

UNDERGRADUATE CURRICULUM FRAMEWORK -2022
BASED ON
NATIONAL EDUCATION POLICY 2020

PROPOSED SYLLABUS AND SCHEME OF EXAMINATION
FOR
B.Sc. (Hons.) / B.A. (Hons.) / B.Com (Hons.) Mathematics

Submitted to
Dhanamanjuri University, Manipur

August 2022

COURSE STRUCTURE FOR FOUR-YEAR UNDERGRADUATE PROGRAMMES

Semester wise Details of B.Sc. (Hons.) /B.A(Hons.) Mathematics Course & 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	CMA101: Calculus CMA102: Algebra CMA103: Analytic Geometry		GMA(select any one) GMA-101:Calculus GMA-102: Analytic Geometry GMA-103:Probability Theory and Statistics	English Communication	SECMA-1(select any one) SECMA-101:Linear Programming and its application SECMA-102:Graph Theory		VAC-1	
L+T/P	3+1=4,3+1=4,3+1=4		3+1=4	2	2		2	22
II	CMA204: Real Analysis CMA205: Differential Equations-1 CMA206: Vector analysis and Solid Geometry		GMA(select any one) GMA-203: Vector Analysis and Solid Geometry GMA-204:Differential Equation GMA-205:Linear Programming and game theory	Environmental Science	SECMA-2(select any one) SECMA-203: Transportation and Game Theory SECMA-204:Laplace Transform		VAC-2	
L+T/P	3+1=4,3+1=4,3+1=4		3+1=4	2	2		2	22
							Total	44
	EXIT OPTION WITH BACHELOR'S CERTIFICATE IN A DISCIPLINE ON COMPLETION OF COURSES EQUAL TO A MINIMUM OF 44 CREDITS							
III	CMA-307: Theory of Real		GMA(select any one) GMA-305:Transpor		SECMA-3(choose any one)		VAC-3	

	Functions CMA308:Part ial Differential Equations CMA309: Group Theory-I		tation and Network problems GMA- 306:Algebra		1. LaTe X and HTM L Or Maple/LA TEX or Laplace transform			
L+T/P	3+1=4,3+1=4 ,3+1=4		3+1=4		2		2	22
IV	CMA410: Riemann Integration and Series of Functions CMA411: Mechanics CMA 412:Numeric al Analysis		GMA(select any one) GMA- 407:Inventor y systems and Marketing management GMA- 408:Group Theory		SECMA- 4(Choose any one) Computer Algebra system and related software or Network analysis and project Managem ent		VAC-4	
L+T/P	3+1=4,3+1=4		4		2		2	22
							Total	88
EXIT OPTION WITH BACHELOR'S DIPLOMA IN A DISCIPLINE ON COMPLETION OF COURSES EQUAL TO A MINIMUM OF 96 CREDITS								
V	CMAT511: Multivariate Calculus CMA512: Ring Theory and Linear Algebra-I CMA513:C programmin g	DSE-1 MATLAB	GMA(select any one) GMA- 509:Linear programming and applications GMA- 510:Graph Theory		SECMA-5			
L+T/P	3+1=4, 3+1=4.3+1=4	3+1=4	3+1=4,		2			22
VI	CMA614: Ring Theory and Linear Algebra-II CMA615:	DSE-2	GMA(select any one) GMA- 611:Cryptogr aphy and		SECMA-6			

	Group Theory-II MATH616:M ATLAB		Network Security GMA-612: Probability Theory and Statistics					
L+T/P	3+1=4, 3+1=4,3+1=4	3+1=4	3+1=4		2		2	22
							Total	132
	EXIT OPTION WITH BACHELOR'S DEGREE IN A DISCIPLINE ON COMPLETION OF COURSES EQUAL TO A MINIMUM OF 140 CREDITS							
VII	CMA717: Topology	DSE-3 DSE-4 DSE-5				Acade mic projec t/Diss ertatio n/Fiel d work		
L+T/P	3+1=4,	3+1=4, 3+1=4, 3+1=4				<u>6</u>		
VIII	CMA817: Complex Analysis	DSE-6 DSE-7 DSE-8				Acade mic projec t/Diss ertatio n/Fiel d work		
L+T/P	3+1=4,	3+1=4, 3+1=4, 3+1=4				<u>6</u>		
						Total		176
	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.

