# P.K.R. ARTS COLLEGE FOR WOMEN

# (AUTONOMOUS)

**(Accredited with 'A' grade by NAAC - Affiliated to Bharathiar University, Coimbatore)**

**GOBICHETTIPALAYAM – 638 476**

# DEPARTMENT OF MATHEMATICS

# MASTER OF SCIENCE IN MATHEMATICS

**Syllabus**

***For the candidates admitted from the Academic Year 2021-2022 and onwards***

**Under CBCS PATTERN**

## MASTER OF SCIENCE - MATHEMATICS

**Programme Scheme and Scheme of Examinations**

***(For students admitted from 2021-2022 & onwards)***

***Scholastic Courses:***

| Category / Part | Component | Course Code | Title of the Course | Contact Hrs/ week | Exam Duration hrs. | Max.Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CIA | ESE | Total | |
| | | | **SEMESTER - I** | | | | | | |
| III | Core: I | 21MAP01 | Advanced Algebra | 6 | 3 | 50 | 50 | 100 | 5 |
| III | Core :II | 21MAP02 | Real Analysis | 6 | 3 | 50 | 50 | 100 | 5 |
| III | Core : III | 21MAP03 | Ordinary Differential Equations | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core : IV | 21MAP04 | Classical Mechanics | 5 | 3 | 50 | 50 | 100 | 4 |
| III | Core:V Elective : I | 21MAP05A/ 21MAP05B | Numerical Analysis/ Optimization Techniques | 5 | 3 | 50 | 50 | 100 | 3 |
| III | Core : VI Practical | 21MAP06 | Programming in Python Practical | 2 | 3 | 50 | 50 | 100 | 1 |
| | | | **TOTAL** | **30** | | | | **600** | **22** |
| | | | **SEMESTER - II** | | | | | | |
| III | Core :VII | 21MAP07 | Complex Analysis | 6 | 3 | 50 | 50 | 100 | 5 |
| III | Core : VIII | 21MAP08 | Partial Differential Equations | 5 | 3 | 50 | 50 | 100 | 4 |
| III | Core : IX | 21MAP09 | Measure Theory and Integration | 5 | 3 | 50 | 50 | 100 | 4 |
| III | Core :X | 21MAP10 | Differential Geometry | 5 | 3 | 50 | 50 | 100 | 4 |
| III | Core : XI Elective : II | 21MAP11A / 21MAP11B | Mathematical Statistics/ Programming in C++ | 5 | 3 | 50 | 50 | 100 | 3 |
| III | Core : XII Elective : II Practical | 21MAP12A/ 21MAP12B | Mathematical Software – I (SPSS) – Practical/ Programming in C++ - Practical | 2 | 3 | 50 | 50 | 100 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| IV | Ability Enhancement | 21AEPMA01 | Cyber Security | 2 | 3 | - | 100 | 100 | 2 |
| | | | **TOTAL** | **30** | | | | **700** | **23** |

**SEMESTER – III**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| III | Core : XIII | 21MAP13 | Topology | 6 | 3 | 50 | 50 | 100 | 5 |
| III | Core :XIV | 21MAP14 | Theory of Numbers | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core : XV | 21MAP15 | Operator Theory | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core : XVI Practical | 21MAP16 | Mathematical Software – II (R Software) - Practical | 3 | 3 | 50 | 50 | 100 | 1 |
| III | Core :XVII Open Elective | **** | Offered for students of other programmes / departments | 3 | 3 | 50 | 50 | 100 | 2 |
| V | Proficiency Enhancement | 21PEPMA01 | Industrial Mathematics (Self Study) | - | 3 | - | 100 | 100 | 2 |
| III | Core :XVIII Elective : III | 21MAP17A/ 21MAP17B | Graph Theory / Integral Transforms | 6 | 3 | 50 | 50 | 100 | 3 |
| | | | **TOTAL** | **30** | | | | **700** | **21** |

**SEMESTER – IV**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| III | Core :XIX | 21MAP18 | Functional Analysis | 6 | 3 | 50 | 50 | 100 | 5 |
| III | Core: XX | 21MAP19 | Mathematical Methods | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core :XXI | 21MAP20 | Fluid Dynamics | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core : XXII | 21MAP21 | Project Work & Viva Voce | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core : XXIII Elective : IV | 21MAP22A / 21MAP22B | Fuzzy Logic and Fuzzy Sets / Actuarial Mathematics | 6 | 3 | 50 | 50 | 100 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **TOTAL** | **30** | | | | **500** | **20** |
| V | Competency Enhancement | Online Course / Learning Object Repository (LOR) | | SEMSTER I – IV | | | | | 2 |
| | | Certificate Course | | SEMESTER I - IV | | | | | 2 |
| | | | | | | | | | 90 |

**Total Marks -2500 & Total Credits - 90**

15/10/22

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## SYLLABUS

***(For students admitted from 2021-2022 & onwards)***

**SEMESTER - I**

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE : I | 21MAP01 | ADVANCED ALGEBRA | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | I | 50 | 50 | 100 |

**Preamble**

To enable the students to learn and gain knowledge about algebraic structures, theory of groups, rings, fields and linear transformations.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the basic definitions in theory of Groups, Rings, Fields and linear transformations. | $K_1$ |
| CO2 | identify the difference between algebraic and transcendental extensions and to find the minimal polynomial for algebraic elements over a field. | $K_2$ |
| CO3 | apply the concept of Groups, Rings, Fields and linear transformations to find the dimensions. | $K_3$ |
| CO4 | analyze the results in Groups, Rings, Fields and linear transformations. | $K_4$ |
| CO5 | Evaluate the problems using permutations, | $K_5$ |

| | | |
|---|---|---|
| | polynomials and linear transformations | |
| **CO6** | Create some examples in Groups, Rings, Fields and linear transformations. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 1 | 1 | 1 |
| **CO5** | 9 | 9 | 3 | 3 | 0 | 0 | 0 |
| **CO6** | 9 | 9 | 3 | 0 | 0 | 0 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 42 | 39 | 22 | 22 | 10 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 3.33 | 3.25 | 3.55 | 3.63 | 2.24 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: GROUP THEORY** **(15 Hours)**

Another counting principle – Sylow's theorem .

