensions; P.K. Jain & K. Ahmed, Wiley Eastern Ltd., 1994.

2. A Text Book of Analytical Geometry of three Dimension ; P.K. Jain & K. Ahmed, Wiley Eastern Ltd., 1994.

3. Analytical Geometry of two and three dimensions; R.M. Khan, New Central Book Agency Calcutta.

4. Abstract Algebra; Surjit Singh and Quazi Zamiruddin, Vikas Publishing House Pvt. Ltd. Seventh Revised Edition, 1990, Reprint 2003.

5. Abstract Algebra, David S. Dummit, R. M. Foote, John Wiley & Sons (Asia) Pvt. Ltd.

6. Contemporary Abstract Algebra, Joseph A. Gallian, Narosa Publishing House.

**SEMESTER – IV**  
**Course Code: MM 401**

**Objective :** Students will be able to formulate simple programmes for numerical evaluation of computational problems. By Computer Laboratory, they will be exposed to a hand on experience on various Mathematical Software.

**(A) Computer Programming:( C- Programming)** **29 Classes    Marks : 50**

**Unit – I:** Introduction to C-Programming: Basic programming concept, programming approach to solving problem, flowcharts, algorithm, character set, C tokens, keywords and identifiers, constants, variables, data types, declarations of variables, declaration of storage class, assigning values to variables. 6 Classes    Marks : 10

[1] Chapters – 1 (Section: 1.1 – 1.10), 2 (Section: 2.1 – 2.10).

**Unit – II:** Operators and expressions: Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bitwise operators, arithmetic expressions, precedence of arithmetic operators, type conversions in expressions operator precedence and associativity, mathematical functions.

[1] Chapter – 3. 5 Classes    Marks : 7

**Unit – III:** Input output operations: Reading and writing a character, formatted input and formatted output. 4 Classes    Marks : 7

[1] Chapter – 4.

**Unit – IV:** Decision Making and Branching, IF statement, IF ... ELSE statement, nested IF, ELSE IF Ladder, WHILE statement, DO statement, FOR statement, Jumps in Loops.

[1] Chapters – 5, 6. 4 Classes    Marks : 8

**Unit – V:** Arrays: One dimensional arrays, declaration of one dimensional arrays, initialization of one dimensional arrays, two dimensional arrays, initializing two dimensional arrays, multi-dimensional arrays. 6 Classes    Marks : 10

[1] Chapter – 7 (Section: 7.1 – 7.7).

**Unit – VI:** User defined functions: Elements of user defined functions, Definition of functions, return values and their types, function calls, function declaration, category of functions, no arguments and no return values, arguments with return values, no arguments but returns a value, functions that return multiple values. 4 Classes    Marks : 8

[1] Chapter – 9 (Section: 9.1 – 9.14)

**(B) Computer Laboratory (Practical)** **21 Classes    Marks : 30**

**(a) C- Programming** **14 Classes    Marks : 15**

1. Temperature conversion                      2. Area of triangle                      3. Solution of linear equations

- |  |  |                                   |
|--|--|-----------------------------------|
| 4. Simple and compound interest  | 5. Sum of series   | 6. Solution of quadratic equation |
| 7. Checking of Prime numbers   | 8. Sum of sine, cosine and Fibonacci series,             |                                   |
| 9. Mean and standard deviation   | 10. Printing of a matrix                                 |                                   |
| 11. Matrix addition, subtraction, multiplication, transpose            |  |                                   |
| 12. Solution of equation by Newton – Raphson method, Bisection method. |  |                                   |
| 13. Simpson's 1/3 rule   | 14. Sorting of numbers (ascending and descending)        |                                   |
| 15. Computation of salary  | 16. Find the largest number among three numbers          |                                   |
| 17. Finding the factorial of a number                                  | 18. Printing of even and odd numbers in a range.         |                                   |
| 19. Sum of digits of a number  | 20. Printing of numbers in various forms, number tables. |                                   |

**(b) Matlab****7 Classes    Marks : 5**

Evaluation of arithmetic expression, exponential, logarithmic and trigonometric functions, computation of complex numbers, Plotting of curves (Algebraic function, trigonometric function and exponential function), Operations in matrices, Plotting of 3D curves and shapes, Solution of algebraic equation, simultaneous linear equations.

(References [2], [3]).

**Note:** There will be one internal examiner for the practical examination. The duration of the practical examination will be 3 Classes .:

Marks : distribution:    20 Marks : for practical,  
                                   5 Marks : for viva-voce,  
                                   5 Marks : for laboratory note book.

All materials related to examination have to be sent to the controller of examinations by the colleges after the examination is over.

