SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS AND SCIENCE
(Autonomous)
COIMBATORE – 641 020

DEPARTMENT OF MATHEMATICS

Under Choice Based Credit System (CBCS)
2020 – 2021 Onwards

B.Sc. MATHEMATICS

SRI RAMAKRISHNA MISSION VIDYALAYA COLLEGE OF ARTS AND SCIENCE
COIMBATORE – 20.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO1: Demonstrate ability to adapt to a rapidly changing environment by having learned and applied new skills and new competencies.

PEO2: Solve the complex problems in the field of Mathematics with an understanding of the Societal, legal and cultural impacts of the solution.

PEO3: Progressively adopt and learn continuously through ICT module.

PEO4: Form a part of member in a team with right attitudes

PROGRAMME OUTCOMES (PO)

PO1: Provide platforms to learn Physics, Chemistry and Mathematics theories, concepts and practical skills with appropriate knowledge.

PO2: Assimilate the knowledge on understanding the nature and ability to link the facts to observe and discover scientific laws.

PO3: Create new skills and tools to obtain possible solutions in comprehension of the physical science problems incorporating mathematical modeling and theories.

PO4: Enhancement of critical thinking, problem solving skills, digitally efficient and making effective working professionals to suit for science, technical and research field.

PO5: Making best suitable personalities to serve for nation and society with ethical awareness and reasoning ability.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Graduates will be exposed to a wide range of modern mathematical ideas from pure and applied mathematics.

PSO2: Students will understand the mathematical and technical knowledge that provides a solid foundation for extended learning.

PSO3: Students will obtain mathematical and quantitative skills to solve the real life problems.

PSO4: Understanding the concepts of core and allied areas of mathematics that provides a strong foundation for the systematic development of learning process.

PSO5: Students will identify, formulate and analyze mathematical problems in reaching sustained conclusions.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core1: Classical Algebra**	**Course Code**	**:**	**20UMA1C01**
Year	**:**	**First Year**	**Semester**	**:**	**I**
Hours/Week	**:**	**6**	**Credits**	**:**	**5**

Course Objectives

1. To get the knowledge of convergence and divergence of a series.
2. To know how to find the summation of series.
3. To understand the nature of the roots of the algebraic equations.

Course Outcomes (CO)

CO1	Finding the roots of polynomial functions.	K1
CO2	Classifying convergence and divergence of series.	K2
CO3	Applying the Binomial theorem, Exponential theorem, logarithmic theorem to find the summation of series.	K3
CO4	Analyzing the nature of the roots of the equations.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S
CO3	S	S	S	M	M		S	M	S	M	M
CO4	S	S	S	M	L		M	S	M	S	L

S – Strong; M – Medium; L - Low

Unit -I

CONVERGENCY AND DIVERGENCY OF SERIES: Infinite series – **Geometric series*** – some general theorems concerning infinite series- The series is convergent when k is greater than unity and divergent when k equal to or less than unity – Cauchy's condensation test- D'Alembert's Ratio test – Cauchy's Root test – Raabe's test.

Chapter 2: Sections 8 - 19

Unit-II

BINOMIAL THEOREM: Binomial theorem – Positive integral index –**The greatest term in the expansion of $(1 + x)^n$*** - Summation of various series involving binomial coefficients - Vandermonde's theorem – Binomial theorem for a rational index – Some important particular cases of Binomial expansion – The method of splitting functions into partial fractions - Application of the binomial theorem to the summation of series.

Chapter 3: Sections 1 – 10

Unit –III

EXPONENTIAL AND LOGARITHMIC SERIES: The Exponential theorem – Summation - The Logarithmic series – Euler's constant – **summation*** – The application of the exponential and logarithmic series to limits and approximations.

Chapter 4 Sections:1 - 11

Unit –IV

THEORY OF EQUATIONS: Roots of an equation* – Relations between the roots and co- efficient of equations – Symmetric functions of the roots – Transformation of equations – Reciprocal equations

Chapter 6.Sections:1 to 12, 15 & 16

Unit -V

THEORY OF EQUATIONS: To increase or decrease the roots of a given equation by a given quantity – Removal of terms – Descartes' Rule of signs - **Roll's theorem*** – Multiple roots – Strum's theorem - Horner's method of approximation.

Chapter 6 Sections: 17, 19, 24 –27 and 30. (Omit section 30.1)

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

Manickavachagam Pillay, T. Natarajan, K. S. Ganapathy, *Algebra, Vol. I,* S. Viswanathan Pvt. LTD, 2007.

Books for reference:

1. P.N.Chatterji, *Algebra,*RajhansPrakasham Mandir, Meerut (U.P), 1994.
2. M.L.Khanna, *Algebra,* Jai Prakash Nath& Co, Meerut (U.P), 1991.
3. A.R.Vasishtha and R.K.Gupta,Krishna PrakashamMandir, Meerut (U.P), 1990-91.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core2: Calculus**	**Course Code**	**:**	**20UMA1C02**
Year	**:**	**First Year**	**Semester**	**:**	**I**
Hours/Week	**:**	**6**	**Credits**	**:**	**5**

Course Objectives

1. To give basic knowledge about Mathematical concepts in calculus.
2. To evaluate double and triple integrals.
3. To learn different methods of integration, Beta and Gamma functions which forms the basis for higher studies.

Course Outcomes (CO)

CO1	Remembering the formulas in differentiation and integration.	K1
CO2	Interpret the definite integral geometrically as the area under a curve.	K2 & K3
CO3	Apply the concept of definite integral to solve various kinds of problems.	K3
CO4	Analyze the values of the derivative at a point algebraically.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	L		M	S	M	S	M
CO2	S	S	S	S	M		S	S	S	S	M
CO3	S	S	S	S	M		S	S	M	S	S
CO4	S	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit-I

CURVATURE OF PLANE CURVES: Curvature – Circle, radius and centre of curvature – Cartesian formula for the radius of curvature – The coordinates of the centre of curvature - Evolute and involute – **Radius of curvature when the curve is given in polar co-ordinates*** - Pedal equation of a curve – finding asymptotes of rational algebraic curves.

Chapter X: Sections 2.1 to 2.7, Chapter XI: Sections 1 to 4

Unit-II

INTEGRATION: Integration of rational algebraic functions - Integration of irrational functions – **Properties of definite integrals***.

Chapter 1: Sections 7 to 11

Unit-III

MULTIPLE INTEGRALS: Evaluation of the double integral – Change of order of integration – Double integral in polar co-ordinates – Triple integrals – Applications of Multiple integrals – Volumes of solids of revolution – Volumes of solids as double integrals– **Volume as a triple integral***.

Chapter 5: Sections 1 to6.3

UNIT– IV

IMPROPER INTEGRALS: Beta and Gamma functions – Recurrence formula for Gamma functions – **Properties of Beta functions*** - Relation between Beta and Gamma functions – Applications of Gamma functions to multiple integrals.

Chapter 7: Sections 2.1 to 6

Unit - V

CHANGE OF VARIABLES: Jacobian – Two important results regarding Jacobians - Change of variables in the case of two variables – Change of variables in the case of three variables. Transformation from Cartesian to polar co-ordinates – **Transformation from Cartesian to spherical polar co-ordinates***.

Chapter 6: Sections 1.1 to 2.4

*** denotes self-study (Questions may be asked from these portions also)**

Books for study:

1. S. Narayanan and T. K. M. Pillai, *Calculus, Vol-1*, Viswanathan Publishers, 2007.
   For Unit I
2. S. Narayanan and T. K. M. Pillai, *Calculus, Vol-2*, Viswanathan Publishers, 2007.
   For Units II to V

Books for reference:

1. N. P. Bali, *Integral Calculus*, Laxmi Publications, 4th Edition, 1980.
2. A. R. Vasishtha and S. K. Sharma, *Integral Calculus*, Krishna PrakashanMandir, Meerut, 1990.
3. Shanthi Narayan, *Differential Calculus*, Shyam Lal Charitable Trust, New Delhi, 1993.

e-resources:

1. https://www.math24.net/integration-rational-functions
2. https://www.rtu.ac.in/expert/app/documents/kjangid@rtu.ac.in_21829122020100843am.pdf
3. https://math.libretexts.org/Bookshelves/Calculus/Book%3A_Calculus_(OpenStax)
4. https://www.youtube.com/watch?v=6ntZ1KQL04A&t=15s
5. https://www.youtube.com/watch?v=gAOwckHlDl8

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 3: Differential Equations and Laplace Transforms**	**Course Code**	**:**	**20UMA2C03**
Year	**:**	**First Year**	**Semester**	**:**	**II**
Hours/Week	**:**	**6**	**Credits**	**:**	**5**

Course Objectives

1. To solve second-order linear differential equations with constant and variable coefficients.
2. To get the ability of solving first and second order ordinary differential equations and first order partial differential equations.
3. To get the knowledge about Laplace and inverse Laplace transforms.