List of Discipline Specific Elective (DSE) Courses:

DSE-1 (including practical): Any one of the following

(i). C++ Programming for Mathematics

(ii). Probability and Statistics

DSE-2: Any one of the following

(i). Number Theory

(ii). Logic and Boolean Algebra

DSE-3: Any one of the following

(i). Mathematical programming and its applications

(ii). Differential Geometry and Tensor

DSE-4: Any one of the following

(i). Mathematical Modelling and Graph Theory

(ii). Mechanics

DSE-5: Any one of the following

(i)Biomathematics

(ii). Introduction to Coding Theory

DSE-6: Any one of the following

(i). Cryptography and Network Security

(ii). Inventory Systems and Marketing Management

Skill Enhancement Course (SEC)

Choices for SEC 1 (choose one)

SMA-101:

SMA-102: Graph Theory

Choices for SEC 2 (choose one)

SMA-203: Linear programming and application

SMA-204: Laplace Transform

Choices for SEC3 (choose one)

1. LaTeX and HTML or MATLAB

2. Transportation and Game theory

Choices for SEC4 (choose one)

1. Computer Algebra Systems and Related Software
2. Network Analysis and Project Management

Choices for SEC 5 (choose one)

Choices for SEC 6 (choose one)

Course Wise Content Details for B.Sc. (Hons.) Math/B.A.(Hons)Math

FIRST YEAR MATHEMATICS

Discipline Specific Course (DSC)

CMA 101: SEMESTER-I

[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,Ch 9,Ch 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.

CMA 102: SEMESTER-I
[ALGEBRA]

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 theory of equations, complex numbers, number theory and matrices to understand their linkage to the real-world problems.

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

- i) Apply Euclid's algorithm and backwards substitution to find greatest common divisor.
- ii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
- iii) Find eigenvalues and corresponding eigenvectors for a square matrix.

Course Contents:

Unit -I: De Moivre's theorem and its application (30 marks) (Lectures:18)

Polar representation of complex numbers, The n th roots of unity, De Moivre's theorem for integer and rational indices and its applications. Expansion of $\sin x$ and $\cos x$ in powers of x , Exponential values for circular functions, Complex argument, Gregory's series, Hyperbolic functions, Summation of series including C+iS method.

Unit-II: Inequalities and Theory of Equations (40 marks) (Lectures; 20)

Arithmetic mean, Geometric mean, Harmonic mean, mean of the m^{th} powers, Cauchy-Schwartz inequality, Holder's inequality, Minkowski's inequality.

Polynomials, Fundamental theorem of Algebra (Statement only). properties of equations, Descartes rule of signs, Relations between the roots and the coefficients of polynomial equations, Symmetric functions of roots, Reciprocal equations, Transformation of the cubic equation to standard form, Solution of cubic equations by Cardan's method and of biquadratic equation by Ferrari's method.

Unit -III: Theory of Matrices and its Applications (30 marks) (Lectures: 18)

Hermitian and Skew- Hermitian matrices, inverse of a square matrix, Rank of a matrix, Nullity of a matrix, Reduction to Echelon forms, Linear independence and dependence of vectors (column and row matrices), Row rank, column rank, and equivalence of column

and row ranks, Eigen values, Eigen vectors, and characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding inverse of a matrix.

Books Recommended:

- 1 .Das and Mukherjee, Higher trigonometry, U.N. Dhur and sons pvt. Ltd. Kolkata
1. Chandrika Prasad- Algebra and Theory of Equations, Pothisala Private Limited.
2. Shanti Narayan and P.K. Mittal- A text Book of Matrices, S. Chand and Co. New Delh

References:

1. Andreescu, Titu & Andrica Dorin. (2014). Complex Numbers from A to...Z. (2nd ed.). Birkhäuser.
2. Dickson, Leonard Eugene (2009). First Course in The Theory of Equations. The Project Gutenberg EBook (<http://www.gutenberg.org/ebooks/29785>)
3. Goodaire, Edgar G., & Parmenter, Michael M. (2005). Discrete Mathematics with Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint 2015.

CMA103: 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 (30 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. general equation of second degree in two variables, 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: (30 marks)

(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:

1. 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.

Skill Enhancement Paper SEC-1:

SECMA-101: Semester-1

[Linear Programming and Applications]

Total Marks: 50 Workload: 2 Lectures, (per week) Credits: 2 Duration: 14 Weeks (28 Hrs.) Examination: 2 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:

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.

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.

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

SECMA-102(SEMESTER-I)

[Graph Theory]

Total Marks: 50 Workload: 2 Lectures, (per week) Credits: 2 Duration: 14 Weeks (28 Hrs.) Examination: 2 Hrs.

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

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

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

Course Contents:

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, types of graphs, null graph, subgraph, operations of graph, Connected graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles

Representation of graphs, Trees, Spanning tree, binary tree, Matrix representation, , the adjacency matrix, weighted graph, travelling salesman's problem, konigsberg's bridge problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm, minimal spanning tree, transport network.

Books Recommended

C. Vasudev, Graph Theory with Application, New age international (p) Limited

References:

1. B.A. Davey and H.A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

CMA-204: SEMESTER-II

[Real Analysis]

Total Marks: 100 Workload:

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

Course Objectives:

The course will develop a deep and rigorous understanding of real line and of defining terms to prove the results about convergence and divergence of sequences and series of real numbers. These concepts have wide range of applications to the real-world problems.