**Text Books :**

- [1] Programming in ANSI C; E Balagurusamy, 4Ed, Tata McGraw-Hill Publishing Company Ltd, New Delhi.  
 [2] Getting started with Mat lab, A quick introduction for scientist and Engineers; Rudrapratap, Oxford university Press.  
 [3] Numerical Methods using Mat lab. J. H. Matheus, H. D. Kink, Prentice Hall India (2005).

**Reference Books :**

1. C- Programming; B.S. Gottfried, Tata McGraw Hill.
2. How to solve it; R.G.Dromey, Prentice Hall of India.

**Course Code: MM 402**

**Objective :** Students will be able to determine the Mathematical know how of linear programming problems of Operations Research and also to solve them using LPP techniques. Students will be exposed to the further analytical aspects of Mathematical concepts.

**(A) Linear Programming (LP)****25 Classes    Marks : 45**

**Unit I:** LP Model formulation & Graphical Method: Introduction, General structure and assumption of LP model, Mathematical formulation of a linear programming problem, Example of LP model Formulation, Feasible solution, basic solution, graphical method for the solution of a linear programming problem, convex set. 7 Classes    Marks : 10

[1] Chapter – 2 (2.1, 2.2, 2.6, 2.8), 3 (3.2 – 3.4).

[2] Chapter – 5 (5.1, 5.2 Th 5.1.1, Th 5.2.2, Th 5.1.3, Th 5.2.4).

**Unit II:** Theory of simplex algorithm and simplex method: Standard form of an LP Problem, Simplex Algorithm, Solutions of unique optimal solution, alternative optimal solution, unbounded solution, artificial variable technique (Charnes' M-technique, two phase method), Degeneracy. 8 Classes    Marks : 15

[1] Chapter – 4 (4.2, 4.3, 4.4, 4.5.2, 4.5.3, 4.6).

**Unit III:** Duality Theory: Concept of duality, Types of primal dual problem, standard form, Rules for constructing the dual from primal, Simple and mixed type problems, Theorem on duality, Fundamental duality theorem(Statement only). 4 Classes    Marks : 8

[2] Chapter –12 (12.1 –12.4, 12.6, 12.7, 12.9 Th12.5.1, Th12.6.1, Th12.6.2, Th12.9.1, Th12.9.2).

**Unit IV:** Transportation Problem: Definition, Transportation Table, Loops in transportation tables and their properties, Determination of an initial basic feasible solution by North West corner method, Matrix minima or least cost method and Vogel approximation method, unbalanced transportation problem, optimization by Modi method. 6 Classes    Marks : 12

[2] Chapter – 13 (13.1 – 13.3, 13.4.10, Th13.1.1, Th13.1.3).

**(B) Analysis II (Multiple Integral)****25 Classes    Marks : 35**

**Unit I:** Fourier series: Preliminary & other theorems, main theorem, series for even function, odd functions, half range series, Interval other than  $[-\pi, \pi]$  7 Classes    Marks : 10

[3] Chapter – 14 (Section: 1 – 4).

**Unit II:** Integration over  $\mathbf{R}^2$  : Line integrals , double integrals, double integrals over a region double integrals over a closed domain, Green's theorem. 9 Classes    Marks : 13

[3] Chapter – 17 (Section: 1.1 – 1.4, 2.1 – 2.8, 3.1 – 3.4, 4.).

**Unit III:** Integration over  $\mathbf{R}^3$  : Surface and surface integral, Stoke's and Gauss's theorems and their applications. 9 Classes    Marks : 12

[3] Chapter – 18 (Section: 3 – 8).

**Text Books :**

[1] Operations Research – Theory and Application; J.K.Sharma, McMillan India Ltd. N. Delhi.

[2] Linear Programming and Theory of Game; P. M. Karak, New Central Book Agency(P) Ltd.

[3] Mathematical Analysis; S C Malik & Savita Arora, New Age International (P)Ltd, Publishers, Edition 2007(reprint) New Delhi.

**Reference Books :**

1. Linear Programming and Game Theory; Dipak Chatterjee, Prentice Hall of India (P) Ltd.

2. Linear Programming; G. Hadley, Narosa Publishing House.

**SEMESTER – V**  
**Course Code: MM 501**

**Objective :** Students will be able to identify the basics of Mathematical Logic and that of the counting principles. Students will be allowed to have insights to more generalized analytical aspects.

**(A) Logic and Combinatorics** **23 Classes    Marks : 35**

**(a) Mathematical Logic** **12 Classes    Marks : 20**

**Unit I:** The Statement Calculus: Introduction, Sentential Connectives, Truth tables, Truth value, Validity, truth function, tautology and related theorems, arithmetic representation of sentential connectives. 6 Classes    Marks : 10

[1] Chapter – 4 (Section: 1, 2, 3).

**Unit II:** Theory of Inference: Consequence, rule of inference and applications. Predicate calculus: symbolizing language. 6 Classes    Marks : 10

[1] Chapter – 4 (Section: 4, 5, 6).

