UNIVERSITY OF MADRAS

SYLLABUS

B.Sc. Mathematics

(with effect from the academic year 2020-2021)

Note: The Committee is designed Learning Outcome Based Curriculum Framework of Under Graduate Mathematics Programmes prescribed by UGC

CORE PAPER I-ALGEBRA

Learning Outcomes:

Students will acquire

- **Basic ideas on Theory of Equations, Matrices and Theory of Numbers.**
- **Knowledge to solve theoretical and applied problems.**

Unit 1

Theory of Equations :Polynomial equations with Imaginary and irrational roots- Relation between roots and coefficients- Symmetric functions of roots in terms of coefficients.
Chapter 6 : Section 9 to 12.

Unit 2

Reciprocal equations - Standard form-Increase or Decrease the roots of the given equation -Removal of terms Approximate solutions of roots of polynomials by Horner's method.
Chapter 6:   section 16, 16.1, 16.2, 17, 30.

Unit 3

Summation of Series : Binomial- Exponential -Logarithmic series (Theorems without proof):
Chapter 3: Section 10, Chapter 4: Section 3, 3.1, 3.5, 3.6, 3.7 (omit 3.4)

Unit 4

Symmetric- Skew Symmetric- Hermitian- Skew Hermitian- Orthogonal Matrices- Eigen values & Eigen Vectors- Similar matrices- Cayley - Hamilton Theorem.
Chapter 2: Section 6.1 to 6.3, 9.1, 9.2, 16, 16.1, 16.2, 16.3.

Unit 5

Prime number and Composite number - Divisors of a given number N- Euler's function (without proof) - Integral part of a real number - congruences.
Chapter 5: Section 1 to 13.

Contents and treatment as in

1. Algebra,   Volume I by T. K. ManicavachagamPillay,T.Natarajan, K.S.Ganapathy, Viswanathan Publication 2007 -   Unit – 1 and 2.

2. Algebra, Volume II by T. K. ManicavachagomPillay ,T.Natarajan ,K.S.Ganapathy, Viswanathan Publication 2008 - Unit – 3, 4 and 5.

Reference:-

1. Algebra by S. Arumugam (New Gama publishing house, Palayamkottai).
2. Algebra and Trigonometry, Volume I and II by P.R.Vittal, V.Malini (Margham Publishers).

1. http://mathworld.wolfram.com
2. http://www.themathpage.com/

CORE PAPER II - DIFFERENTIAL CALCULUS

Learning outcomes:

Students will acquire Knowledge about

- **The basics of differentiation and its applications.**
- **The notion of curvature, evolutes, involutes and polar co-ordinates.**

Unit 1

Successive differentiation - n^{th} derivative- standard results – Trigonometrical transformation – formation of equations using derivatives - Leibnitz's theorem and its applications

Chapter 3 section 1.1 to 1.6, 2.1 and 2.2

Unit 2

Total differential of a function – special cases – implicit functions - partial derivatives of a function of two functions - Maxima and Minima of functions of two variables- Lagrange's method of undetermined multipliers.

Chapter 8 : Section 1.3 to 1.5 and 1.7, Section 4, 4.1 and 5.

Unit 3

Envelopes – method of finding envelopes – Curvature- circle, radius and centre of curvature- Cartesian formula for radius of curvature – coordinates of the centre of curvature – evolute-and involute - radius of curvature and centre of curvature in polar coordinates – p-r equation

Chapter 10 Section 1.1 to 1.4 and Section 2.1 to 2.7

Unit 4

Polar coordinates - angle between the radius vector and the tangent – slope of the tangent in the polar coordinates – the angle of intersection of two curves in polar coordinates- polar sub tangent and polar sub normal – the length of arc in polar coordinates.

Chapter 9 Section 4.1 to 4.6

Unit 5

Definition-Asymptotes parallel to the axes – special cases – another method for finding asymptotes - asymptotes by inspection – intersection of a curve with an asymptote.

Chapter 11 - Section 1 to 7.

Content and treatment as in

"Calculus", Volume - 1 by S. Narayanan and T.K. Manicavachagompillay -
S.Viswanathan publishers – 2006

Reference:-

     1.Calculus , Dr. P.R. Vittal&Dr. V. Malini, Margham Publications, Chennai.

     2.Calculus by Thomas and Fenny, Pearson Publication.

     3.Calculus by Stewart

     4. Calculus , Dr. P.R. Vittal&Dr. V. Malini, Margham Publications, Chennai.

e-Resources:

1. http://www.themathpage.com/
2. http://mathworld.wolfram.com
3. http://www.univie.ac.at/future.media/moe/galerie.html
4. http://www.analyzemath.com/calculus

SECOND SEMESTER

CORE PAPER III-TRIGONOMETRY

Learning outcomes:

Students will acquire Knowledge

- **About the expansions of Trigonometric Functions, Hyperbolic Functions and sum of Trigonometric Series.**

Unit 1

Expansions of powers of $\sin\theta$, $\cos\theta$ - Expansions of $\cos^n\theta$, $\sin^n\theta$,$\cos^m\theta\sin^n\theta$

Chapter 2, Section 2.1, 2.1.1, 2.1.2,2.1.3

Unit 2

Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ - Expansions of $\tan(\theta_1+\theta_2+\ldots\ldots+\theta_n)$ - Expansions of $\sin x$,

$\cos x$, $\tan x$ in terms of x-Sum of roots of trigonometric equations – Formation of equation with trigonometric roots.

Chapter 3, Section 3.1 to 3.6

Unit 3

Hyperbolic functions-Relation between circular and hyperbolic functions - Formulas in hyperbolic functions – Inverse hyperbolic functions

Chapter 4, Section 4.1 to 4.7 .

Unit 4

Inverse function of exponential functions – Values of Log (u+iv) - Complex index.

Chapter 5, Section 5.1 to 5.3

Unit 5

Sums of Trigonometric series – Applications of binomial, exponential, , logarithmic and Gregory's series - Difference method.

Chapter 6, Section 6.1 to 6.6.3

Content and treatment as in

Trigonometry by P. Duraipandian and KayalalPachaiyappa, Muhil Publishers.

Reference:-

1.Trigonometry, Calculus , Dr. P.R. Vittal , Margham Publications, Chennai.
2. Trigonometry by T.K. Manickavachagam Pillay.S.Viswanathan (Printers and Publishers) Pvt.   Ltd.

e-Resources:

1. http://mathworld.wolfram.com
2. http://ocw.mit.edu/courses/mathematics/

CORE PAPER IV- INTEGRAL CALCULUS
Learning outcomes:

Students will acquire Knowledge about
- **Integration and its geometrical applications, double, triple integrals and improper integrals.**
- **Vector differentiation and Vector integration.**

Unit 1
Reduction formulae– Types, $\int x^n e^{ax} dx$, $\int x^n cosaxdx$, $\int x^n sinaxdx$, $\int cos^n xdx$, $\int sin^n xdx$, $\int sin^m x cos^n xdx$, $\int tan^n xdx$, $\int cot^n xdx$, $\int sec^n xdx$, $\int cosec^n xdx$, $\int x^n (\log x)^m dx$ -Bernoulli's formula.
 Chapter 1 Section 13, 13.1 to 13.10,14,15.1.

Unit 2

Multiple Integrals- definition of the double integrals- evaluation of the double integrals- double integrals in polar coordinates – triple integrals – applications of multiple integrals – volumes of solids of revolution – areas of curved surfaces – change of variables – Jacobians.