Course Outcomes (CO)

CO1	Recalling the concept of first order linear differential equations.	K1
CO2	Understanding the concept of first order higher degree ordinary differential equations	K2
CO3	Solving Linear partial differential equations by using the Lagrange's method.	K3 & K4
CO4	Analyzing the concepts of Laplace transforms and inverse Laplace transforms to solve ODE with constant and variable coefficients.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	M	L		M	S	M	S	M
CO2	S	M	M	S	S		S	M	S	S	M
CO3	S	S	S	M	M		M	S	M	M	S
CO4	M	M	S	S	S		S	M	S	L	S

S – Strong; M – Medium; L - Low

Unit –I

DIFFERENTIAL EQUATIONS: Equations of the first order and the first degree - Variable separable - Homogeneous equations - Non homogeneous equations of the first degree in x and y- **Linear equation***- Bernoulli's equation. Differential Equations of the first order, but of the higher degree - Equations solvable for dy/dx – Equations solvable for y- Equations solvable for x- Clairaut's form.

Vol III: Chapter 1 section 2.1 to 2.5,5.1 to 6.1

Unit –II

DIFFERENTIAL EQUATIONS (cont.): Linear differential equations with constant coefficients – special methods of finding particular integral – Linear equations with variable coefficients – Equations reducible to the linear homogeneous equations – **Variation of parameters***.

Vol III: Chapter 2 sections 2 to 4, 8 to 10

Unit – III

DIFFERENTIAL EQUATIONS (cont.) : Simultaneous equations of the first order and first degree – Methods for solving $dx/P = dy/Q = dz/R$ simultaneous linear differential equations with constant coefficients.

VOL III: Chapter 3 sections 1 to 6

Unit -IV

PARTIAL DIFFERENTIAL EQUATIONS: Derivation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Different integrals of partial differential equations - **standard types of first order equations*** - Lagrange's equations.

Vol III: Chapter 4, Omit section 4, 5.5 and 7.0

Unit –V

LAPLACE TRANSFORMS: Laplace transforms – Definition – Transform of f(t), - **exp at, cos at, sin at** * and t^n when n is an integer – The inverse Laplace transform - Laplace transforms to solve ordinary differential equations with constant and variable co-efficient – to solve system of differential equations.

Vol III Chapter 5

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

T. K. Manicavachagam Pillay and S. Narayanan, *Calculus Vol III*, S. Viswanathan Printers, 2007.

Books for reference:

1. N. P. Bali, *Differential Equations*, Laxmi Publications (P) Ltd., New Delhi, 2004.
2. Dr. J. K. Goyal and K. P. Gupta, *Laplace and Fourier Transforms,*PragatiPrakashanPublishers, Meerut, 2000.

e-resources:

1. http://www.nptelvideos.in/2012/11/mathematics-iii.html
2. https://www.whitman.edu/mathematics/calculus_online/chapter17.html
3. https://www.khanacademy.org/math/differential-equations

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 4 : Trigonometry, Vector Calculus and Fourier Series**	**Course Code**	**:**	**20UMA2C04**
Year	**:**	**First Year**	**Semester**	**:**	**II**
Hours/Week	**:**	**6**	**Credits**	**:**	**5**

Course Objectives

1. To enable the students to provide basic knowledge of trigonometry
2. To inculcate the knowledge of vector calculus and integral theorems
3. To understand the expansions of Fourier series.

Course Outcomes (CO)

CO1	Understanding the hyperbolic and inverse hyperbolic functions.	K1
CO2	Illustrating the Fourier co-efficient for periodic functions.	K2
CO3	Applying the differential operator to find gradient, divergence and curl.	K3
CO4	Examining the multiple integrals by applying Gauss divergence theorem, Stoke's theorem and Green's theorem.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S		M	S	M	S	S
CO2	S	M	S	S	M		S	M	S	S	M
CO3	S	S	L	S	M		S	S	M	S	S
CO4	M	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit -I

TRIGONOMETRY: Expansions of cos nθ, sin nθ, tan nθ, tan (A+B+C+…), cos θ, sin θ, Hyperbolic functions – **Inverse Hyperbolic functions***- Separation of real and imaginary parts of Hyperbolic functions.

Chapter. III: Sec 1, 2, 3, 5, Chapter. IV

Unit -II

TRIGONOMETRY: Logarithms of Complex quantities – Summation of Trigonometric series.

Chapter. V: Sec 5, Chapter. VI

Unit III

VECTOR CALCULUS: Scalar and Vector point function – **Differentiation of vectors*** – Directional derivative – gradient, divergence and curl.

Chapter 1 and Chapter 2

Unit -IV

VECTOR CALCULUS: Integration of vectors – line, surface and **volume integrals*** – Integral theorems and their applications.

Chapter 3 and Chapter 4

Unit -V

FOURIER SERIES: Definition – finding Fourier coefficient for a given periodic function with period 2 π – **odd and even functions***, Change of Interval.

Chapter VI: Sec 1, 2, 3 and 6

*** denotes self-study (Questions may be asked from these portions also)**

Books for study:

1. S. Narayanan and Manickavachagam Pillai, *Trigonometry*,S. Viswanathan (Printers and Publishers) PVT Ltd

   For Units I and II.

2. N. Namasivayam,*Vector Calculus***,** S. Viswanathan (Printers and Publishers) PVT Ltd.

   For Units III and IV.

3. T.K.ManicavachagamPillay and S.Narayanan, *Calculus - Vol III*, S.Viswanathan Printers, 2007. For Unit V.

Books for reference:

1. P.Kandasamy and K.Thilagavathi, *Mathematics*, S.Chand's and Company Ltd., New Delhi - 55, 2004.
2. S.Narayanan and T.K.Manicavasagampillay, *Vector Algebra and Analysis*, S. Viswanathan Printers and Publishers Pvt., Ltd, 1995.
3. K.Viswanathan and S.Selvaraj, *Vector Analysis*, Emerald Publishers, Chennai – 2, 1998.

e-resources:

1. https://www.youtube.com/watch?v=uMXcKY_w3w4
2. https://www.youtube.com/watch?v=TYOYID9gJxM
3. https://www.youtube.com/watch?v=NyG0vRn5FfU

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 5 : Analytical Geometry of 2D& 3D**	**Course Code**	**:**	**20UMA3C05**
Year	**:**	**Second Year**	**Semester**	**:**	**III**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To gain knowledge about co-ordinate geometry.
2. To know the basic concepts of cone and cylinder.
3. To determine co-ordinate axes and co-ordinate planes in the dimensional space.

Course Outcomes (CO)

CO1	Remembering the equation of a line that passes through a given point which is parallel or perpendicular to a given line.	K1
CO2	Understanding the results based on the properties of a sphere.	K2
CO3	Identifying conic sections.	K1& K3
CO4	Analyzing the concepts of geometry.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	M		M	S	M	S	M
CO2	S	S	S	S	M		S	S	S	S	M
CO3	S	S	S	S	L		S	S	M	S	S
CO4	S	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L – Low

Unit-I:

ANALYTICAL GEOMETRY OF 2D: POLAR equation of a Conic – Directrix – Chord – Tangent – **Normal*** - simple problems.

Chapter IX: Sections 9 – 13.

Unit-II:

ANALYTICAL GEOMETRY 3D: DIRECTION Cosines – Direction Ratios – Planes – Equation of the plane passing through the points – **Angle between the planes***– Equation of the plane through the line of intersection of two given planes.