**(b) Combinatorics** **11 Classes    Marks : 15**

**Unit I:** Fundamental Principles of Counting: Binomial Theorem, Pascal and Vander Monde's identity, Multinomial theorem, Ramsey number, Catalan numbers, Stirling and Bell number.

[5] Chapter – 1 (Section: 1.5, 1.6, 1.7, 1.8). 5 Classes    Marks : 7

[6] Chapters – 1, 2.

**Unit II:** The principles of Inclusion-Exclusion: The principles of Inclusion-Exclusion, Generalization of the principles of Inclusion-Exclusion, Pigeon Hole Principle, Derangement, Generating function and introductory examples, 6 Classes    Marks : 8

[5] Chapters – 2 (Section: 2.1 – 2.5), 3 (Section: 3.1, 3.2).

[6] Chapters – 1, 2.

**(B) Analysis III (Complex Analysis)** **27 Classes    Marks : 45**

**Unit I:** Analytic Function: Limit, Continuity and differentiability, Analytic functions, Cauchy-Riemann equations. Necessary and sufficient condition for a function to be analytic, polar form of C.R. equation, Harmonic functions, Construction of analytic function.

[3] Chapter – 5 (Section: 5.2, 5.4, 5.6 – 5.9). 6 Classes    Marks : 10

[4] Chapter – 2 (Section: 12, 14, 15, 17 – 20).

**Unit II:** Complex Integrals : Definite integral, Jordan arc, contour, line integrals, Cauchy's theorem, simply and multiply connected domains, Cauchy's integral formula, Derivatives of analytic function, Morera's theorem, Liouville's theorem. 9 Classes    Marks : 14

[2] Chapters – 4 (Solved Problems 1 – 3), 5 (Solved Problems 1 – 9).

[3] Chapters – 8 (Section: 8.2, 8.3, 8.4, 8.6), 9 (Section: 9.3, 9.4, 9.5.1, 9.5.3, 9.6, 9.7, 9.8).

**Unit III:** Power series: Taylor's series, Laurent's series and their related problems.

[2] Chapter – 6 (Solved Problems 22 – 27). 4 Classes    Marks : 8

**Unit IV: Poles & Residues:** Definition and statement of the related theorems of isolated singularity, removable singularity and poles, calculation of residues, Cauchy's residue theorem,

Contour Integration (Integration round the unit circle, Integration of the type  $\int_{\gamma} f(x)dx$  where no poles on the real axis) 8 Classes Marks : 13

[2] Chapter – 7 (Solved Problems 1 – 17).

[3] Chapters – 10 (Section: 10.2 – 10.4, 10.6, 10.7, 10.9, 10.10), 11 (Section: 11.2, 11.3, 11.4).

### Text Books :

[1] Set Theory and Logic; Robert R. Stoll, Eurasia Publishing House (P) Ltd.

[2] Complex Variables; Murray R. Spiegel: McGraw Hill.

[3] Theory of Functions of a Complex Variable; Shanti Narayan & P.K. Mittal, S. Chand & Company (Revised Edition)

[4] Complex Variable and Application; R.V. Churchill, Mc Graw Hill book Company

[5] Theory and problems of Combinatorics; C. Vasudev, New Age International Publishers

[6] Combinatorics; V.K. Balakrishnan, Schaum's Outlines Series

### Reference Books :

1. A First Course in Probability; Sheldon Ross, Pearson's Publication.

2. Discrete Mathematical Structures; G. Shanker Rao, New International Publishers.

3. Introduction to Logic; Patrick Suppes. East West Pvt Ltd. New Delhi.

4. Combinatorics and Graph Theory, J. M. Harris, J. L. Hirst, M. Mosinghoff, Springer Graduate Text Book.

### Course Code: MM 502

**Objective :** Students will be able to use algebraic structures for explaining geometric concepts. Students will be exposed to the fundamentals of Numbers and their properties .

#### (A) Linear Algebra

**25 Classes Marks : 40**

**Unit I:** System of linear equations, Definitions and examples of Vector space, vector subspace, basis and dimension of a Vector Space.

[1] Chapters – 1, 2.

12 Classes Marks : 20

**Unit II:** Definition of a line, Affine Space, Quotient Space, Linear transformation, Representation of Linear maps by Matrices, Kernel and image of a linear transformation, linear isomorphism, Geometric Ideas and some loose ends.

[1] Chapters – 3, 4.

13 Classes Marks : 20

#### (B) Number Theory

**25 Classes Marks : 40**

**Unit I:** Peano's axiom, Well ordering property of positive integer, Division Algorithm, Theorems, G.C.D., Theorems, Euclidean Algorithm.