Chapter 5 Section 1, 2.1, 2.2, 3.1, 4, 6.1, 6.2, 6.3, 7
Chapter 6 Section 1.1, 1.2, 2.1 to 2.4.

Unit 3

Beta and Gamma functions - infinite integral – definitions –   recurrence formula of Γ functions - properties of β-functions - relation between β and Γ functions.
Chapter 7 Sections 1.1 to 1.4 , 2.1, 2.3, 3, 4, 5.

Unit 4

Introduction - directional derivative- Gradient- divergence- curl- Laplacian Differential Operator.

Chapter 2 Sections 2.1 - 2.13.

Unit 5

Line, surface and volume integrals - Integral Theorems - Gauss, Greens and Stokes (Without proof) – Problems.

Chapter 3 Sections 3.1 to 3.6 and

Chapter 4 Sections 4.1 to 4.5.

Content and treatment as in

1. "Calculus", Vol- II by S. Narayanan and T.K. Manicavachagampillay - S. Viswanathanpublishers– 2007 for Unit 1 , Unit 2 , Unit 3.

2. "Vector Analysis" by P.Duraipandian and KayalalPachaiyappa, S.ChandFor Unit 4, Unit 5.

Reference:-

1. Integral Calculus and differential equations : Dipak Chatterjee (TATA McGraw Hill Publishing companyLtd.).

2. Vector Algebra and Analysis by Narayanan and T.K.Manickvachagam Pillay S .Viswanathan Publishers.

3. Vector Analysis: Murray Spiegel (Schaum Publishing Company, NewYork).

e-Resources:

1. http://mathworld.wolfram.com.
2. http://www.sosmath.com.

CORE PAPER V - ANALYTICAL GEOMETRY

Learning outcomes:

Students will acquire Knowledge
- **To analyze characteristics and properties of two and three dimensional geometric shapes.**
- **To develop mathematical arguments about geometric relationships.**
- **In Geometry and its applications in real world.**

Unit 1
Chord of contact – polar and pole,- conjugate points and conjugate lines – chord with (x_1, y_1) as its midpoint – diameters – conjugate diameters of an ellipse.- semi diameters- conjugate diameters of hyperbola
Chapter 7: Sections 7.1 to 7.3 , Chapter – 8 Section 8.1 to 8.5.

Unit 2
Polar coordinates: General polar equation of straight line – Polar equation of a circle on $A_1 A_2$ as diameter, Equation of a straight line, circle, conic – Equation of chord, tangent, normal. Equations of the asymptotes of a hyperbola.
Chapter 10 : Sec 10.1 to 10.8.

Unit 3
Introduction – System of Planes - Length of the perpendicular – Orthogonal projection.
 Chapter 2 Sec 2.1 to 2.10.

Unit 4
Representation of line – angle between a line and a plane- co-planar lines- shortest distance 2 skew lines- Length of the perpendicular- intersection of three planes
Chapter 3 :Sec 3.1 to 3.8.

Unit 5
Equation of a sphere - general equation - section of a sphere by a plane - equation of the circle - tangent plane - angle of intersection of two spheres- condition for the orthogonality -radical plane.
Chapter 6 : Sec 6.1 to 6.8.

Contents and treatment as in
1. Analytical Geometry of 2D by P.Durai Pandian- Muhil publishers for Unit – 1 and 2
2. Analytical Solid Geometry of 3D by Shanthi Narayan and Dr.P.K. Mittal-S.Chand& Co. Pvt.Ltd.- for Unit – 3 to 5

Reference :
1. Analytical Geometry of Two Dimension by T. K. Manikavachakam Pillai and S. Narayanan.S.Viswanathan (Printers and Publishers) Pvt. Ltd.

2. Analytical Geometry of Three Dimension by T. K. Manikavachakam Pillai and S. Narayanan.S.Viswanathan (Printers and Publishers) Pvt. Ltd.

e-Resources:

1. http://mathworld.wolfram.com.
2. http://www.univie.ac.at/future.media/moe/galerie.html

CORE PAPER-VI-DIFFERENTIAL EQUATIONS

Learning outcomes:

Students will acquire knowledge

- **About the methods of solving Ordinary and Partial Differential Equations.**
- **To introduce Differential Equation as a powerful tool in solving problems in Science.**

Unit 1

Ordinary Differential Equations:Variable separable-Homogeneous Equation-Non-Homogeneous Equations of first degree in x and y-Linear Equation-Bernoulli's Equation-Exact differential equations.
Chapter 2: Section 1 to 6.

Unit 2

Equation of first order but not of higher degree: Equation solvable for dy/dx- Equation solvable for y-Equation solvable for x- Clairauts form-Linear Equations with constant coefficients-Particular integrals e^{ax}, sinax, cosax, x^m, Ve^{ax} where V is sinax or cosax or x^m .
Chapter 4: Section 1, 2.1, 2.2, 3.1.
Chapter 5: Section 4.

Unit 3

Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals- Reduction to the Normal form- Change of the Independent Variable - Method of Variation of Parameters.
Chapter 6: Section- 6
Chapter 8:Section- 1,2,3,4.

Unit 4

Partial differential equation: Formation of PDE by Eliminating arbitrary constants and arbitrary functions-complete integral-singular integral-General integral- Lagrange's Linear Equations Pp+Qq=R.

Chapter 12: Section- 1, 2, 3.1, 3.2, 4.

Unit 5

Special methods - Standard forms - Charpit's Methods - Related problems

Chapter 12: Section-5.1, 5.2, 5.3, 5.4, 6.

Contents and treatment as in

"Differential Equations and its applications", by S.Narayanan,   T.K.Manikavachagam Pillay —- S.Viswanathan (Printers and Publishers) Pvt. Ltd(2006).

Reference:

1.Mathematics for B.Sc-Branch-I Volume –III by P.Kandasamy ,K.Thilagavathy

S.Chand Publications.

2.Differential equations with applications and historical notes by George F.Simmons,

  2ndEd,TataMcgraw Hill Publications .

3. Differential Equations by ShepleyL.Ross, 3 rdEd ,JohnWiely and sons 1984.

4 .Differential Equations by N.P.Bali,Laxmi Publications Ltd,New Delhi-2004.

5. Ordinary and Partial differential Equation by Dr.M.D.Raisinghania ,S.Chand.

e-Resources:

1.http://mathworld.wolfram.com
2. http://www.analyzemath.com/calculus/Differential_Equations/applications. html

CORE PAPER VII TRANSFORM TECHNIQUES

Learning outcomes:

Students will acquire knowledge

- **About Laplace Transforms and its inverse**
- **To apply Laplace transform in solving Ordinary Differential Equations with constant coefficients, simultaneous Ordinary Differential Equations.**
- **To solve problems in Fourier series and Fourier transforms.**

UNIT I: The Laplace Transforms-Definitions-Sufficient conditions for the existence of the Laplace transform(without proof)-Laplace transform of periodic functions-some general theorems-evaluation of integrals using Laplace transform-Problems.

Chapter 5: Section-1 to 5.

UNIT II:The inverse Laplace Transforms- Applications of Laplace Transforms to ordinary differential equations with constant co-efficients and variable co-efficients, simultaneous equations and equations involving integrals-Problems.

Chapter 5: Section-6 to 12.