Chapter I: Sections 7 – 11 and Chapter II

Unit-III:

STRAIGHT LINE: Equation of the straight lines passing through two given points – Coplanarity of straight Line -**Shortest Distance (SD)*** and equation of SD between two lines-simple problems.

Chapter III: Sections 1, 2, 3, 4, 7, 8

Unit-IV:

SPHERE: Standard equation of Sphere* - results based on the properties of a Sphere - Equation of circle on a Sphere - Equation of tangent plane to a Sphere.

Chapter IV

Unit-V:

CONE AND CYLINDER: Cone whose vertex is at the origin - right circular cone - Equation of a cylinder - right circular cylinder – Enveloping cylinder – **Central quadrics***.

Chapter V: Sections 1, 2, 8

*** denotes self-study (Questions may be asked from these portions also)**

Books for study:

1. T.K. Manickavachagam Pillai and T. Natarajan, *Analytical Geometry – 2D*, S. Viswanathan (Printers & Publishers), PVT., LTD, 2007.

   For Unit I.

2. T.K. Manickavachagam Pillai and T. Natarajan,*Analytical Geometry – 3D*, S. Viswanathan (Printers & Publishers), PVT., LTD, 2001.

   For Units II, III, IV & V.

Books for reference:

1. T. K. ManicavachagomPillay and T. Natarajan, *Analytical Geometry,* S. Viswanathan Printers and Publishers Pvt., Ltd, 2001.
2. A. R. Vasistha and J. N. Sharma, *Analytical Geometry 3D*, Krishna Prakashan Media (P) Ltd, Meerut, 1997.

e-resource:

http://www.brainkart.com/article/Three-Dimensional-Analytical-Geometry_6453/

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 6: Statics**	**Course Code**	**:**	**20UMA3C06**
Year	**:**	**Second Year**	**Semester**	**:**	**III**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To enable the knowledge of forces and moments.
2. To understand the notions of friction.
3. To solve problems under friction and equilibrium of strings**.**

Course Outcomes (CO)

CO1	Remembering the notions of friction and equilibrium of strings and deploy them in solving the problems.	K1&K3
CO2	Understanding the concepts of forces and moments.	K2
CO3	Applying the concepts of forces in finding the resultant of any number of forces.	K3
CO4	Analyzing the basics of coplanar forces and equilibrium of forces acting on a rigid body and solving the problems.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M		S	S	S	S	S
CO2	S	S	S	S	M		S	S	S	S	M
CO3	S	S	S	S	M		S	S	M	S	S
CO4	S	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit -I

KINEMATICS: Mechanics, Units, Vector and Scalar quantities, A vector as a sum of three mutually perpendicular vectors, A vector as a sum of two non – perpendicular vectors.

FORCES: Force, **types of forces***, magnitude and direction of the resultant of forces acting on a particle (in particular resultant of two forces acting on a particle), equilibrium examples.

EQUILIBRIUM OF A PARTICLE: Equilibrium of a particle acted on a rough inclined plane, examples.

Chapter 1, Sec. 1-5, Chapter 2&6

Unit –II

FORCES ON A RIGID BODY: Moment of a vector, General motion of rigid body, equivalent or equipotent systems of forces, **resultant of parallel forces***, couple, resultant of several coplanar forces.

Chapter 7, Sec 7.1 – 7.6

Unit –III

Moment of the resultant force, couples in a plane or in parallel planes, resultant of a couple and a force, three coplanar forces on a rigid body, **equation of the line of action of the resultant***, equilibrium of a rigid body under three coplanar forces examples.

Chapter 7,Sec 7.7 – 7.12

Unit –IV

A SPECIFIC REDUCTION OF A SYSTEM OF FORCES: Reduction of a system of forces to a force at a chosen point and a couple, **central axis***, problems involving frictional force, problems involving tilting of bodies, examples.

Chapter 8.

Unit -V

STABILITY OF EQUILIBRIUM AND HANGING STRINGS: Equilibrium of a uniform homogeneous string, sag, suspension bridge, examples.

Chapter 10 &11

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

P. Duraipandian and others, *Mechanics,* S. Chand& Co., 1990.

Books for reference:

1. A. V. Dharmapadam, *Statics*, S. Viswanathan Printers and Publishing Pvt., Ltd,1993.
2. P. Duraipandian and LaxmiDuraipandian, *Mechanics*, S.Chand and Company Ltd,Ram Nagar, New Delhi -55, 1985.
3. Dr. P. P. Gupta, *Statics*, KedalNath Ram Nath, Meerut, 1983-84.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Allied 3: Mathematical Statistics I**	**Course Code**	**:**	**20UMA3AL3**
Year	**:**	**Second Year**	**Semester**	**:**	**III**
Hours/Week	**:**	**6**	**Credits**	**:**	**5**

Course Objectives

1. To enable the students to acquire the knowledge of statistics.
2. To remember the properties of various statistical functions.
3. To understand the concepts of some statistical distributions.

Course Outcomes (CO)

CO1	Remembering the concepts of probability and random variables	K1
CO2	Understanding the properties of some distributions.	K2
CO3	Finding mean, median, mode, moments and moment generating functions of Binomial, Poisson and Normal distributions.	K1&K3
CO4	Analyzing how correlation is used to identify the relationships between variables and how regression analysis is used to predict outcomes.	K3 &K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	L		M	M	S	M	L
CO2	S	S	S	M	M		S	M	S	S	S
CO3	S	S	S	S	M		M	S	M	S	M
CO4	S	S	S	M	S		S	S	S	S	M

S – Strong; M – Medium; L - Low

Unit –I

Random Variables - Mathematical Expectations-**Properties of Expectation***.

Chapter 2: pages 2.1 to 2.32

Chapter 3: pages 3.1 to 3.18

Unit –II

Variance -Moments -Moment Generating Function.

Chapter 4: pages 4.1 to 4.25

Chapter 5: pages 5.1 to 5.17

Unit –III

Correlation **(Omit Bivariate sample) - Types of Correlation *–** Regression

Chapter 8: pages 8.1 to 8.51

Chapter 9: pages 9.1 to 9.24

Unit –IV

Binomial Distribution – Poisson Distribution - **Geometric Distribution*.**

Chapter 12: pages 12.1 to 12.25

Chapter 13: pages 13.1 to 13.21

Chapter 15

Unit –V

Normal Distribution - **Uniform Distribution* - Exponential Distribution*** - Gamma Distribution – Beta distribution.

Chapters 16,17,18,19 and 20.

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

P. R. Vittal, *Mathematical Statistics,* Margham Publications, Chennai, 2004.

(Omit all Exercise Problems)

Books for reference:

1. S. C. Gupta and V. K. Kapoor, *Fundamental of Mathematical Statistics*, Sultan Chand & Sons, 2008.
2. R. S. N. Pillai and V. Bagavathi, *Statistics*, Sultan Chand, New Delhi, 2008.
3. S. P. Gupta, *Statistical Methods*, Sultan Chand, New Delhi, 33rd Edition, 2005.

e - resources:

1. https://www.tutorialspoint.com/statistics/index.htm
2. https://nptel.ac.in/courses/111/105/111105041/
3. https://www.youtube.com/watch?v=p1Y4yJ1XnKY&list=PLbMVogVj5nJQWowhOG0-K-yI-bwRRmm3C&index=5

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 7: Dynamics**	**Course Code**	**:**	**20UMA4C07**
Year	**:**	**Second Year**	**Semester**	**:**	**IV**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To enable the students to know the laws, principles and understand the concepts of motion of a particle and projectiles.
2. To provide the knowledge about the field of kinematics and impact between spheres.
3. To gain knowledge about simple harmonic motion and central orbits.