[2] Chapter – 1 (Section: 1.1.1, 1.1.15, 1.2.1, 1.2.2).

4 Classes Marks : 7

**Unit II:** Prime numbers, unique factorization theorem (fundamental theorem of arithmetic), Euclid's theorem, greatest integer function[n].

[2] Chapter – 1 (Section: 1.4, 1.5).

4 Classes Marks : 8

**Unit III:** Definition, Basic properties of congruence, complete residue system, reduced residue system. Fermat's little theorem, Euler's theorem, Wilson's theorem, Solution of Congruence, Solutions of the problems of type  $ax+by+c=0$ , Chines Remainder theorem, Solutions of simultaneous equations by using Chines Remainder theorem. 11 Classes Marks : 15  
[2] Chapter – 2 (Section: 2.1 – 2.4, 2.6, 2.7).

**Unit IV:** Arithmetic Function, Euler's function, Division function, Mobius function  $\mu(n)$ , the functions  $\sigma, \sigma_k(n), P(n)=\prod_{d/n} d, \square$  Mobius inversion formula, Properties of arithmetic functions. 6 Classes Marks : 10  
[2] Chapter – 4 (Section: 4.1 – 4.8).

### Text Books :

- [1] Linear Algebra – A Geometric Approach; S. Kumaresan, Prentice Hall of India.  
[2] A first course in Number Theory; K. C. Choudhury, Asian Book Pvt. Ltd.

### Reference Books :

1. Linear algebra; G. Hadley, Narosa Publishing House.
2. Linear Algebra; Kenneth Hoffman & Ray Kunze, Second Edition, Prentice Hall of India.
3. Linear algebra; Third Edition, Schaum's outlines Series.
4. Theory and Problems of Linear Algebra, R.D. Sharma, IK Intl. Pub. House, New Delhi
5. Elementary Number theory; David M. Burton, Universal Book Stall, New Delhi.
6. Number theory; J. Hunter, Oliver and Boyd Ltd.

### Course Code: MM 503

**Objective :** Students will be introduced to the fundamental concepts of Fluid Mechanics and its various applications in Physical Sciences.

**(A) Fluid Mechanics** 50 Classes Marks : 80

**(a) Hydro Dynamics** 21 Classes Marks : 35

**Unit I:** Kinematics: Real and ideal fluid, velocity of a fluid at a point, Eulerian and Lagrangian method, stream lines and path lines, steady and unsteady flows, velocity potential, rotational and irrotational motions, local and particle rate of change, equation of continuity, examples, acceleration of a fluid at a point, General analysis of fluid motion. 9 Classes Marks : 15  
[1] Chapter – 2.

**Unit II:** Equation of Motion: Euler's equation of motion, Bernoullis equation, steady motion under conservative forces, impulsive motion, circulation, Kelvin's circulation theorem. 7 Classes Marks : 12  
[1] Chapter – 3 (Section 3.4 – 3.7, 3.11, 3.12).

**Unit III:** General theory of irrotational motion : Potential flow, deductions from Green's theorem, kinetic energy of a liquid, uniqueness theorems, Kelvin's minimum energy theorem, Mean value of velocity potential. 5 Classes Marks : 8  
[2] Chapter – 6 (Section 6.7 – 6.10, 6.12).

**(b) Hydro Statics** 29 Classes Marks : 45



**Unit I: Fluid Pressure:** Introduction, Fluid Pressure and related theorems, Density and specific gravity, Theorems on fluid pressure under gravity, Rate of variation of pressure, Differential equation of pressure, Condition of equilibrium, Equi-pressure surfaces and lines of force, Curves of equi-pressure and equi-density, Examples. 11 Classes Marks : 17  
[3] Chapters – 1, 2, 3.

**Unit II: Resultant Pressure and Centre of Pressure:** Resultant fluid pressure and related theorems, Centre of pressure, Determination of centre of pressure of parallelogram, triangle, circle under different conditions, Examples, Thrust on curved surfaces, Examples. 11 Classes Marks : 16  
[3] Chapters – 4 (Section: 4.01 – 4.08), 5(Section: 5.01 – 5.15), 6(Section: 6.01 – 6.14).

**Unit III: Equilibrium and Stability of Floating Bodies:** Condition of equilibrium of floating bodies, Examples, Unstable and Neutral equilibrium, Determination of Meta centre, Examples. 7 Classes Marks : 12  
[3] Chapters – 7(Section: 7.01 – 7.15), 9 (Section: 9.01 – 9.07).

### **Text Books :**

- [1] Text Books of Fluid Dynamics; F. Chorlton, CBS Publishers & Distributors.  
[2] Fluid Dynamics; M.D. Raisinghania, S. Chand & Company Ltd.  
[3] A Text Book of Hydrostatics; M.Ray and H.S. Sharma, S. Chand & Company Ltd, New Delhi.