UNIT III: Fourier series- Expansion of periodic functions of period 2π- Expansion of even and odd functions, Half range Fourier series-Change of intervals –Problems.

Chapter 6: Section-1 to 6.

UNIT IV: Fourier Transform- Infinite Fourier Transform(Complex form) – Properties of Fourier Transform – Fourier cosine and Fourier sine Tranform – Properties – Parseval's identity – Convolution theorem - Problems.

Chapter 6: Section-8 to 15.

UNIT V: Z Transforms: Definitionof Z-Transform and its properties - Z-Transforms of some basic functions- Examples and simple problems

Chapter 7: Sections -7.1 to 7.3.

Contents and treatment as in

1. "Calculus-Volume III" – S.Narayananand T.K.ManicavachagamPillai. (Ananda Book Depot)(**for Units I to IV**)
2. "Engineering Mathematics for Semester III- Third Edition – T.Veerarajan (Tata McGraw-Hill Publishing Company Ltd, New Delhi) (**for Unit-V**)

Reference Books

1. Engineering Mathematics Volume III – P.Kandasamy and others (S.Chand and Co.)
2. Advanced Engineering Mathematics- Stanley Grossman and William R.Devit.

Engineering Mathematics III-A.Singaravelu, Meenakshi Agency, Chenani, 2008

e-Resources:

1. http://mathworld.wolfram.com.
2. http://www.sosmath.com.

CORE PAPER- VIII - STATICS

Learning outcomes:

Students will acquire knowledge about

- **Particles or body in rest under the given forces.**
- **Forces, equilibrium of a particle and centre of mass of various bodies.**

Unit 1

Force- Newtons laws of motion - resultant of two forces on a particle- Equilibrium of a particle
Chapter 2 - Section 2 .1 , 2.2 , Chapter 3 - Section 3.1.

Unit 2

Forces on a rigid body – moment of a force – general motion of a rigid body- equivalent systems of forces – parallel forces – forces along the sides of a triangle – couples
Chapter 4 - Section 4 .1 to 4.6.

Unit 3

Resultant of several coplanar forces- equation of the line of action of the resultant- Equilibrium of a rigid body under three coplanar forces – Reduction of coplanar forces into a force and a couple.- problems involving frictional forces
Chapter 4 - Section 4.7 to 4.9,
Chapter 5 - Section 5.1, 5.2.

Unit 4

Centre of mass – finding mass centre – a hanging body in equilibrium
Chapter 6 - Section 6.1 to 6.3.

Unit 5

Hanging strings- equilibrium of a uniform homogeneous string – suspension bridge
Chapter 9 - Section 9.1, 9.2.

Contents and treatment as in

"Mechanics" by P. Duraipandian ,LaxmiDuraipandian , MuthamizhJayapragasham, S. Chand and Co limited 2008 .

Reference:

1.Dynamics – K. ViswanathaNaik and M. S. Kasi, Emerald Publishers.

2.Dynamics – A. V. Dharmapadam, S. Viswanathan Publishers.

3.Mechanics – Walter Grenier.

e-Resources:

1.   https://www.wikipedia.org/
2.   https://physics.info

The Allied Subjects may be chosen from the following List.

List of Allied subjects:

1 .Physics - I

2. Chemistry - I

3. Calculus of finite differences and Numerical Analysis -I

4. Mathematical Statistics - I

5. Financial Accounting - I

6. Physics - II (pre-requisite Physics - I) .

7. Chemistry - II (pre-requisite Chemistry - I)

8. Calculus of finite.differences and Numerical Analysis -II (pre-requisite
   Calculus of finite differences and Numerical Analysis -I).

9. Mathematical Statistics - (pre requisite Mathematical Statistics- I)

10. Financial Accounting - II (prerequisite Financial Accounting - I)

11. Cost Accounting

12. Management Accounting.

NOTE : Syllabus for Financial Accounting - I and II .can be obtained from Board of Studies for Commerce.

CALCULUS OF FINITE DIFFERENCES AND NUMERICAL ANALYSIS-I

Learning outcomes:

Students will acquire knowledge about
- **Numerical techniques used as powerful tools in scientific computing.**
- **Linear algebraic,transcendental equations and interpolation using finite difference formulae.**

Unit 1
Solutions of algebraic and transcendental equations: Bisection method- Iteration method- Regula-falsi method- Newton-Raphson method.
Chapter 1 :Section 1.1 - 1.4

Unit 2
Solutions of Simultaneous Linear Equations: Gauss-Elimination method, Gauss-Jordan method, Crout's method, Gauss-Seidel method.
Chapter 2 :Section 2.1 - 2.4 , 2.6

Unit 3
 Finite Differences: E operators and relation between them- Differences of a polynomial-Factorial polynomials- inverse operator Δ^{-1} -Summation Series.
Chapter 3 :Section 3.1 to 3.4, 3.6, 3.7.

Unit 4
 Interpolation with Equal Intervals:Newton's Forward and Backward Interpolation formulae- Central Differences Formulae: Gauss-Forward and Backward Formulae- Stirling's Formula and Bessel's Formula-Equidistant terms with one or more missing values.
Chapter 4 :Section 4.1- 4.3 (omit 4.1a, 4.4), 4.7 .
 Chapter 5 :Section 5.1- 5.6.

Unit 5
Interpolation with Unequal Intervals: Divided Differences - Newton's Divided Differences Formula for Interpolation -Lagrange's Formula for Interpolation-Inverse Interpolation-Lagrange's method-Reversion of Series method.
Chapter 6 :Section 6.1, 6.2, 6.5, 6.7.

Content and Treatment as in
" Calculus of Finite Differences and Numerical Analysis" by P. Kandasamy and K. Thilagavathy,
S. Chand and Co Pvt.Ltd.

Reference:
1. " Numerical Analysis " by B. D. Gupta, Konark Publishing.
2. "Numerical methods in Science and Engineering" by M. K. Venkataraman, National Publishing House, Chennai.

CALCULUS OF FINITE DIFFERENCES AND NUMERICAL ANALYSIS-II

<u>Learning outcomes:</u>

Students will acquire knowledge about

- **Numerical techniques used as powerful tools in scientific computing.**
- **Numerical Differentiation , Numerical Integration and Difference Equations.**

Unit 1
Numerical Differentiation: Derivatives using Newton's forward and backward difference formulae-Derivatives using Stirling's formula- Derivatives using divided difference formula- Maxima and Minima using the above formulae.
Chapter 7 :Section 7.1- 7.4, 7.6.

Unit 2
Numerical Integration: General Quadrature formula- Trapezoidal rule-Simpson's one-third rule-Simpson's three-eighth rule- Weddle's rule- Euler-Maclaurin Summation formula-
Stirling's formula for n!.
Chapter 7 :Section 7.7- 7.9, 7.13- 7.15.

Unit 3
Difference equations:Linear homogenous and nonhomogenous difference equation with constant coefficients- particular integrals for $a^u x^m, x^m, sinkx, coskx$.
Chapter 8 :Section 8.1- 8.4, 8.6

Unit 4
Numerical solution of Ordinary Differential Equations (I order only):
Taylor's series method- Picard's method- Euler's method- Modified Euler's method.
Chapter 9: Section 9.5-9.7, 9.9.

Unit 5
Numerical solution of Ordinary Differential Equations (I order only):
Runge-kuttamethod(fourth order only)- Predictor-Corrector method- Milne's method -
Adams-Bashforth method.
Chapter 9 : Section 9.10 - 9.14.