Course Outcomes (CO)

CO1	Remembering the concepts of motion of a particle and projectile in different angles.	K1
CO2	Understanding the notions of impact between two smooth spheres in different ways.	K2
CO3	Applying the concept of simple harmonic motions in composition of two bodies in different directions.	K3
CO4	Distinguishing between the pedal equations of well-known curves and solving two-fold problems in central orbits.	K2 &K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	M		S	S	S	S	M
CO2	S	S	S	S	M		S	S	S	S	M
CO3	S	S	M	S	M		S	S	M	M	S
CO4	S	S	S	S	M		S	M	S	S	M

S – Strong; M – Medium; L - Low

Unit –I

KINEMATICS :Velocity*, resultant of $\bar{v}_1$ and $\bar{v}_2$ relative velocity acceleration, velocity and acceleration in a rectilinear motion, velocity and acceleration in a co-planar motion, angular velocity, rectilinear motion when the acceleration is constant, examples.

RECTILINEAR MOTION UNDER GRAVITY: Motion along a vertical line under gravity, line of quickest descent, motion along a smooth inclined plane, motion along a rough inclined plane, motion of connected particles, examples.

Chapter 1: Sec 1.6 to 1.15 Chapter 3: Sec 3.1 to 3.6

Unit -II

RECTILINEAR MOTION OF A PARTICLE UNDER VARYING FORCE: Simple harmonic motion, Orthogonal projection of a uniform circular motion, composition of two simple harmonic motions of same period, motion of a heavy particle attached to one end of a horizontal spiral spring, motion of heavy particle attached to one end of a vertical spiral spring, **motion under gravity in a resisting medium***, examples.

Chapter 5: Sec 5.1 to 5.7

Unit -III

IMPACT: Impulsive force, Impulse, conservation of linear momentum, elasticity, Impact of two smooth spheres, direct impact of two smooth spheres, Impact of smooth sphere on a fixed smooth plane, **Oblique impact between two smooth spheres***, examples.

Chapter 12: Sec 12.1 to 12.9

Unit –IV

MOTION OF A PROJECTILE UNDER GRAVITY:Motion of projectile*, Nature of a projectory, Results pertaining to the motion of a projectile, maximum horizontal range and speed of a projectile, examples.

Chapter 13: Sec 13.1 to 13.4, 13.6 to 13.11

Unit -V

CIRCULAR AND CYCLODIAL MOTIONS: Conical pendulum, circular motion in a vertical plane under gravity, **simple pendulum***, cyclodial motion in a vertical plane, examples.

CENTRAL ORBITS: Central force and central orbit, equation of a central orbit, law of force and speed for given orbit, determination of the orbit when the law of force is given.

Chapter 14: Sec 14.1 to 14.6 and **Chapter 15: Sec 15.1 to 15.5**

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

P.Duraipandian and others, *Mechanics*, S. Chand & Co., 1990.

Books for reference:

1. A.V.Dharamapadam, *Dynamics*, S.Viswanathan Printers and Publishers Pvt., Ltd, Chennai, 1998.
2. K.ViswanathaNaik and M.S.Kasi, *Dynamics*, Emerald Publishers, 1992.
3. Naryanamurthi, *Dynamics,* National Publishers, New Delhi, 1991.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 8: Numerical Methods**	**Course Code**	**:**	**20UMA4C08**
Year	**:**	**Second Year**	**Semester**	**:**	**IV**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To solve algebraic and transcendental equations using numerical methods.
2. To solve simultaneous algebraic linear equations numerically.
3. To know about finite differences and its uses to interpolate the values for equal and unequal intervals.

Course Outcomes (CO)

CO1	Derive numerical methods for approximating the solution of the problems of algebraic and transcendental equations, ordinary differential equations.	K1
CO2	Implement a variety of numerical algorithms using appropriate technology	K2&K3
CO3	Get practical knowledge of polynomial interpolation, also numerical algorithms are used in C++ for solving scientific problems	K3
CO4	Solve the ordinary differential equations by using the methods like Euler's, RungeKutta, Modified Euler and Improved Euler	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	L	M	M		M	S	M	S	M
CO2	S	S	S	S	M		S	S	S	S	M
CO3	S	S	S	M	M		S	S	M	S	S
CO4	S	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit -I

THE SOLUTION OF NUMERICAL, ALGEBRAIC AND TRANSCENDENTAL EQUATIONS: Introduction – The Bisection method – Method of Successive Approximation or the Iteration method – The Method of False Position– Newton's Iteration method.

SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS: Introduction – **Gauss Elimination method*** – Computation of the inverse of a matrix using Gauss's Elimination method – Method of Triangularisation– Crout's method – Iterative methods – Comparison of Gauss Elimination and Gauss-Seidal Iteration methods – Relaxation methods – examples.

Chapter – III & IV

Unit -II

FINITE DIFFERENCES: First Differences – Higher Differences – Backward Differences – Central difference notation – Properties of the operator Δ - Differences of a polynomial – Factorial polynomials – Relation between the operators E and Δ - Relation between the operators (D) and Δ - other difference operators – **Relationship between the operators*** – Examples.

Chapter – V

Unit –III

INTERPOLATION: Introduction – Linear Interpolation – Gregory Newton Forward Interpolation Formula – Gregory Newton Backward Interpolation Formula – Equidistant terms with one or more missing values. Central difference tables – Central Difference Interpolation Formulae – Gauss's Forward Interpolation Formula - **Gauss's Backward Interpolation Formula*** – Stirling's Formula – Bessel's Formula – Lagrange's Interpolation Formula – Examples.

Chapter –VI &VII

Unit -IV

NUMERICAL DIFFERENTIATION AND INTEGRATION: Newton's Forward Difference Formula to compute the Derivatives – Newton's Backward Difference Formula to compute the derivatives – Derivatives using Striling's formula – The Trapezoidel Rule – Truncation error in the Trapezoidal Formula – Romberg's method – Simpson's rule – **Practical Applications of the Simpson's rule*** – Examples.

Chapter –IX

Unit -V

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS. Solutions by Taylor's series – Euler's method – Improved Euler's method – **Modified Euler's method*** – RungeKutta method – Second order RungeKutta method – Higher order RungeKutta method – Examples.

Chapter – X

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

Dr. M.K. Venkataraman, *Numerical Methods in Science and Engineering*, The National Publishing Company, Fifth Edition, 1999.

Books for reference:

1. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computations*, New Age International publishers, New Delhi, 2004.
2. A. Singaravelu, *Numerical Methods*, Meenakshi Publications, Arpakkam, 2002.

e-resources:

1. https://nptel.ac.in/courses/122/102/122102009/
2. https://nptel.ac.in/courses/111/107/111107105/
3. https://www.britannica.com/science/difference-equation
4. https://nptel.ac.in/courses/122/102/122102009/
5. https://nptel.ac.in/courses/111/107/111107063/

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Allied 4: Mathematical Statistics II**	**Course Code**	**:**	**20UMA4AL4**
Year	**:**	**Second Year**	**Semester**	**:**	**IV**
Hours/Week	**:**	**6**	**Credits**	**:**	**5**

Course Objectives

1. To enable the students to give inference on statistical population based on sample statistics.
2. To understand the concepts of various estimators.
3. To study the concepts of analysis of variance.

Course Outcomes (CO)

CO1	Finding the derivations of $t, \chi 2$ and F distributions.	K1
CO2	Explaining the procedure for testing of hypothesis and sampling of attributes.	K2
CO3	Applying the concepts of various distributions in real time situations.	K2 & K3
CO4	Analyzing one - way and two – way classifications and design of experiments.	K3 &K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	L		S	M	M	L	M
CO2	S	S	S	S	M		S	M	S	S	M
CO3	S	S	S	S	M		S	S	S	M	M
CO4	S	S	S	M	S		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit –I

Sampling Distribution – Chi Square, t, F - Distributions.

Chapter 22: page 22.1 to 22.40

Unit –II

Estimation - **ML estimator*(Omit Cramer – Rao inequality and Rao-Blackwell Theorem).**

Chapter 23: page 23.1 to 23.56

Unit –III

Large Samples -**Test for specified standard deviation of the population***.

Chapter 24: page 24.1 to 24.44

Unit –IV

Small Samples – **t- test Test for a specified mean*(Omit t-test for paired observation)** – Small Samples – F test - **One way classification***.