### **Reference Books :**

1. Theoretical Hydrodynamics; Milne Thomson, Macmillan & Co.

### **Course Code: MM 504**

**Objective :** Students will be introduced to the Mathematical background of Mechanics and the corresponding problem solving techniques.

**(A) Mechanics** 29 Classes Marks : 50

**(a) Statics** 15 Classes Marks : 25

**Unit I:** Reduction of a system of forces on a rigid body, Change of base point, Conditions of equilibrium, Point's central axis, wrench, pitch, screw, Invariants, Equations of central axis.  
[1] Chapter - 6(Section 6.4, 6.5, 6.9 - 6.14). 6 Classes Marks : 10

**Unit I:** Virtual work , Common catenary, Stability of equilibrium. 9 Classes Marks : 15  
[1] Chapters – 3(Section: 3.3 - 3.7), 4(Section: 4.1 – 4.7), 5(Section 5.1, 5.2, 5.5).

**(b) Dynamics** 14 Classes Marks : 25

**Unit I:** Motion in a straight line and plane, Radial and transverse velocities and acceleration, angular velocity and angular acceleration, tangential and normal acceleration, Simple Harmonic Motion. 4 Classes Marks : 8  
[2] Chapters – 1 (Section: 1.1 – 1.6), 2 (Section: 2.3).

**Unit II:** Central forces, Motion under resistance. 4 Classes Marks : 7  
[2] Chapters – 8, 9.

**Unit III:** Dynamics of Rigid Body: Moments of inertia, Theorems of parallel and perpendicular axes, Moment of inertia about a line, Moment and product of inertia of a plane lamina, Momental ellipsoid and momental ellipse. D'Alembert's principle and general equations of motion, Motion of the centre of inertia and relative to the centre of inertia.

[3] Chapters – 1 (Section: 1.1 – 1.13), 2 (section: 2.2 – 2.7). 6 Classes Marks : 10

### **(B) Integral Transforms**

**21 Classes Marks : 30**

**Unit I:** Laplace Transforms: Laplace Transforms of some elementary functions, Linearity property, First and second translational or shifting theorem. Change of scale property, Laplace transforms of derivatives Multiplication by powers of t, and related problems.

[4] Chapter – 1. 6 Classes Marks : 8

**Unit II:** The inverse Laplace transforms: Definition, some inverse Laplace transforms properties of inverse Laplace transform, inverse Laplace transforms of derivatives, Multiplication by s, Convolution property, partial fraction method, Complex inversion formula.

[4] Chapter – 2. 6 Classes Marks : 8

**Unit III:** Application to differential equations: Solution of ordinary differential equations with constant coefficients, Solution of ordinary differential equations with variable coefficients, solution of Simultaneous ordinary differential equations, Solution of partial differential equations.

[4] Chapter – 3 (3.1 – 3.8B). 9 Classes Marks : 14

### **Text Books :**

[1] Statics ; Dr Md Motiur Rahman, New Central Book Agency (P) Ltd 2007.

[2] A Text Book on Dynamics; M. Ray & G.C. Sharma, S. Chand and Company Ltd.

[3] Rigid Dynamics; Dr Md Motiur Rahman, New Central Book Agency (P) Ltd 2009.

[4] Laplace and Fourier Transforms; M.D. Raisinghania. S. Chand and Company Ltd.

### **Reference Books :**

1. Dynamic of a Particle and of Rigid Bodies; S.L. Loney, S. Chand and Company Ltd.

2. An Elementary Treatise on Statics; S.L. Loney, Cambridge University Press.

3. A Text Book on Statics; M. Ray. R.D. Manglik, G.C. Sharma. S. Chand and Company Ltd.

## **SEMESTER – VI**

### **Course Code: MM 601**

**Objective :** Students will be exposed to the Topological Structures and the generalization concepts arising out of Real Analysis.

### **(A) Metric Spaces**

**25 Classes Marks : 40**

**Unit I:** Definition and examples of metric spaces, Open spheres and closed spheres, Neighborhoods, Open sets, Equivalent metrics, Interior points, Closed sets, Limit points and isolated points, Closure of a set, Boundary points, Distance between sets and diameter of a set, Subspace of metric space, Product metric spaces (definition only), Bases.

[1] Chapter – 2 (2.1 – 2.12, 2.13.1, 2.14). 9 Classes Marks : 15

**Unit II:** Convergent sequences, Cauchy sequences, complete & separable spaces, dense sets.

[1] Chapter – 3 (3.1 – 3.4). 6 Classes Marks : 12

**Unit III:** Continuous functions: Definition and characterizations, Extension theorem, Uniform continuity (definition only), Homeomorphism. 6 Classes Marks : 8

[1] Chapter – 4 (4.1, 4.2, 4.3.1, 4.3.2, 4.4).