Content and Treatment as in
" Calculus of Finite Differences and Numerical Analysis" by P. Kandasamy and K. Thilagavathy,
S. Chand and Co. Pvt.Ltd.

Reference:
1) " Numerical Analysis " by B. D. Gupta, Konark Publishing.
2) "Numerical methods in Science and Engineering" by M. K. Venkataraman, National Publishing House, Chennai.

e-Resources:
1. https://nptel.ac.in
2. https://www.encyclopediaofmath.org/index.php/Finite-difference_calculus

NON MAJOR ELECTIVE I & II

FUNCTIONAL MATHEMATICS I

Unit 1

Ratio and Proportion

Unit 2

Percentages

Unit 3

Profit and Loss, Discounts

Unit 4

Simple Interest and Compound interest

Unit 5

Solutions of Simultaneous equations, Problems on Ages and Numbers.

Reference:

Quantitative Aptitude- R.S. Agarwal

FUNCTIONAL MATHEMATICS II

Unit 1

Time and work – Pipes and cisterns- Problem

Unit 2

Time and Distance, Relative speeds- Problems on Races, Boats and Trains.

Unit 3

Mensuration – Problems

Unit 4

Polygons – Interior angles- Number of diagonals- Regular Polygons- Problems

Unit 5

Stocks and Shares – Problems

Reference:

1.Quantitative Aptitude- R.S. Agarwal

2. Functional Mathematics, M. Sivananda Rani, Margham Publications, Chennai.

MATHEMATICAL STATISTICS – I

Learning outcomes:

Students will acquire knowledge of

- **The laws of Probability and Baye's theorem.**
- **Measures of Location, Dispersion, Correlation and Regression**
- **The Discrete and Continuous Probability Distributions.**

Unit 1

Concept of sample space- Events- Definition of Probability (Classical,Statstical& Axiomatic)- Addition and Multiplication laws of Probability- Independence- Conditional Probability- Baye's theorem – Simple Problems.

Unit 2

Random Variables (Discrete and Continuous) Distribution function- Expected values and Moments- Moment generating function – Probability generating function- Examples.

Unit 3

Characteristic function- Uniqueness and Inversion theorems (Statements and applications only)- Cumulants - Chebychev's Inequality – Simple Problems.

Unit 4

Concepts of bivariate distributions- Correlation and Regression- Linear Prediction- Rank Correlation coefficient-Concepts of partial and multiple correlation coefficients- Simple problems.

Unit 5

Standard Distributions – Binomial- Poisson- Normal- Uniform distributions- Geometric- Exponential- Gamma -Beta distributions- Inter relationship between distributions.

Reference:

- S.C.Gupta&V.K.Kapoor : Elements of Mathematical Statistics, Sultan Chand & Sons, NewDelhi.
- Hogg R.V. & Craig A.T. (1988) : Introduction to Mathematical Statistics, McMillan.
- Mood A.M. &Graybill F.A. &Boes D.G. (1974): Introduction to theory of Statistics, McGraw Hill.
- Snedecor G.W. & Cochran W.G(1967) : Statistical Methods, Oxford and IBH.

e-Resources:

1. https://nptel.ac.in
2. https://www.wikipedia.org.
3. http://ebooks.lpude.in.statistics.

MATHEMATICAL STATISTICS II

Learning outcomes:

Students will acquire knowledge

- **To provide the foundation of statistical analysis used in varied applications.**
- **Of Sampling methods, Tests of significance and testing of hypothesis.**

Unit 1

Sampling theory – Sampling Distributions – Concept of Standard error – Sampling distribution based on normal distribution- t, Chi Square and F distributions.

Unit 2

Point estimation – Concepts of unbiasedness – consistency – efficiency and sufficiency- Cramer Rao inequality – Methods of estimation- Maximum likelihood- moments - minimum square and their properties (Statement only).

Unit 3

Test of significance – Standard error- Large sample test, Exact test based on normal, t, chi-square and F distribution with respect to population mean/means, proportion/proportions, variance and correlation coefficient. Test of independence of attributes based on contingency tables- Goodness of fit based on chi-square.

Unit 4

Analysis of Variance: One way, two way classification concepts &Problems.Interval estimation – Confidence intervals for population mean/means- Proportion/proportions and variances based on t, Chi-Square and F.

Unit 5

Test of hypothesis- Type I and II errors- Power of test – Neymann Pearson lemma- Likelihood ratio test-concepts of most powerful test- statements and results only-simple problems.

Reference:

- S.C.Gupta&V.K.Kapoor : Elements of Mathematical Statistics, Sultan Chand & Sons, NewDelhi.
- Hogg R.V. & Craig A.T. (1988): Introduction to Mathematical Statistics, McMillan.
- Mood A.M. &Graybill F.A. &Boes D.G. (1974): Introduction to theory of Statistics, McGraw Hill.
- Snedecor G.W. & Cochran W.G(1967) : Statistical Methods, Oxford and IBH.
- Hoel P.G. (1971) : Introduction to Mathematical Statistics, Wiley.
- Wilks S.S. Elementary Statistical Analysis, Oxford and IBH.

e-Resources:
1. https://nptel.ac.in
2.https://www.wikipedia.org.
3.http://ebooks.lpude.in.statistics.

SEMESTER-V
CORE PAPER- IX   ALGEBRAIC STRUCTURES - I

<u>**Learning outcomes:**</u>

Students will acquire knowledge about the concepts of Sets, Groups and Rings.

Unit 1
Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange's Theorem- A counting principle.
Chapter 2 Section 2.4 and 2.5.

Unit 2
Normal subgroups and Quotient group- Homomorphism- Automorphism.
Chapter 2 Section 2.6 to 2.8.

Unit 3

Cayley's Theorem- Permutation groups.

Chapter 2 Section 2.9 and 2.10.

Unit 4

Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.
Chapter 3 Section 3.1 to 3.5.

Unit 5

The field of quotients of an integral domain- Euclidean Rings- The particular Euclidean ring.
Section 3.6to 3.8.

Contents and treatment as in
"Topics in Algebra" – I. N. Herstein, Wiley Eastern Ltd.

Reference:
1.Modern Algebra by M.L.Santiago, McGraw Hill Education India pvt Ltd.
2.Modern Algebra by S. Arumugam and others, New Gamma publishing House, Palayamkottai.
3.Modern Algebra by Visvanathan Nayak, Emerald Publishers, Reprint 1992.

e-Resources:

1.https://nptel.ac.in
2.http://garsia.math.yorku.ca/~sdenton/algstruct.

CORE PAPER-X- REAL ANALYSIS -I

Learning outcomes:

Students will acquire knowledge to
- **Apply Mathematical concepts and Principles to perform numerical and symbolic computations.**
- **Understand and perform simple proofs.**
- **Know how abstract ideas and rigorous methods in Mathematical Analysis can be applied to practical problems.**

Unit 1

Sets and Functions:Sets and elements- Operations on sets- functions- real valued functions- equivalence-countability - real numbers- least upper bounds.
Chapter 1 Section 1. 1 to 1.7

Unit 2

Sequences of Real Numbers:Definition of a sequence and subsequence- limit of a sequence- convergent sequences- divergent sequences- bounded sequences- monotone sequences-

Chapter 2 Section 2.1 to 2.6

Unit 3

Operations on convergent sequences- operations on divergent sequences- limit superior and limit inferior- Cauchy sequences.