Chapter 25: page 25.1 to 25.39, Chapter 26: page 26.1 to 26.27

Unit-V

Small samples – Chi square Test – Design of experiments (**Omit Factorial Experiments)** – **Test of Hypothesis*.**

Chapter 27: page 27.1 to 27.35, Chapter 28: page 28.1 to 28.17,

Chapter 29: page 29.1 to 29.6

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

Dr. P. R. Vittal, *Mathematical Statistics*, Margham Publications, Chennai, 2004.

(Omit all Exercise Problems)

Books for reference:

1. S. C. Gupta and V. K. Kapoor, *Fundamental of Mathematical Statistics*, Sultan Chand & Sons, 2008.
2. B. L. Agarwal, *Basic Statistics*, New Age International Publishers, Chennai, 2009.
3. S. P. Gupta, *Statistical Methods*,Sultan Chand and Sons, New Delhi, 2011.

e-resources:

1. https://www.tutorialspoint.com/statistics/index.htm
2. https://nptel.ac.in/courses/111/105/111105041/
3. http://www.comfsm.fm/~dleeling/statistics/text.html

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 9 : Modern Algebra**	**Course Code**	**:**	**20UMA5C09**
Year	**:**	**Third Year**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credits**	**:**	**5**

Course Objectives

1. To know the concepts of group theory and ring theory.
2. To understand the concepts of ideals and quotient rings.
3. To enable the concepts of Cauchy's theorem for Abelian groups, automorphisms, inner automorphism and Cayley's theorem.

Course Outcomes (CO)

CO1	Finding whether a given abstract structure is a group or a ring.	K1
CO2	Understanding the elementary concepts of rings and fields.	K2
CO3	Applying the concepts of homomorphism and isomorphism for comparing the algebraic features of mathematical systems in groups, rings and fields	K3
CO4	Examining the results from group theory to study the properties of rings and fields.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	*S*	S	S
CO3	S	S	S	M	M		S	S	M	S	M
CO4	S	S	S	L	M		S	S	L	S	S

S – Strong; M – Medium; L - Low

Unit -I

PRELIMINARY NOTIONS: Set theory-Mappings – The Integers.

GROUP THEORY: **Definition of a Group*** - Some Examples of Groups-Some Preliminary Lemmas.

Chapter 1: Sections 1.1 to 1.3 and Chapter 2 : Sections 2.1 to 2.3.

Unit –II

GROUP THEORY: **Subgroups*** – A Counting Principle- Normal Subgroups and Quotient Groups.

Chapter 2: Sections 2.4 to 2.6.

Unit –III

GROUP THEORY: Homomorphisms – Automorphisms – Cayley's Theorem- **Permutation Groups***.

Chapter 2: Sections 2.7 to 2.10.

Unit –IV

RING THEORY: **Definition*** and examples of rings- Some special classes of rings-Homomorphisms.

Chapter 3: Sections 3.1 to 3.3.

Unit -V

RING THEORY: Ideals and Quotient Rings- **More Ideals and Quotient Rings***- The field of Quotients of an Integral Domain.

Chapter 3: Sections 3.4 to 3.6.

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

I.N. Herstein, *Topics in Algebra,* Vani Educational Books a Division of Vikas Publishing House Pvt Ltd, New Delhi, 1984.

Books for reference:

1. Surjeet Singh and QaziZameeruddin, *Modern Algebra,*Vikas Publishing house, 1992.
2. A. R. Vasishtha, *Modern Algebra,* Krishna PrakashanMandir, Meerut, 1994 – 95

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 10 : Real Analysis – I**	**Course Code**	**:**	**20UMA5C10**
Year	**:**	**Third Year**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credits**	**:**	**5**

Course Objectives

1. To know about the basic notions of the real number system, set theory, relations and functions.
2. To enable to have knowledge about the basic topological properties and theorems based on point set topology.
3. To Study about the covering theorems, compactness, metric spaces and continuity of a function.

Course Outcomes (CO)

CO1	Remembering the basic properties in the field of real numbers.	K1
CO2	Understanding the concepts of continuity,convergent sequences and metric spaces.	K2 & K3
CO3	Applying the concept of point set topology in related theorems	K3
CO4	Analyzing the compactness and to classify the continuity of a function with its limits.	K4

K1-Remmber, K2-Understand, K3-Apply, K4-Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	M		S	M	M	M	M
CO2	S	S	S	S	S		S	S	S	M	M
CO3	S	S	M	S	S		S	S	S	S	L
CO4	S	S	S	S	S		S	S	S	S	M

S- Strong, M- Medium, L- Low

Unit-I

THE REAL AND COMPLEX NUMBER SYSTEMS: Introduction – The field and order axioms - the unique factorization theorem for integers – rational and irrational numbers – upper bounds and the completeness axiom – **the Archimedean property of the real number system***- the Cauchy Schwarz inequality.

Chapter 1: Sections 1.1 to 1.19

Unit- II

SOME BASIC NOTATIONS OF SET THEORY: Ordered pairs- relations and functions- sequences- similar sets – finite and infinite sets – countable and uncountable sets - **countable collection of countable sets***.

Chapter 2: Sections 2.1 to 2.15.

Unit-III

ELEMENTS OF POINT SET TOPOLOGY: Introduction – Eucliedan space R^n- open balls and open sets in R^n– The Structure of open sets in R^1– closed sets – Adherent points. Accumulation points – **closed sets and adherent points*** – the Bolzano – Weirstress theorem - the Cantor intersection theorem.

Chapter 3: Section 3.1 to 3.9.

Unit-IV

COVERING: The Lindelofs covering theorem – the Heine – Borelcovering theorem –compactness in R^n- metric spaces- point set topology in metric spaces – compact subsets of a metric spaces – **boundary of a set***.

Chapter 3: Section 3.10 to3.16.

Unit-V

LIMITS AND CONTINUITY: Introduction – convergent sequence in metric spaces- Cauchy sequences – complete metric spaces – Limit of a function – continuous functions – continuity of a composite functions– examples of continuous functions – continuity and inverse images of open or closed sets – **functions continuous on compact sets***.

Chapter 4: Sections 4.1 to 4.5,4.8,4.9,4.11,4.12,4.13.

*** denotes self-study (Questions may be asked from these portions also)**

Book for study

Tom M. Apostal, *Mathematical Analysis*, Addison Wesley, 1974.

Books for reference:

1. R. R. Goldberg, *Methods of Real Analysis*, NY, John Wiley, New York 1976.
2. G. F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw – Hill, New York, 1963.
3. G. Birkhoff and MacLane, *A survey of Modern Algebra*, Macmillian, New York, 3rd Edition, 1965.
4. J. N. Sharma and A. R. Vasistha, *Real Analysis*, Krishna Prakashan Media (P) Ltd, 1997.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 11: Complex Analysis**	**Course Code**	**:**	**20UMA5C11**
Year	**:**	**Third Year**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To recognize complex analysis as an essential part of mathematical background.
2. To introduce the students about the complex number system.
3. To Justify the need for a complex number system and explain how it is related to other existing number systems.

Course Outcomes (CO)

CO1	Defining continuity, differentiability and analyticity of a complex valued function which helps the students to acquire deeper knowledge.	K1
CO2	Showing the condition(s) for a complex valued function to be analytic and/or harmonic.	K2
CO3	Developing the concept of sequences and series with respect to the complex number system.	K3
CO4	Analyzing complex integration, Cauchy's integral formulae and Cauchy's fundamental theorem.	K4

K1- Remember; K2-Understand; K3-Apply; K4-Analyse

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	M		M	M	M	M	L
CO2	S	S	S	S	S		S	S	S	S	M
CO3	S	S	S	S	S		S	S	S	S	M
CO4	S	S	S	S	S		S	S	S	S	M

S-Strong; M-Medium; L-Low

Unit- I

ANALYTIC FUNCTIONS: Complex functions - Limit of a function - Continuity of a function - Uniform Continuity - Differentiability and analyticity of a function – Necessary conditions for Differentiability - **Sufficient conditions for Differentiability*** – C-R equations in polar coordinates

Chapter 4: Sections: 4.1-4.8

Unit- II

ELEMENTARY AND CONFORMAL MAPPINGS: Bilinear transformation- **Special bilinear transformation*** – Circles and inverse points – Transformations $w = z^2$, $w = z^{\frac{1}{2}}$, $w = e^z$, Conformal mapping

Chapter 7: Sections: 7.1-7.6 &7.8.