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

- i) Understand many properties of the real line.

- ii) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
- iii) Apply the ratio test, root test, comparison tests for convergence and absolute convergence of an infinite series of real numbers.

Course Contents:

Unit-I: Properties of \mathbb{R} (30 marks)

(Lectures: 18)

Finite and infinite sets, definition and examples of countable and uncountable sets, bounded and unbounded sets, supremum and infimum of a non-empty set. The order completeness property in \mathbb{R} (statement only), Archimedean property of \mathbb{R} , Definition and types of Intervals, Neighbourhood of a point, Limit point of a set, Bolzano-Weierstrass theorem on set, Open and closed sets, their related properties. Concept of Compactness, Heine Borel Theorem.

Unit-II: Sequence in \mathbb{R} (35 marks)

(Lectures: 18)

Real Sequence, Bounded, unbounded and oscillatory sequence, limit point of a sequence, Bolzano-Weierstrass theorem of sequence, Limit superior and limit inferior of a sequence, related properties, Cauchy sequence, Cauchy convergence criterion, monotonic sequence and their properties, subsequence, nested interval theorem,

Unit-III: Series in \mathbb{R} (35 marks)

(Lectures: 20)

Infinite series, a necessary condition for convergence of infinite series, convergence and divergence of geometric series and p -series, Comparison test, limit comparison test, D'Alembert's ratio test, Cauchy's root test, alternating series, Definition and examples of absolute and conditional convergence, Leibnitz's test

Books Recommended

1. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International (P) Limited.
2. Shanti Narayan and M.D. Raisinghania, Elements of Real Analysis, S. Chand & Company

References:

1. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000.
2. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.

45. K.C. Maity & R.K. Ghosh, An Introduction to Analysis, Differential Calculus Part-I ,

CMA205: SEMESTER-II

[Differential Equations-1]

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:

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. Raisinghania- 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).

CMA-206: 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, Gauss's Theorem, Green's Theorem, Stoke's Theorem and related problems.

Unit 2: Sphere, Cone and Cylinder: (40 marks)

(Lectures: 20)

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

Unit 3: Conicoid: (30 marks)

(Lectures: 18)

Central Conicoids, Ellipsoid, The hyperboloid of one sheet, the hyperboloid of two sheets, , Intersection of a line with a Conicoid, condition for tangent planes, Tangent lines and tangent plane at a point, Director sphere, Enveloping Cone and Cylinder, locus of chords bisected at a given point, locus of mid-points of a system of parallel chords, Conjugate diameters, : Plane section of Conicoids, Paraboloids, Elliptic paraboloid, Hyperbolic paraboloid, Equations and their properties.

Recommended Books:

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

Reference Books:

3. Shanti Narayan and P K Mittal, Analytical Solid Geometry, S Chand & Co.
4. S L Loney, Co-Ordinate Geometry of Three Dimensions, Macmillan and Co.
5. R J T Bell, An Elementary Treatise on Co-Ordinate Geometry of Three Dimensions, Macmillan and Co.
6. Shanti Narayan, Dr. P.K. Mittal, Analytical Solid Geometry, S. Chand & Company Ltd.

SECMA-203(SEMESTER-II)

[Transportation and Game Theory]

Total Marks: 50 Workload: 2 Lectures, (per week) Credits: 2 Duration: 14 Weeks (28 Hrs.) Examination: 2 Hrs.

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

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

- iii) Solve Transportation models of real life situations.
- iv) Solve Assignment models of real life situations.
- v) Solve Game Theory models of real life situations.

Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

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

Books Recommended:

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

Reference Books:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
2. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 200
4. D.c Sanyal, K.Das, Linear Programming and Game Theory

SECMA-204 :(SEMESTER-I)

[Laplace Transform]

Total Marks: 50 Workload: 2 Lectures, (per week) Credits: 2: Duration: 14 Weeks (28 Hrs.) Examination: 2 Hrs.

Definition of Laplace Transformations, Kernel of the Integral transformation, Existence of Laplace Transformation Transformations of some elementary functions such as $f(t) = e^{-at}$, $\cos at$, $\sin at$, $\cosh at$, $\sinh at$, t^n etc. Properties of Laplace Transformation, First Translation or Shifting Theorem, Second Translation or Heaviside's shifting Theorem, Differentiation property, Change of scale property with examples, Laplace Transformation of Derivatives of order n with Theorems, Inverse Laplace transformations, Theorems on multiplication by s and $1/s$, First and Second Shifting properties with examples, Convolution Theorem, Properties of Convolution, Examples and Application of Laplace Transformation in solving PDE.

Books recommended:

J.k.Goyal, K.P.Gupta (2019). Integral Transforms (28th ed.), Pragati Prakashan, Meerut