Chapter 2 Section 2.7 to 2.10

Unit 4

Series of Real Numbers: Convergence and divergence- series with non-negative terms- alternating series- conditional convergence and absolute convergence- tests for absolute convergence- series whose terms form a non-increasing sequence- the class l^2
Chapter 3 Section 3.1 to 3.4, 3.6, 3.7 and 3.10

Unit 5

Limits and Metric Spaces:Limit of a function on a real line-. Metric spaces - Limits in metric spaces. Continuous Functions on Metric Spaces: Function continuous at a point on the real line-Reformulation-Function continuous on a metric space.

Chapter 4 Section 4.1 to 4.3 Chapter 5 Section 5.1-5.3

Contents and Treatment as in

 "Methods of Real Analysis" : Richard R. Goldberg (Oxford and IBH Publishing Co.).

Reference:
1.   Principles of Mathematical Analysis by Walter Rudin,TataMcGrawHill.
2.   Mathematical Analysis Tom M Apostol, Narosa Publishing House.

e-Resources:
1.   https://mathcs.org/analysis/reals/numseq/sequence.html.
2.   http://www-groups.mcs.st-andrews.ac.uk/~john/analysis/index.html
3.   http://www.phengkimving.com.

CORE PAPER- XI- DYNAMICS

Learning outcomes:

Students will acquire knowledge of

- **The motion of bodies under the influence of forces.**
- **Rectilinear motion of particles, Projectiles, Impact and Moment of Inertia of Particles**.

Unit 1
Kinematics -Basic units – velocity – acceleration- coplanar motion .
Chapter 1 - Section 1.1 to 1.4

Unit 2

Work, Energy and power – work – conservative field of force – power – Rectilinear motion under varying Force: Simple harmonic motion (S.H.M.) – S.H.M. along a horizontal line- S.H.M. along a vertical line

Chapter 11 - Section 11.1to 11.3 ,

Chapter 12 - Section 12.1 to 12.3

Unit 3

Projectiles -Forces on a projectile- projectile projected on an inclined plane.

Impact: Impulsive force - impact of sphere - impact of two smooth spheres – impact of a smooth sphere on a plane – oblique impact of two smooth spheres

Chapter 13 - Section 13.1,13.2

 Chapter 14 - Section 14.1, 14.5

Unit 4

Circular motion – Conical pendulum – simple pendulum – central orbits -general orbits - central orbits-conic as centered orbit.

Chapter 15 - Section 15.1, 15.2, 15.6

Chapter 16 - Section 16.1 to 16.3

Unit 5

Moment of inertia, Perpendicular and parallel axes theorem.

Chapter 17 -Section 17.1, 17.1.1

Contents and treatment as in

"Mechanics" – P. Duraipandian, LaxmiDuraipandian ,MuthamizhJayapragasham, S. Chand and Co limited 2008 .

Reference :

1. Dynamics – K. ViswanathaNaik and M. S. Kasi, Emerald Publishers.
2. Dynamics – A. V. Dharmapadam, S. Viswanathan Publishers.
3. Mechanics – Walter Grenier

   e-Resources:

   1. https://nptel.ac.in
   2. https://www.wikipedia.org

CORE PAPER- XII- DISCRETE MATHEMATICS

Learning outcomes:

Students will acquire knowledge

- **To apply tools and ideasin Mathematics for solvingApplied Problems.**
- **To Evaluate Boolean functions and to express a logic sentence in terms of predicates, quantifiers, and logical connectives.**

Unit 1
Integers:Set, some basic properties of integers, Mathematical induction, divisibility of integers, representation of positive integers
Chapter 1 - Sections 1.1 to 1.5

Unit 2
Boolean algebra &Applications:Boolean algebra, two element Boolean algebra, Disjunctive normal form, Conjunctive normal form
Chapter 5 - Sections 5.1 to 5.4

Unit 3
Application, Simplication of circuits, Designing of switching circuits, Logical Gates and Combinatorial circuits.
Chapter 5 - Section 5.5, 5.6

Unit 4
Recurrence relations and Generating functions:Sequence and recurrence relation, Solving recurrence relations by iteration method, Modeling of counting problems by recurrence relations, Linear (difference equations) recurrence relations with constant coefficients, Generating functions, Sum and product of two generating functions, Useful generating functions, Combinatorial problems.
Chapter 6 - Section 6.1 to 6.6

Unit 5
Proportional logic and Predicate logic: Proportional logic, Adequate system of connectivies, Translation of sentences in a Natural Language into Statement Formula, Logical validity of arguments, Predicate Logic, Negation of a statement obtained by qualification of a predicate, Logical operations on predicates or quantified predicates, Symbolization of sentences by using predicates, Quantifiers and connectives, Logical validity of arguments.
Chapter 8 - Sections 8.1, 8.5 to 8.8 (Omit Section 8.2 to 8.4)

Contents and treatment as in
"Introduction to Discrete Mathematics", 2nd edition, 2002 by   M. K. Sen and B. C. Chakraborty,   Books and Allied Private Ltd., Kolkata.

Reference:-

1. Discrete mathematics for computer scientists and mathematicians by J. L. Mertt,AbrahamKendel and T. P. Baker prentice-hall, India.
2. Discrete mathematics for computer scientists by John Truss-Addison Wesley.
3. Elements of Discrete Mathematics, C. L. Liu, New York Mcgraw-Hill, 1977.

e-Resources:

1. https://brilliant.org/wiki/discrete-mathematics/.
2. https://www.tutorialspoint.com/discrete_mathematics/.

SEMESTER-VI
CORE PAPER-XIII - ALGEBRAIC STRUCTURES - II

Learning outcomes:

Students will acquire knowledge about the Vector Spaces, Dual spaces, Inner product spaces and linear transformations.

Unit 1
Vector spaces. Elementary basic concepts- linear independence and bases Chapter 4 Section 4.1 and 4.2.

Unit 2
Dual spaces
Chapter 4 Section 4.3.

Unit 3
Inner product spaces.
Chapter 4 Section 4.4.

Unit 4
Algebra of linear transformations- characteristic roots.
Chapter 6 Section 6.1 and 6.2.

Unit 5
Matrices- canonical forms- triangular forms.
Chapter 6 Section 6.3 and 6.4.

Content and Treatment as in
"Topics in Algebra" – I. N. Herstein-Wiley Eastern Ltd.

Reference:

1. University Algebra – N. S. Gopalakrishnan – New Age International Publications, Wiley Eastern Ltd.
2. First course in Algebra – John B. Fraleigh, Addison Wesley.
3. Text Book of Algebra – R. Balakrishna and N. Ramabadran, Vikas publishing Co.
4. Algebra – S. Arumugam, New Gamma publishing house, Palayamkottai.

e-Resources:

1. https://nptel.ac.in.
2. http://ebooks.lpude.in.linearalgebra.

CORE PAPER – XIV- REAL ANALYSIS -II

Learning outcomes:

Students will acquire knowledge about

- **The Real Numbers and the Analytic Properties of Real- Valued Functions.**
- **The Analytic concepts of Connectedness, Compactness, Completeness And Calculus.**

Unit 1

Continuous Functions on Metric Spaces: Open sets- closed sets- Discontinuous function on R^1. Connectedness, Completeness and Compactness :More about open sets- Connected sets. Chapter 5 Section 5.4 to 5.6

Chapter 6 Section 6.1 and 6.2

Unit 2

Bounded sets and totally bounded sets: Complete metric spaces- compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.