Unit- III

COMPLEX INTEGRATION: Simple rectifiable oriented curves – Integration of complex functions – **Simple integrals using definition*** – Definite integrals – Interior and exterior of a closed curve – Simply-connected region – Cauchy's fundamental theorem using Goursat's lemma - Goursat's lemma (statement only) theorem 8.6 (statement only) – Integral along an arc joining two points, theorem 8.7 (statement only)- Cauchy's integral formula and formulas for derivatives , theorem 8.9, 8.10 (statements only), Morera's theorem.

Chapter 8: Sections: 8.1- 8.9.

Unit- IV

COMPLEX INTEGRATION: Zeros of a function – Related integral theorems, theorem 8.13-8.16 only. **Taylor's and Laurent's Series: Taylor's series*** – Zeros of an analytic function – Laurent's series – Singular point or singularity – Isolated singularities – Removable singularity – Pole – Essential singularity.

Chapter 8: Sections: 8.10, 8.11.

Chapter 9: Sections: 9.1- 9.3, 9.5-9.9.

Unit-V

RESIDUES: RESIDUE* – Calculation of residues – Real definite integrals (types I, II, III only)

Chapter 10: Sections: 10.1-10.3.

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

P. Duraipandian, LaxmiDuraipandian and D. Muhilan**,** *Complex Analysis***,** M.D. Gopalakrishnan, Emerald Publishers, 2001.

Books for references:

1. S. Narayanan and T. K. Manicavachagompillay, *Complex Analysis*,S. Viswanathan (Printers and Publishers), PVT. LTD, 1997.
2. J. N. Sharma, *Functions of a Complex Variable*, Krishna PrakasanMandir PVT, Meerut, Twenty Third Edition, 1992-1993.
3. Churchill and Others, *Complex Variable and Applications*, Tata Mecgrow Hill Publishing Company Ltd, 1974.
4. Santhinarayan, *Theory of functions of Complex Variable*, S. Chand and Company Meerut, 1995.
5. Tyagi B.S, *Functions of Complex Variable*, PragatiPrakasham Publishing Company Ltd, Meerut, 17th Edition, 1992-93.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 12 – Discrete Mathematics**	**Course Code**	**:**	**20UMA5C12**
Year	**:**	**Third Year**	**Semester**	**:**	**V**
Hours/Week	**:**	**4**	**Credits**	**:**	**4**

Course Objectives

1. To understand the concepts of discrete structures, formal languages.
2. To use finite state machines to model computer operations.
3. To genuine use in computer science and elsewhere are identified and combined together in a logically coherent fashion

Course Outcomes (CO)

CO1	Acquire knowledge about the basic concepts of Discrete Mathematics and its applications	K1
CO2	Apply logically valid forms of arguments to avoid logical errors by studying mathematical logic	K2
CO3	Understand abstract algebra, posets, lattices, Boolean algebra and their applications in the field of engineering and computer science.	K3
CO4	Define the basic definitions of graph theory and a knowledge about types of graphs including isomorphic graphs, homeomorphic graphs, Eulerian graphs and Hamiltonian graphs	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	L		M	S	M	S	M
CO2	S	S	M	S	M		S	S	S	S	M
CO3	S	S	S	S	M		S	S	M	S	S
CO4	S	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit – I

MATHEMATICAL LOGIC: Statements – Truth tables – Connectives – **Normal forms***.

Chapter 1: Sections 1.2.1 to 1.2.4, 1.2.6 to 1.2.11, 1.3.1 to 1.3.5.

Unit –II

MATHEMATICAL LOGIC: Predicate Calculus – Inference theory of Predicate Calculus.

Chapter 1: Sections 1.4.1 to 1.4.3, 1.5.1 to 1.5.5, 1.6.4, 1.6.5.

Unit –III

GRAMMAR AND AUTOMATA: Grammar and languages – Finite state acceptors and **regular grammar***.

Chapter 3: Sections 3.1, 3.3.2, Chapter 6: Sections 6.1, 6.2.

Unit –IV

LATTICE THEORY: Partial ordering – Posets – Hasse diagram – Lattices – Properties of Lattices – Boolean Algebra – **Boolean Functions*** – Minimization.

Chapter 4: Sections 4.1.1, 4.1.2, 4.2 - 4.4

Unit –V

GRAPH THEORY: Introduction to Graphs – Matrix Representation of Graphs – Paths, Reachability, and Connectivity – **Euler and Hamiltonian paths***, Trees.

Chapter 5: Sections 5.1.1 to 5.1.4.

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

J. P. Tremblay and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science,* Tata McGraw Hill Book Edition, 1997.

Book for reference:

V. Sunderesan, K. S. Ganapathy Subramanian and K. Ganesan, *Discrete Mathematics*, A.R publications.

e-resources:

1. https://nptel.ac.in/courses/106/106/106106094/
2. https://nptel.ac.in/courses/111/107/111107058/

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 13: Operations Research – I**	**Course Code**	**:**	**20UMA5C13**
Year	**:**	**Third Year**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To introduce certain OR techniques such as LPP, transportation and assignment problems.
2. To help the students to develop logical reasoning.
3. To apply mathematical tools to managerial and real life problems.

Course Outcomes (CO)

CO1	Remembering the concept of linear programming problem using Simplex Method.	K1
CO2	Applying the notions of linear programming in solving transportation problems and assignment Problem.	K3
CO3	Understanding the rules for sequencing problems.	K2
CO4	Analyzing the concepts of dynamic programming.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S		M	S	M	S	M
CO2	S	L	S	S	M		S	S	S	M	M
CO3	S	S	S	L	M		S	S	M	S	S
CO4	M	S	S	S	S		S	L	M	S	M

S – Strong; M – Medium; L - Low

Unit -I

THE LINEAR PROGRAMMING PROBLEM: Introduction – Mathematical Formulation of the Problem – Graphical Solution Method – Some Exceptional Cases – General Linear Programming Problem – Standard Form of LPP – Some important definitions.

THE SIMPLEX METHOD: Introduction – The Computational procedure – Use of Artificial variables – Two Phase Method – **Big-M Method***.

Chapter 2 and **Chapter 3.**

Unit-II

DUALITY IN LINEAR PROGRAMMING: Introduction – General Primal-Dual pair – Formulating a Dual Problem – Duality and Simplex Method – Economic Interpretation of Dual – Dual Simplex Method.

INTEGER PROGRAMMING: Introduction – Gomory's all LPP Method – Construction of Gomory's Constraints – Gomory's Fractional Cut Method – **Geometrical Interpretation of the Cutting Plane***.

Chapter 4 and **Chapter 5.**

Unit-III

THE TRANSPORTATION PROBLEM: Introduction – General Structure of the Problem – Basic Feasibile Solution of a Transportation problem – The Transportation Tables – Loops in Transportation Tables – Solution of a Transportation problem – **Finding Initial Basic Feasible Solution* -** Moving Towards Optimality – The Transportation Algorithm – Some exceptional cases.

Chapter 6.

Unit-IV

THE ASSIGNMENT PROBLEMS: The Assignment Problems – Mathematical Statement of the Problem – Method for Solving an Assignment Problem – Variations of the Assignment Problem – **Travelling Salesman Problem***.

Chapter 7.

Unit-V

SEQUENCING PROBLEMS: Introduction – Problem of Sequencing – Terminology, Notations and Assumptions – Problems with n Jobs and two Machines – Problems with n Jobs and three Machines – Problems with n Jobs and m Machines – **Problems with two Jobs and m Machines*.**

DYNAMIC PROGRAMMING: Introduction – Characteristics of Dynamic Programming – The Recursive Equation Approach – The Computational Procedure – An Application in Production – Solution of an L.P.P. by Dynamic Programming.

Chapter 8 and **Chapter 9.**

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

KantiSwarup, P.K. Gupta and Man Mohan, *Introduction to Operations Research*, Sultan Chand and Sons, Third Edition, 1997.