**Unit IV:** Compact spaces and compact sets, Sequential compactness.

[1] Chapter – 5 (Section 5.1, 5.2.1 – 5.2.4). 4 Classes Marks : 5

### **(B) Statistics**

**25 Classes Marks : 40**

**Unit I:** Probability: Basic terminology, Mathematical probability, Statistical probability, Axiomatic approach to probability. Some theorems on probability, Conditional probability, Multiplication theorem of probability, Independent events, Multiplication theorem of probability for independent events, Extension of multiplication theorem of probability, Baye's theorem.

[2] Chapters – 3 (Section: 3.1 – 3.5, 3.8 – 3.14), 4 (Section: 4.2). 7 Classes Marks : 10

**Unit II:** Measures of Dispersion: Standard deviation, Quartile deviation, co-efficient of variation. 3 Classes Marks : 5

[2] Chapter – 2 (2.12, 2.13, 2.14).

**Unit IV:** Correlation and regression: Karl Pearson's co-efficient of correlation, Spearman Rank correlation co-efficient, regression lines and equation. 4 Classes Marks : 7

[2] Chapters – 10 (10.1 - 10.4, 10.7), 11 (11.1 -11.2.3).

**Unit V:** Theoretical Probability Distribution: Binomial, Poisson and Normal Distribution and their applications to simple problems. 7 Classes Marks : 12

[2] Chapters – 8 (8.1 – 8.4.1, 8.5, 8.5.2), 9 (9.1 – 9.2.2).

**Unit VI:** Time series analysis: Different components of time series, analysis of trends (Least Square Method and Moving Average Method) 4 Classes Marks : 6

[3] Chapter – 2 (Section: 2.1 – 2.4.4).

### **Text Books :**

[1] Metric Space; P.K.Jain & K. Ahmad, Narosa Publishing House, Second Edition, 2010.

[2] Fundamentals of Mathematical Statistics; V.K. Kapoor, S.C.Gupta, Sultan Chand & Sons.

[3] Fundamentals of Applied Statistics; V.K. Kapoor, S. C. Gupta, Sultan Chand & Sons TMGH.

### **Reference Books :**

1. Principles of Mathematical Analysis, Walter Rudin, McGraw Hill International.

2. Introduction to Topology and Modern Analysis; G.F. Simmon, Tata Mc Graw Hill.

**Objective :** The students will be able to identify the relations between Mathematics and Theoretical Computer Science. Students will be introduced to the fundamentals of Graph Theory and different representations of a Graph for practical applications.

**(A) Discrete Mathematics**

**29 Classes    Marks : 45**

**Unit I:** Recurrence Relations: Formulation as Recurrence Relations, Solutions of Recurrence Relations, Solutions of homogeneous and non homogeneous linear Recurrence Relations, Generating Functions. 7 Classes    Marks : 10

[1] Chapter – 6 (Section: 6.1 – 6.6).

**Unit II:** Lattice: Definition and examples, Hasse diagram, Properties of Lattice, Lattice as an Algebraic systems, Sub lattice and lattice isomorphism, Special Classes : of lattice, Distributive lattice and Boolean algebras. 7 Classes    Marks : 10

[1] Chapter – 8 (Section: 8.1 – 8.6).

**Unit III:** Boolean Algebra: Boolean algebra as lattice and an algebraic system, Properties of Boolean algebra, Sub-algebra and homomorphism of Boolean algebra, Boolean expressions, sum-of-products canonical form, values of Boolean expression & Boolean functions, representation by Karnaugh Maps, minimization of Boolean functions using Karnaugh Maps.

[1] Chapter – 9 (Section: 9.1 – 9.4, 9.5.1 – 9.5.3, 9.6.1, 9.6.2). 8 Classes    Marks : 15

[2] Chapter – 3 (Section: 3.1 – 3.3, 9.5).

**Unit IV:** Logic Gates, Switching circuits & Logic circuits: Introduction, Gates and Boolean algebra, Applications, Special Sequences, Switching circuits, simplification of circuits, bridge circuits, logic circuits, multiple output logic circuit, minimization. 7 Classes    Marks : 10

[2] Chapter – 4 (Section: 4.1 – 4.4, 4.6, 4.7).

[3] Chapter – 6 (Section: 6.1 – 6.4).

**(B) Graph Theory**

**21 Classes    Marks : 35**

**Unit I:** Graph Theory: Definition, Directed and undirected graphs, basic terminologies, finite and infinite graph, incidence and degree of vertex, isolated and pendent vertices, null graph, Handshaking theorem, types of graphs, sub graphs, graphs isomorphism, operations of graphs, connected graph, disconnected graphs and components.