Chapter 6 Section 6.3 to 6.8

Unit 3

Calculus:Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral- properties of Riemann integral.

Chapter 7 Section 7.1 to 7.4

Unit 4

Derivatives- Rolle's theorem, Law of mean, Fundamental theorems of calculus.

Chapter 7 Section 7.5 to 7.8

Unit 5

Taylor's theorem- Pointwise convergence of sequences of functions, uniform convergence of sequences of functions.

Chapter 8 Section 8.5 Chapter 9 Section 9.1 and 9.2

Content and Treatment as in
"Methods of Real Analysis"- Richard R. Goldberg (Oxford and IBH Publishing Co)

Reference:-
1.   Principles of Mathematical Analysis by Walter Rudin,TataMcGrawHill.
2.   Mathematical Analysis Tom M Apostal,Narosa Publishing House.

e-Resources:
1.   https://nptel.ac.in.
2.   https://mathonline.wikidot.com.
3.   https://en.wikipedia.org/wiki/Metric_space.

CORE PAPER XV – COMPLEX ANALYSIS

Learning outcomes:

Students will acquire knowledge about the basic ideas of analysis of Complex Functions in solving Complex Variables.

Unit 1
Analytic Functions:Functions of a Complex Variable – Limit- Theorems on Limits – Continuuous functions- Differentiability – Cauchy – Riemann equations – Analytic functions-Harmonic functions – Conformal mapping.
Chapter 1 – sec 2.1 to 2.9.

Unit 2
Bilinear Transformations:Elementary transformations – Bilinear transformations – Cross ratio-Fixed Points of Bilinear Transformations – Mapping by Elementary Functions -   The Mapping $w = z^2$, z^n, n is a positive integer,$w = e^z$, sin z, cos z.
Chapter 3 – sec 3.1 to 3.4 , Chapter 5 – sec 5.1 to 5.5

Unit 3
Complex Integration – definite integral – Cauchy's Theorem – Cauchy's integral formula – Higher derivatives.
Chapter 6 – sec 6.1 to 6.4

Unit 4
Series expansions – Taylor's series – Laurent's Series – Zeroes of analytic functions-Singularities.
Chapter 7 – 7.1 to 7.4

Unit 5
Residues – Cauchy's Residue Theorem – Evaluation of definite integrals.
Chapter 8 – 8.1 to 8.3.

Content and treatment as in
"Complex Analysis" byDr.S.Arumugam,Thangapandi Isaac, Dr.A.Somasundaram, SciTech publications(India) Pvt Ltd,2002.

Reference:
1. Complex variables and Applications (Sixth Edition) by James Ward Brown and RuelV.Churchill, Mc.Grawhill Inc.
2. Complex Analysis by P.Duraipandian,KayalakPachaiyappa,S.Chand& Co Pvt.Ltd.
3. Complex Analysis ,T.K.Manickavachagom Pillay, S.Viswanathan Publishers Pvt. Ltd.

e-Resources:
1. http://ebooks.lpude.in.complexanalysis.
2. https://nptel.ac.in.

GROUP   A
1. PROGRAMMING IN 'C' WITHPRACTICALS

THEORY
Learning outcomes:

Students will acquire knowledge

- **About the basic concepts and structure of 'C' program.**
- **To write simple programs with Mathematical Applications.**

Unit 1
Introduction - Constants-Variables-Data-types -Operators, Precedence of operators – Managing Input   and Output Operations .
Chapters : 2,3 and 4.

Unit 2
Decision making and branching: Simple if, if else, nested if, else if ladder and switch statement – conditional operator – go to statement.
Decision making and looping : while, do while and for statement – nested for loops – jumps in loops (continue and break statements).
Chapters : 5 and 6.

Unit 3
Arrays : One dimensional and 2 dimensional arrays – declarations – initialization of arrays.
 Character Arrays and Strings: Declaration   andIntialization of Strings - Reading and Writing strings - Operations on strings - String handling functions.

Chapters: 7 and 8

Unit 4

Functions : Need for User defined functions- A Multi function Program- Elements of User defined functions - Function definition , Function Call and Function Declaration – Return Values and their types- Categories of functions – Nesting of Functions- Recursion .
Pointers: Understanding Pointers-Accessing address of a variable- Declaration and Intialization of Pointers- Accessing a Variable through its Pointer- Function call by reference - call by value.
Chapters : 9 and 11.

Unit 5

 File Management in C : Definition-Opening and Closing a file- Input/ Output
operations on Files- Error Handling during I/O operations.
 Chapter 12.

Content and Treatment as in
"Programming in ANSI C", 7thEdition, 2017, by E. Balagurusamy, McGraw Hill Education India Private Limited**.**
Reference:-
1.   "Programming in C" by Venugopal.
2.   "Programming with C" by Gottfied.B.S ,Schaum‟s outline series, TMH 2001.
3.   "Let us 'C'" by YashvantKanitkar ,BPB Publications.
         4.   "Programming with C" by R.S.Bichkar,Universities Press (INDIA) Pvt.Ltd.
 e-Resources:

 1.https://www.w3schools.in/c-tutorial.
 2.https://en.cppreference.com/w/c.

PRACTICALS

Writing 'C' programs for the following:

1. To convert Centigrade to Fahrenheit
2. To find the area, circumference of a circle
3. To convert days into months and days
4. To solve a quadratic equation
5. To find sum of n numbers
6. To find the largest and smallest numbers
7. To generate Pascal's triangle, Floyd's triangle
8. To find the trace of a matrix
9. To add and subtract two matrices
10. To multiply two matrices
11. To generate Fibonacci series using functions
12. To compute factorial of a given number, using functions

13. To add complex numbers using functions
14. To concatenate two strings using string handling functions
15. To check whether the given string is a palindrome or not using string handling functions.

Question paper pattern: **External (60)+ Internal(40)**

Internal:

Internal Practical Assessment + Attendence + Record = 30 + 5 + 5 = 40 marks

External:
- Answer any 2 questions out of 3 questions : (2 **x 30 = 60)**

2. PROGRAMMING IN PYTHON WITH PRACTICALS

THEORY

Learning outcomes:
    Students will acquire knowledge
- **About the basic concepts and structure of Python program.**
- **In Developing Programming skills.**

UNIT 1
Basics of Python Programming:Features – History – Future – Python Interpreter and Interactive Mode – Writing and Executing First Python Programme – Values and Types – Data Types – Operators and Expressions – Operations on Strings – Type Conversion – Comments – Functions and Modules.
Chapter 2: Section 2.1 – 2.22

UNIT 2
Control Flow Statements:Introduction to Decision Control Statements –Conditional Branching – Loops Structures – Nested Loops – Break – Continue – Pass – Else Statement Used with Loops.
Chapter 3: Section 3.1 – 3.8

UNIT 3
Functions:Introduction – Defining a function– Function Call – Variable Scope and Lifetime – Fruitful Function –Lambda – Function Composition – Documentation Strings –Recursive Functions
Chapter 4: Section 4.1 – 4.8, 4.10 (Omit 4.9)

UNIT 4
Strings:Concatenating, Appending, and Multiplying Strings – Immutable – Formatting Operator – Built-in String Methods and Functions – Slice Operation – Comparing Strings – Iterating String.