Books for reference:

1. Prem Kumar Gupta and D.S.Hira, *Problems in Operations Research*, Chand and Company, New Delhi, 1998.
2. B.S. Goel and S.K. Mittal, *Operations Research*, 16th Edition, PragathiPrakashan, Publishers, Meerut,1999.

e-resources:

1. https://www.youtube.com/watch?v=xrGVe6gMRyk
2. https://www.youtube.com/watch?v=ItOuvM2KmD4
3. https://www.youtube.com/watch?v=rrfFTdO2Z7I

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 14 - Linear Algebra**	**Course Code**	**:**	**20UMA6C14**
Year	**:**	**Third Year**	**Semester**	**:**	**VI**
Hours/Week	**:**	**5**	**Credits**	**:**	**5**

Course Objectives

1. To know the concepts of Hermitian and Skew-Hermitian, orthogonal andunitary matrices, characteristic roots and characteristic vectors of a square matrix.
2. To enable the concepts of linear independence, basis and dimension of a vectorspaces.
3. To understand the concept of linear transformation and matrices which will enrich theknowledge of logical thinking.

Course Outcomes (CO)

CO1	Recalling the basic concepts of matrices, rank of a matrix.	K1
CO2	Understanding the basic ideas of vector spaces and the concepts of linear span, linear independence, basis, dimension.	K2
CO3	Applying the principles of matrix algebra to linear transformations.	K3
CO4	Examining whether the given set of vectors is linearly dependent or independent.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	M	L		S	S	*S*	M	S
CO3	S	S	M	S	S		S	S	S	S	L
CO4	S	S	S	S	S		S	M	S	S	S

S – Strong; M – Medium; L - Low

Unit –I

MATRICES: Algebraic operations – Triangular, Diagonal, Scalar, Unit matrices – **Transpose***, adjoint and inverse of a square matrix – Symmetric and Skew Symmetric matrix.

Chapter 1: Sections 1.1 to 1.7.

Unit-II

Hermition and Skew Hermition Matrices-Orthogonal and Unitary Matrices:

Rank of a matrix* - Eigen values and Eigen Vectors of linear operators – Solutions of Homogeneous linear equations, Solutions of non-homogeneous linear equations. Characteristic roots and Characteristic vectors of a square matrix

Chapter 1: Sections 1.8 -1.9, Chapter 2: Section 2.9, Chapter 3: Sections 3.6 to3.9.

Unit -III

VECTOR SPACES: Elementary basic concepts, linear Independence and **bases***.

Chapter 4: Sections 4.1 to 4.2.

Unit –IV

Dual spaces – Inner product spaces

Chapter 4: Sections 4.3 and 4.4.

Unit –V

LINEAR TRANSFORMATIONS: Algebra of linear transformations – **Characteristic roots*** – Matrices.

Chapter 6: Sections 6.1 to 6.3.

*** denotes self-study (Questions may be asked from these portions also)**

Books for study:

1. R. Balakrishnan and N. Ramabhadran, *A Text Book of Modern Algebra* by Vikas Publishing House Pvt Ltd, New Delhi, 1979.

   (For Units I and II)

2. I. N. Herstein, *Topics in Algebra,* Vani Educational Books a Division of Vikas Publishing House Pvt Ltd, New Delhi, 1984.

   (For Units III, IV and V)

Books for references:

1. Schaum's Outline series, *Linear Algebra,* McGraw Hill Book Company, New Delhi.
2. Dr. S. N. Goel, *Linear Algebra,* Kadar Nath, Ram Nath, Meerut, 4^{th} Edition.

Programme	:	**B.Sc. Mathematics**			
Course Title	:	**Core 15 - Real Analysis II**	**Course Code**	:	**20UMA6C15**
Year	:	**Third Year**	**Semester**	:	**VI**
Hours/Week	:	**5**	**Credits**	:	**5**

Course Objectives

1. To understand the concept of functions, Connectedness, uniform continuity, fixed point and related theorems.
2. To find the derivatives and functions of bounded variations.
3. To know about the Reimann- Stieltjes integrals and its properties.

Course Outcomes (CO)

CO1	Remembering the concept of derivatives, bounded variations.	K1
CO2	Understanding the concept of connectedness.	K2
CO3	Applying the differentiability of real functions.	K3
CO4	Analyzing the Riemann integrals to a finite sum.	K4

K1-Remember, K2-understand, K3-Apply, K4-Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	M		S	M	M	M	M
CO2	S	S	S	S	M		S	S	M	S	M
CO3	S	S	S	S	S		S	S	S	S	M
CO4	S	S	S	S	S		S	S	S	S	L

S- Strong, M- Medium, L- Low

Unit-I

Topological mappings (homeomorphisms)- Bolzano's theorem- connectedness- components of a metric space – uniform continuity and compact sets – fixed point theorem for contractions – **discontinuities of real valued functions***– monotonic functions.

Chapter 4 : Sections 4.14 to 4.17, 4.19 – 4.23.

Unit- II

DERIVATIVES: Introduction – definition of derivative – derivatives and continuity – algebra of derivatives – algebras of derivatives – the chain rule – Rolle 's theorem – the mean value theorem for derivatives – intermediate- value theorem for derivatives – Taylor's formula with remainder – derivatives of vector – valued functions – **partial derivatives***.

Chapter 5: Section 5.1 to 5.5, 5.9 - 5.14.

Unit-III

FUNCTIONS OF BOUNDED VARIATION: Introduction – **properties of monotonic functions*** –

Function of bounded variation – Total Variation – Additive property of total variation – Total variation on $[a, x]$ as a function of x- Functions of bounded variation expressed as the difference of increasing functions – continuous functions of bounded variation.

Chapter 6: Sections 6.1 to 6.8

Unit-IV

The Riemann-Stieltjes Integral: Introduction –**Notation***– The definition of the Riemann Steiltjes integral- Linear properties – Integration by parts – change of variables in a Riemann Stieltjes integral- Reduction to a Reimann integral – Step function as integrators.

Chapter 7: Section 7.1 to 7.8.

Unit-V

Reduction of a ReimannSteiltjes integral to a finite sum – Eulers summation formula – monotonically increasing integration, Upper and lower integrals- **Additive and linearity properties of upper and lower integrals*** – Reimann condition.

Chapter 7: Section 7.9 to 7.13.

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

Tom M. Apostal, *Mathematical Analysis*, Addison Wesley, 1974.

Books for reference:

1. R.R. Goldberg, *Methods of Real Analysis,* NY, John Wiley, New York 1976.
2. G.F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw – Hill, New York, 1963.
3. G. Birkhoff and MacLane, *A survey of Modern Algebra*, Macmillian, New York, 3rd Edition, 1965.
4. J. N. Sharma and A. R. Vasistha, *Real Analysis*, Krishna Prakashan Media (P) Ltd, 1997.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 16– Special Functions**	**Course Code**	**:**	**20UMA6C16**
Year	**:**	**Third Year**	**Semester**	**:**	**VI**
Hours/Week	**:**	**4**	**Credits**	**:**	**4**

Course Objectives

1. To introduce certain types of special functions.
2. To help the students to simplify hyper geometric functions.
3. To apply mathematical tools to solve Chebyshev's polynomials.

Course Outcomes (CO)

CO1	Remembering the concept of special functions.	K1
CO2	Understanding the applications of hyper geometric functions.	K2
CO3	Using the solution of Bessel's equation in solving science and engineering problems.	K3
CO4	Analyzing the use of Hermite's polynomial.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	M		S	S	S	S	M
CO2	S	S	M	S	M		S	S	S	S	M
CO3	S	S	M	S	S		S	S	M	S	S
CO4	S	S	M	S	S		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit -I

SPHERICAL HARMONICS: Spherical Harmonics, Kelvin's theorem, Legendre's equation from Laplace equations, Bessel's equation from Laplace equations.