[4] Chapter – 1 (Section: 1.1, 1.3, 1.4, 1.5), 2 (Section: 2.1, 2.2, 2.5, 2.7).

[5] Chapter – 1 (Section: 1.1 – 1.10, 1.12). 12 Classes    Marks : 20

**Unit II:** Walk, path and circuits, Eulerian graphs, Hamiltonian graphs, Dirac's theorem, Ore's, theorem, Konigsberg's Bridge problem, Representation of graphs, matrix representation of graph, adjacency matrix, Incidence matrix, Linked representation of graphs.

[4] Chapter – 2 (Section: 2.4, 2.6, 2.8, 2.9).

[5] Chapter – 1 (Section: 1.13, 1.14, 1.16 – 1.18, 1.21, 1.22). 9 Classes    Marks : 15

**Text Books :**

[1] Discrete Mathematics; N. Chandrasekaran & M. Umaparvathi Prentice Hall of India, New Delhi, 2010.

[2] Boolean Algebra and swithing circuits; Schaum outline Series, Tata McGraw Hill Pub-2004.

[3] Discrete Mathematical Structures; G. Shanker Rao, New Age International Publishers.

[4] Graph Theory with application to Engineering and computer Science; Narasingh Deo, Prentice Hall of India, New Delhi, 2006.

[5] Graph Theory with Application; C. Vasudev, New Age International Publishers.

### Reference Books :

1. Discrete Mathematics; Schaum outline Series, Tata Mc graw Hill Pub – 1999.
2. Discrete Mathematics; Swapan Kumar Sarkar, S. Chand & company.

### Course Code: MM 603

**Objective :** Students will be able to identify the characteristics of Abstract Algebraic Structures and also can have ideas on the basics of partial differential equations.

### (A) Algebra II 25 Classes    Marks : 40

**Unit I:** Automorphism of groups, Inner automorphism, external and internal direct products.

[1] Chapters – 4 (Page: 144 – 153, 203 – 209). 7 Classes    Marks : 13

**Unit II:** Definition and examples of Ring, Special kinds of rings, sub rings and ideals, sum and product of ideals. 9 Classes    Marks : 13

[1] Chapter – 7 (Page: 255 – 265, 276 – 287).

**Unit III:** Quotient Ring, Homomorphism of ring, Imbedding of rings, Maximal and Prime ideal,

[1] Chapter – 8 (Page: 290 – 311, 314 – 323). 9 Classes    Marks : 14

### (B) Partial Differential Equation 25 Classes    Marks : 40

**Unit I:** Introduction, Origins of First order PDE, Cauchy Problem for First order equations, Linear equations of first order, Lagrange equation, Integral Surface passing through a given curve, surface orthogonal to a given system of surfaces. 13 Classes    Marks : 20

[2] Chapter – 2 (1 – 6).

**Unit II:** Nonlinear PDE of first order, Cauchy Method of characteristics, Compatible systems of first order equation, Charpit's Method, special types of first order equations, solution satisfying given conditions, Jacobi's Method. 12 Classes    Marks : 20

[2] Chapter – 2 (7 – 13).

### Text Books :

- [1] A course in Abstract algebra; V.K.Khanna & S.K.Bhambri, Vikas Publishing House Pvt. Ltd. Third Edition, 2008.
- [2] Elements of Partial Differential Equations; I. N. Sneddon, McGraw Hill International.

### Reference Books :

1. Advance Differential Equation; M D Raisinghania, S Chand Company.
2. Introduction to Partial Differential Equation; K. Sankara Rao, Prentice-Hall of India
3. Abstract Algebra, Surjit Singh and Quazi Zamiruddin, Vikas Publishing House Pvt. Ltd., Seventh Revised Edition, 1990, Reprint 2003.
4. Contemporary Abstract Algebra, Joseph A. Gallian, Narosa Publishing House.
5. Algebra, Michael Artin, Prentic- Hall of India.

**Course Code: MM 604**  
**(Any one of the following Groups)**

**Group (A): Financial Mathematics and Operations Research      50 Classes    Marks : 80**

**Objective :** Students will be introduced to the application of Mathematical principles to the problems of Financial Mathematics and Operations Research.

**(a) Financial Mathematics      29 Classes    Marks : 45**

**Unit I:** Mathematical models in Economics: Introduction, A model of the market, Market equilibrium, Excise tax, The element of finance: Interest and capital growth, Income generation, the interval of Compounding.      4 Classes    Marks : 5

[1] Chapters – 1 (1.1 – 1.4), 4.

**Unit II:** The cobweb model: How stable is market equilibrium? An example, the general linear case, Economic Interpretation.      4 Classes    Marks : 5

[1] Chapter – 5.

**Unit III:** Introduction to optimization: Profit maximization, Critical points, optimization in an interval.      4 Classes    Marks : 5

[1] Chapter – 8 (8.1 – 8.3).