Lists, Tuples and Dictionaries:Sequence – Lists.
Chapter 5: Section 5.1 – 5.5, 5.8, 5.9 (Omit 5.6, 5.7)
Chapter 6: Section 6.1 to 6.2

UNIT 5
Lists, Tuples and Dictionaries: Tuple – Dictionaries
File Handling:Opening and Closing Files – Reading and Writing Files.
Error and Exception Handling:Introduction – Handling Exceptions.
Chapter 6: Section 6.4 to 6.5 (Omit 6.3)
Chapter 7: Section 7.4, 7.5
Chapter 8: Section 8.1, 8.2

Content and Treatment in
"Problem Solving and Programming with Python", by ReemaThareja (Second Edition, 2019, OXFORD University Press)

Reference:-
1. "Problem Solving and Python Programming" by Mr. Ashok NamdevKamthane and Mr. Amit Ashok Kamthane (McGraw Hill Education (India) Private Limited).
2. "Python Programming" by Ch.Sathyanarayana, M.Radhika Mani, B.N. Jagadesh, Universities Press (INDIA) Pvt.Ltd.

e-Resources:

1. https://www.pythonforbeginners.com.
2. https://www.w3schools.com.

PYTHON PRACTICALS

Write a Python Program for the following:

1. Compute the Area and Circumference of a Circle
2. To find the greatest among three numbers
3. Program to calculate roots of a quadratic equation
4. Determine the given number is an Armstrong number
5. Compute the G.C.D. of two Numbers
6. Sum the series: $1/1+2^2/2+3^2/3+\ldots+n^2/n$
7. Finding Factorial of a number
8. To print the Fibonacci Series using recursion
9. Count the occurrences of a character in a string
10. Program to reverse a string

11. Calculate distance between two points
12. To add two matrices
13. Print a histogram of frequencies of characters occurring in a message
14. Generate Floyd's triangle.
15. Implement Tower of Hanoi problem

Question paper pattern: External (60)+ Internal(40)

Internal:

Internal Practical Assessment + Attendence + Record = 30 + 5 + 5 = 40 marks

External:
- Answer any 2 questions out of 3 questions : (2 **x 30 = 60**)

3. MATHEMATICAL MODELING

Learning outcomes:

Students will acquire knowledge about

- **Construction and Analysis of Mathematical models inspired by real life problems.**
- **The Meaning of Equations and FunctionalRelationships.**

Unit 1

Mathematical Modeling : Simple situations requiring mathematical modeling, characteristics of mathematical model.
Chapter 1 Sections 1.1-1.5

Unit 2

Mathematical Modeling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.
Chapter 2 Sections 2.1- 2.4

Unit 3
Mathematical Modeling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations.

Epidemics: simple epidemic model, Susceptible-infected- susceptible(SIS) model, SIS model with constant number of carriers.

Medicine : Model for Diabetes Mellitus.
Chapter 3 Sections 3.11, 3.12,3.2.and 3.51

Unit 4
Introduction to difference equations.
Chapter 5 Sections 5.1 and 5.2

Unit 5
Mathematical Modeling, through difference equations:Harrod Model, cobweb model application to Actuarial Science
Sections 5.3 (5.3.3 not included)

Content and treatment as in
J N Kapur, Mathematical Modeling, New Age International publishers.(2009).

Reference:-
1. Mathematical Modeling by Bimalk . Mishra and Dipak K.Satpathi.

e-Resources:

1. https://nptel.ac.in

4. NUMERICAL METHODS

Learning outcomes:

Students will acquire knowledge about
- **Numerical techniques used as powerful tools in scientific computing.**
- **Linear, Algebraic and Transcendental equations and interpolation using finite difference formulae.**
- **Numerical Differentiation, Numerical Integration and Difference Equations.**

Unit 1
Interpolation and Approximation: First difference- Introduction- forward and backward difference-

Newton's forward and backward difference formulas for equal intervals- Divided differences- Newton's divided difference formula- Lagrangian Polynomials for unequal intervals
Chapter 5, Section 5.1, Chapter 6, Section 6.1 to 6.3 and Chapter 8, Section 8.1 to 8.5 and 8.7

Unit 2
Numerical Differentiation and Integration :Differentiation using Newton's forward and backward interpolation formulae- Numerical integration by trapezoidal, Romberg's method- Simpson's 1/3 and 3/8 rules.

Chapter 9, Section 9.1 to 9.4, 9.6, 9.7 to 9.14

Unit 3
Taylor series method- Picard's method - Euler method for first order equation- Modified Euler method-Fourth order Runge – Kutta method for solving first order equations.
Chapter 11, Section 11.1, 11.5 to 11.9, 11.11 to 11.13.

Unit 4
Numerical solution of ordinary differential equation by finite difference method- Numerical solution of partial differential equations - Elliptic equation, Poisson equation.
Appendix E, Chapter 12, Section12.1, 12.4 and 12.5 to 12.7

Unit 5
Numerical solution of partial differential equations - Parabolic equations, Hyperbolic equations Chapter 12, Section 12.8 to 12.10

Content and treatment as in
"Numerical Methods",by Dr P.Kandasamy, Dr. K. Thilagavathy and Dr. K. Gunavathi. S.Chand and Company Ltd

Reference:
1. Numerical Methods With Programming in C by T. Veerarajan and T. Ramachandran.
2. Introductory Methods of Numerical Analysis by S.S.Sastry.

e-Resources:
1. https://nptel.ac.in.
2. https://mathonline.wikidot.com.

5. ELEMENTARY NUMBER THEORY

Learning outcomes:

Students will acquire knowledge

- **About the basic structure and properties of integers.**
- **To improve the ability of mathematical thinking.**

Unit 1
Introduction – divisibility- primes- The Binomial theorem
Chapter 1- Sections - 1.1 to 1.4

Unit 2
Congruences, Solution of Congruences, Chinese Remainder Theorem- primitive roots and power Residues- Number Theory from an Algebric view point - Groups, rings and fields.
Chapter – 2   Sections 2.1 to 2.3, 2.8 (cor 2.42, Th 2.43 and cor 2.44 are omitted) - 2.10.- 2.11

Unit 3
Quadratic Residues , Quadratic reciprocity , The Jacobi
Symbol Chapter – 3 Sections 3.1 to 3.3

Unit 4
Greatest Integer Function, Arithmetic function, The Mobius Inversion
formula Combinational Number Theory
Chapter – 4   Sections 4.1 to 4.3 and 4.5

Unit 5
The equation ax+by=c, Simultaneous Linear Equations, Pythagorean Triangle,
Assorted examples. Chapter – 5 Sections 5.1 to 5.4

Content and treatment as in
"An introduction to the Theory of Numbers (Vth edition)", by Ivan Niven, Herbert S. Zuckarman and Hugh L. Montgometry John Wiley & Sons, Inc.2001.

Reference:-
1. Elementary theory of numbers, cy. Hsiung, Allied publishers, 1995.
2. Elementary Number Theory, Allyn and Bacon Inc., Boston, 1980.
3. Introduction to Analytic Number Theory, Tom. M. Apostol, Narosa Publishing House, New Delhi, 1989.

e-Resources:

1.https://nptel.ac.in.
2.https://mathonline.wikidot.com.