Legendre's equation: Legendre's equation, Solution of Legendre's equation, Definition of $P_n(x)$ and $Q_n(x)$, To show that $P_n(x)$ is the coefficient of h^n in the expansion of $(1-2xh+h^2)^{-1/2}$, Laplace Definite integral for $P_n(x)$, **Orthogonal properties of Legendre's Polynomials***, Recurrence formulae**.**

Chapter 1: Sec: 1.1 – 1.4 and **Chapter 2: Sec: 2.1 – 2.8, Examples:Pg. No:20-26**

Unit -II

HYPER GEOMETRIC FUNCTIONS: Hypergeometric functions, Gauss's hypergeometric equation, The hyper geometric series, Particular cases of hypergeometric series, Different forms of hypergeometric function, Solution of hypergeometric equation, Linear relations between the solution of hypergeometric equation, Symmetric property of hypergeometric function, Integral formula for the hypergeometric function, Kummer's Theorem, Gauss's Theorem, Vandermonde's Theorem, **Differentiation of**

hypergeometric function*.

Chapter 4: Sec: 4.1 – 4.13

Examples:Pg. No:91-95

Unit -III

BESSEL'S EQUATION: Bessel's equation, Solutions of Bessel's general differential equation , General solution of Bessel's equation, Integration of Bessel's equation in series for n=0 , Definition of Bessel's Equation for series for n=0, Definition of$J_n(x)$, **Recurrence formula for $J_n(x)$*.**

Chapter 5: Sec: 5.1 – 5.6.

Examples:Pg. No:107-113

Unit -IV

HERMITE POLYNOMIALs: Hermite's Differential equation, Solution of Hermite's equation, Hermite polynomials, Generating functions, Other forms for the Hermitepolynimals, To find the first few Hermite polynomials, Orthogonal properties of Hemite polynomials, **Recurrence formulae for Hermite polynomials***.

Chapter 6 : Sec 6.1-6.8

Examples:Pg. No:145-149

Unit -V

CHEBYSHEV Polynomials: Chebyshev's Differential equation,Chebyshev polynomial , To prove that $T_n(x)$ and $U_n(x)$ are independent solutions of Chebyshev's equation, Relations for $T_n(x)$ and $U_n(x)$, To find first few Chebyshev polynomials, Generating Functions , Orthogonal properties of Chebyshev polynomials, **Recurrence for $T_n(x)$ and $U_n(x)$***.

Chapter 8: Sec: 8.1 – 8.8.

Examples:Pg. No:180-182

*** denotes self-study (Questions may be asked from these portions also)**

Books for Study:

J. N. Sharma, R. K. Gupta, *Mathematical Methods (Part I)*, KrishnaPrakashanMandir, Edition 1990-91.

Book for reference:

J. N. Sharma and R. K. Gupta, *Special Functions*, Krishna PrakashanMandir, Fifteenth edition, 1992.

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 17: Operations Research II**	**Course Code**	**:**	**20UMA6C17**
Year	**:**	**Third Year**	**Semester**	**:**	**VI**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To understand the mathematical tools that are needed to solve game and queueing theory problems.
2. Knowing the concept of inventory and replacement problems.
3. Understanding the difference between PERT and CPM.

Course Outcomes (CO)

CO1	Applying the maximin and minimax principles in game theory.	K1
CO2	Analyzing the classifications of queueing models.	K4
CO3	Applying the concept of inventory control and replacement techniques in business.	K2
CO4	Examining the concept of traffic intensity in real life problems.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	M		M	M	S	S	M
CO2	S	L	S	M	M		S	S	M	S	M
CO3	M	S	S	S	M		S	M	S	M	S
CO4	S	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L - Low

Unit –I

GAME THEORY: Introduction – Two-person Zero-Sum Games – The MaxiMin - MiniMax Principle – Games Without Saddle Points– Mixed Strategies - Graphical Solution of $2 \times n$ and $m \times 2$ Games – **Dominance Property*** – Reducing the Game Problem to an LPP – A short-cut method for $n \times n$ Games.

Chapter 10

Unit –II

QUEUEING THEORY: Introduction – Queueing Systems – Characteristics of the Queueing Systems – Operating Characteristics of a Queueing System – Poisson Process and Exponential Distribution – Definition of Transient and Steady States - **Classification of Queues – Poisson Queues***.

Chapter 11 (Omit Sec 11.9)

Unit –III

INVENTORY PROBLEMS: Introduction – Inventory Control – Costs Associated with Inventories – Economic Lot Size Problems – Problems of EOQ with Shortage Allowed – Purchase Inventory Problem with Price Breaks – Multi-item Deterministic Problem – **Buffer Stock or Safety Stock** – **Re-Order Level***

Chapter 12 (Omit Sec 12.10)

Unit –IV

REPLACEMENT PROBLEM: Introduction - Replacement of items that deteriorate with time - **Replacement of Items that fail completely***

Chapter 13

Unit –V

NETWORK SCHEDULING BY PERT/CPM: Introduction – Basic Concepts – Construction of the Network – **Critical Path Analysis*** – Statistical Considerations in PERT – Cost Considerations in PERT/CPM

Chapter 14

*** denotes self-study (Questions may be asked from these portions also)**

Book for study:

KantiSwarup, P. K. Gupta and Man Mohan, *Introduction to Operations Research*, Sultan Chand and Sons, Third Edition, 1997.

Book for reference:

V. Sundaresan, K. S. Ganapathy Subramanian and K. Ganesan, *Resource Management Techniques*, A.R. Publications, Second Edition, 2004.

e-resources:

1. https://www.youtube.com/watch?v=xGkpXk-AnWU
2. https://www.youtube.com/watch?v=fW5VYQqcSpY
3. https://www.youtube.com/watch?v=vUMGvpsb8dc

Programme	**:**	**B.Sc. Mathematics**			
Course Title	**:**	**Core 18: Number Theory**	**Course Code**	**:**	**20UMA6C18**
Year	**:**	**Third Year**	**Semester**	**:**	**VI**
Hours/Week	**:**	**5**	**Credits**	**:**	**4**

Course Objectives

1. To impart knowledge in the basic concepts of number theory, fundamental definitions, theorems.
2. To learn congruence, arithmetic function and its properties.
3. To solve challenging problems in number theory.

Course Outcomes(CO)

CO1	Recall the theory of integers from a list of axioms.	K1
CO2	Classify the problems to solve using the learned principles and theorem.	K2&K3
CO3	Explaining various divisibility tests and apply them in real life problems.	K4
CO4	Apply number theory algorithms and procedures to basic problems in mathematics.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	L		M	S	M	S	M
CO2	S	S	S	M	M		S	S	S	S	M
CO3	S	S	S	S	M		S	S	M	S	S
CO4	S	S	S	S	M		S	S	M	S	M

S – Strong; M – Medium; L – Low

Unit –I

INTRODUCTION – Divisibility- Division Algorithm-Euclidean Algorithm- Primes

Chapter 1: 1.1-1.3

Unit-II

CONGRUENCES: Congruences- Solution of Congruences- The Chinese remainder theorem- Prime Power Moduli- Prime Modulus.

Chapter 2: 2.1 – 2.3 & 2.6-2.7

Unit-III

QUADRATIC RECIPROCITY AND QUADRIC FORMS: Quadratic Residue– Quadratic Reciprocity- The Jacobi Symbol – Binary Quadric Forms.

Chapter 3: 3.1 - 3.4

Unit-IV

SOME FUNCTIONS OF NUMBER THEORY: Greatest integer function –Arithmetic function- The Mobius inversion formula- Recurrence functions.

Chapter 4 : 4.1 – 4.4

Unit- V

SOME DIOPHANTINE EQUATIONS: The equation ax+by = c – Simultaneous Equations- Pythagorean Triangles- Assorted Examples

Chapter 5 : 5.1 – 5.4

Book for study:

A. Ivan Niven, S. Herbert, Zuckerman, Hugh and L. Montgomerry, *An Introduction to The Theory of Numbers*, Wiley, Fifth Edition, Reprint-2013.

Books for reference:

1. T. M. Apostol, *Introduction to Analytic Number theory*, Springer Verlag, 1976.
2. Kennath and Rosan, *Elementary Number Theory and its Applications*, Addison Wesely Publishing Company,1968.

e-resources:

1. https://freevideolectures.com/course/3027/cryptography-and-network-security
2. https://www.youtube.com/watch?v=SCvtxjpVQms&t=3321s
3. https://www.youtube.com/watch?v=Oyw5OmOd9B8