**Unit IV:** The derivatives in Economics: Elasticity of demand, profit maximization, Competition versus monopoly, The efficient Small firm, start up and breakeven point.

[1] Chapters – 9, 10.

6 Classes    Marks : 10

**Unit V:** Optimization in two variables: Profit maximization, How prices are related to quantities? Critical point, Maxima, Minima and Saddle points clarification of critical points.

[1] Chapter – 13.

6 Classes    Marks : 10

**Unit VI:** Linear Equations: How to make money with matrices, A two- industry economy. The input output model: An economy with many industries, the technology matrix.

[1] Chapters – 15 (15.3), 16 (16.1), 19 (19.1, 19.2).

5 Classes    Marks : 10

**(b) Operations Research(OR)      21 Classes    Marks : 35**

**Unit I:** Introduction, definition, operation research and decision making, scope of OR, Limitations of OR.      2 Classes    Marks : 5

[2] Chapter – 1 (Section: 1.1, 1.2, 1.7, 1.8, 1.9, 1.23).

**Unit II:** Assignment Problem: Definition, Mathematical Representation of Assignment Model, Comparison with Transportation Problem, Formulation and Solution of Assignment Model.

[2] Chapter – 4 (Section: 4.1 - 4.6).

6 Classes    Marks : 10

**Unit III:** Dynamic Programming: Introduction, Distinguishing Characteristic of Dynamic Programming, Dynamic Programming Approach, Solution of LPP by Dynamic Programming, Application of Dynamic Programming.      6 Classes    Marks : 10

[2] Chapter – 7 (Section: 7.1 – 7.3, 7.7, 7.8).

**Unit IV:** Integer Linear Programming: Introduction, Types of Integer Programming Problems, Enumeration and Cutting Plane Method, Gomory's all integer cutting Plane method: Method for constructing additional constraint (Cut), Steps of Gomory's all integer programming algorithm.

[3] Chapter – 7 (Section: 7.1 – 7.4).

7 Classes    Marks : 10

**Text Books :**

- [1] Mathematics for economics and finance; M. Anthony and N. Biggs, Cambridge Univ.  
 [2] Operation Research; P. K. Gupta, D. S. Hira, S. Chand & Company Ltd.  
 [3] Operation Research – Theory and Application; J. K. Sharma, Mc Millan, New Delhi.

**Reference Books :**

1. Mathematics for Business, Finance and Economics; M. Wilkes, Intl Thomson Business Press.  
 2. Mathematics with application for the management, life and social sciences; Howard Auton, Bernard Kolmar, H.B. Jovanovich publishers.

**Group (B): Space dynamics and Relativity****50 Classes    Marks : 80**

**Objective :** Students will be introduced to the application of Mathematical principles to the problems of Space Dynamics and Relativity..

**(a) Space Dynamics****25 Classes    Marks : 40**

**Unit I:** Spherical Trigonometry: Spherical triangles and its properties, the sine-cosine formulae, four parts formula. 8 Classes    Marks : 13

- [1] Chapter – 1 (Section: 1 – 8).

**Unit II:** Coordinate systems: Position on the earth surface, horizontal system, equatorial system, ecliptic system, elements of the orbit in space, rectangular coordinate system, orbital plane coordinate system, transformation of systems. 10 Classes    Marks : 17

- [2] Chapter – 2 (Section: 2 – 9).

**Unit III:** Gravitation, the one and two body problems, elliptic motion, attraction of irregular bodies, rotational distortion, coordinates the orbits in space. 7 Classes    Marks : 10

- [3] Chapter – 1 (Section: 1.21, 1.3 – 1.5), 2 (Section: 2.1 – 2.3), 3 (Section: 3.1, 3.2).

**(b) Relativity****25 Classes    Marks : 40**

**Unit I:** Special Theory: The fundamental postulates, Lorentz transformation, equations, composition of velocities in terms of rapidity. Lorentz transformation as rotation, consequences of Lorentz transformation equation viz. Lorentz-Fitzgerald contraction, Time dilation, the clock paradox, space like and time like integrals. 12 Classes    Marks : 20

**Unit II:** Relativistic mechanics : The relativistic conception of mass increasing with velocity, transformation laws of mass, velocity, acceleration, density, momentum, energy and force. The mass energy relation and simple examples. 13 Classes    Marks : 20

**Text Books :**

- [1] Text book of Astronomy; Smart, Oxford University Press.  
 [2] The foundations of Astro dynamics; A. E. Roy, Mcmillan Co., New York.  
 [3] An Introduction to Celestial Mechanics; T. E. Sterne, Inter-Science Pub.  
 [4] The Mathematical Theory of Relativity; A.S. Edington.  
 [5] The Theory of Relativity; P.M. Ray.

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