6. GRAPH THEORY

Learning outcomes:

Students will acquire knowledge

- **To describe and apply some basic algorithms for graph.**
- **To model real world problems using graph theory.**

Unit 1

Graphs and Subgraphs: Introduction- Definition and examples, degrees, sub graphs, isomorphism, independent sets and coverings, intersection graphs and line graphs, matrices, operations on graphs
Chapter 2 Sections 2.0 – 2.9 (Omit section 2.5)

Unit 2

Degree sequences and Connectedness:Degree sequences and graphic sequences – simple problems. Walks, trails, paths, connectedness and components, blocks, connectivity – simple problems.
Chapter 3 Sections 3.0 – 3.2 , Chapter 4 Sections 4.0 – 4.4

Unit 3

Eulerian and Hamiltonian graphs
Chapter 5 Sections 5.0 – 5.2

Unit 4

Trees : Characterisation of Trees, Centre of a Tree -simple problems.
Planarity : Definition and properties, characterization of planar graphs.
Chapter 6 Sections 6.0 – 6.2 , Chapter 8 Sections 8.0 – 8.2

Unit 5

Directed Graphs: Definition and basic properties, paths and connections, digraphs and matrices, tournaments .
Chapter 10 Sections 10.0 – 10.4

Content and treatment as in

"Invitation to Graph Theory", by S.Arumugam and S.Ramachandran, Scitech Publications (India) Pvt. Ltd., Chennai 17.

Reference:

1. A first look at graph theory by John Clark and Derek Allan Holton, Allied publishers.

2. Graph Theory by S.Kumaravelu and SusheelaKumaravelu,Publishers authors C/o
   182 Chidambara Nagar, Nagarkoil
.

7. OPERATIONS RESEARCH

Learning outcomes:

Students will acquire knowledge in

- **Solving Linear Programming Problems.**
- **Sequencing the jobs to be carried out based on Cost Optimization.**
- **Solving assignment and transportation problems and Queuing Theory Models.**

Unit 1
Linear programming: Formulation − graphical solution. Simplex method. Big-M method. Duality-primal-dual relation.
Chapter 6 Sections 6.1 − 6.13, 6.20 − 6.31

Unit 2
Transportation problem: Mathematical Formulation. Basic Feasible solution. North West Corner rule, Least Cost Method, Vogel's approximation. Optimal Solution. Unbalanced Transportation Problems. Degeneracy in Transportation problems.

Assignment problem: Mathematical Formulation. Comparison with Transportation Model. Hungarian Method. Unbalanced Assignment problems
Chapter 9 Sections 9.1 − 9.12 ,Chapter 8 Sections 8.1 − 8.5

Unit 3
Sequencing problem: n jobs on 2 machines − n jobs on 3 machines − two jobs on m machines − n jobs on m machines.

Game theory : Two-person Zero-sum game with saddle point − without saddle point − dominance − solving 2 x n or m x 2 game by graphical method.
Chapter 10 Sections 10.1 − 10.6 ,Chapter 12 Sections 12.1 − 12.15

Unit 4
Queuing theory: Basic concepts. Steady state analysis of M / M / 1 and M / M / S models with finite and infinite capacities.
Chapter 5 Sections 5.1 − 5.18

Unit 5
Network: : Project Network diagram − CPM and PERT computations. (Crashing excluded)
Chapter 13

Sections 13.1 – 13.10

Content and treatment as in
Operations Research, by R.K.Gupta , Krishna Prakashan India (p),Meerut Publications.

Reference:
1.Gauss S.I. Linear programming , McGraw-Hill Book Company.

2. Gupta P.K. and Hira D.S., Problems in Operations Research ,S.Chand& Co.
3.KantiSwaroop, Gupta P.K and Manmohan , Problems in Operations Research,Sultan Chand & Sons.

4. Ravindran A., Phillips D.T. and Solberg J.J., Operations Research, John wiley   & Sons.
5. Taha H.A. Operation Research, Macmillan pub. Company, New York.

6. Linear Programming, Transporation, Assignment Game by Dr.Paria, Books and Allied(p) Ltd.,1999.

7. V.Sundaresan,K.S. GanapathySubramaian and K.Ganesan,Resource Management Techniques..A.R Publications.
e-Resources:

1. http://ebooks.lpude.in.operationsresearch.
2. https://ocw.mit.edu.

8.SPECIAL FUNCTIONS

Learning outcomes:
Students will acquire knowledge about

- **The mathematical concepts of Special Functions.**
- **Developing series solution of Differential Equations.**
- **The concepts of Legendre polynomial , Bessel functions and Gamma functions.**

Unit 1

Introduction and Review of power series – Series solution of first order differential equations Chapter 5 Sections 26 and 27

Unit 2
Second order linear differential equations-Regular, singular points.
Chapter 5 Sections 28 and 29

Unit 3
Regular singular points continued: Gauss's hyper geometric equations.
Chapter 5 Sections 30 and 31

Unit 4
Legendre polynomials-Properties of Legendre polynomials
Chapter 8 Sections.44 and 45

Unit 5
Bessel functions and Gamma functions-Properties of Bessel Functions.
Chapter 8 Sections 46 and 47

Contents and treatment as in
 "Differential equations with Applications and Historical Notes "by George F.Simmons,SecondEdition,TataMcgraw Hill Publications.

Reference:
1. Differential Equations by D.Raisinghania.
2. 2.Differential Equations by Ganesh C.Gorian.

 e-Resources:
1. https://dlmf.nist.gov/.
2. https://Specialfunctionswiki.org.

9. APPLIED STATISTICS

Learning outcomes:

Students will acquire knowledge of
- **Measures of Location, Dispersion, Correlation and Regression**
- **To provide the foundation of statistical analysis used in varied applications.**
- **Of Sampling methods, tests of significance.**

Unit 1

Random Variables(Discrete and Continuous) Distribution function- Expected values and Moments- Moment generating function – Probability generating function- Examples.

Unit 2

Concepts of bivariate distributions- Correlation and Regression- Linear Prediction- Rank Correlation coefficient-Concepts of partial and multiple correlation coefficients- Simple problems.

Unit 3

Standard Distributions – Binomial, Poisson, Normal and Uniform distributions- Geometric, Exponential, Gamma and Beta distributions. Inter relationship between distributions.

Unit 4

 Test of significance – Standard error- Large sample test, Exact test based on normal, t, chi-square and F distribution with respect to population mean/means, proportion/proportions, variance and correlation coefficient. Test of independence of attributes based on contingency tables- Goodness of fit based on chi-square.

Unit 5

Analysis of Variance: One way, two way classification concepts &Problems.Interval estimation – Confidence intervals for population mean/means- Proportion/proportions and variances based on t, Chi-Square and F.

Reference:

- S.C.Gupta&V.K.Kapoor: Elements of Mathematical Statistics, Sultan Chand &Sons,NewDelhi
- Hogg R.V. & Craig A.T. 1988): Inttroduction to Mathematical Statistics, Mcmillan.
- Mood A.M. &Graybill F.A. &Boes D.G. (1974): Introduction to theory of Statistics, Mcgraw Hill.
- Snedecor G.W. & Cochran W.G(1967) : Statistical Methods, Oxford and IBH.
- Hoel P.G. (1971) : Introduction to Mathematical Statistics, Wiley.
- Wilks S.S. Elementary Statisticaal Analysis, Oxford and IBH

e-Resources:
1. http://ebooks.lpude.in.statistics.
2. https://nptel.ac.in
3. https://www.wikipedia.org.