**UNIT II: RING THEORY** **(15 Hours)**

Euclidean rings – A particular Euclidean ring – Polynomial rings – Polynomials over the rational field.

**UNIT III**: **FIELDS** **(15 Hours)**

Extension Fields – Roots of polynomials.

**UNIT IV: FIELDS (Continuation)** **(15 Hours)**

Elements of Galois theory – Finite Fields.

**UNIT V: LINEAR TRANSFORMATIONS** **(12 Hours)**

Canonical forms: Triangular form – Trace and Transpose – Hermitian, unitary and normal Transformations.

**TEXT BOOK:**

Herstein.I.N (Reprint 2017)– "Topics in Algebra", 2nd Edition, Wiley Indian Pvt.Ltd, New Delhi-110002.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | II | 2.11 ,2.12 |
| II | III | 3.7 to 3.10 |
| III | V | 5.1,5.3 |
| IV | V<br>VII | 5.6<br>7.1. |
| V | VI | 6.4, 6.8 and 6.10 |

**REFERENCE BOOKS:**


1. Fraleigh.J.B.( 2003) – "A First Course in Abstract Algebra",3rd Edition Narosa Publishing House, New Delhi.
2. Artin.M (1991)– "Algebra", Prentice-Hall, Englewood Cliff.
3. Hungerford.T.W.( 1974) – "Algebra", Springer, New York.


**BOOKS FOR REFERENCE:**

1.https://youtu.be/_PFLMe3TASQ

2.https://youtu.be/wKdYjOYqYGM

3.https://en.m.wikipedia.org/wiki/Sylow_theorems#:~:text=In%20mathematics%2C%20specifically%20in%20the,a%20given%20finite%20group%20contains.

4.https://youtu.be/GrxybUy3UrU

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE : II | 21MAP02 | REAL ANALYSIS | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | I | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Riemann Stieltjes Integral, Sequence and Series of functions and Functions of Several Variables.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the definitions of lower and upper bound, Riemann Stieltjes Integral, point wise , uniform convergence, equi-continuous families of functions, dimension, vector space, invertible operators and determinants. | $K_1$ |
| CO2 | demonstrate the basic concepts of the series of real numbers, necessary conditions of R.S. integral, uniform convergence, uniformly closed algebra, uniform closure, linear transformation and differentiation of integrals. | $K_2$ |
| CO3 | apply the necessary conditions of R.S. Integral, the concepts of Uniform convergence, solution of integrals, linear transformations for finding the solution of integrals convergence criteria of a certain function and dimensions respectively. | $K_3$ |

| | | |
|---|---|---|
| **CO4** | analyze the concept of Riemann Stieltjes Integral sequence and series of functions, functions of several variables. | **$K_4$** |
| **CO5** | evaluate the problems based on Riemann Stieltjes integral, sequence and series of functions and Derivatives of Higher Order. | **$K_5$** |
| **CO6** | construct the necessary conditions of R.S. Integral, Generalisation of Stone-Weierstrass theorem and functions of several variables. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate ; $K_6$ – Create.**

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO2** | 9 | 9 | 9 | 9 | 1 | 2 | 1 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 2 | 1 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 2 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 2 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 16 | 10 | 6 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 2.58 | 1.65 | 1.34 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: THE RIEMANN STILTJES INTEGRAL (15 Hours)**

Definition and Existence of the Integral –Properties of the integral –Integration and Differentiation –Integration of vector valued function .

**UNIT II: SEQUENCE AND SERIES OF FUNCTIONS (15 Hours)**

Uniform convergence - Uniform convergence and continuity –Uniform convergence and integration .

**UNIT III:SEQUENCE AND SERIES OF FUNCTIONS (Continued….) (15 Hours)**

Uniform convergence and differentiation –Equicontinuous families of functions – The Stone Weirstrass theorem.

**UNIT IV: FUNCTIONS OF SEVERAL VARIABLES (15 Hours)**

Linear transformation –Contraction principle.

**UNIT V:FUNCTIONS OF SEVERAL VARIABLES (Continued….) (12 Hours)**

Inverse function theorem –Implicit function theorem – Determinants – Differentiation of Integrals.

**TEXT BOOKS:**

Rudin.W–(2117) "Principles of Mathematical Analysis", Third edition, McGraw Hill Education Pvt.ltd, New York.

| UNIT | CHAPTER | PAGE NUMBER |
|---|---|---|
| I | 6 | 121-134 |
| II | 7 | 143-152 |
| III | 9 | 152-165 |
| IV | 3 | 204-211, 220-221 |
| V | 4 | 221-228, 231-238 |

**REFERENCE BOOKS:**


1. RobertG.Bartle and Donald R.Sherbert (2110), Third Edition,"Introduction to Real Analysis", John Wiley and sons.
2. RudinW(2112),"Real and complex Analysis", McGraw- Hill, New York, 3rd Edition.

**BOOKS FOR REFERENCE:**


**1.https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/**

**2.http://ramanujan.math.trinity.edu/wtrench/texts/TRENCH_REAL_ANALYSIS.PDF**

**3.http://www.math.louisville.edu/~lee/RealAnalysis/**

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - III | 21MAP03 | ORDINARY DIFFERENTIAL EQUATIONS | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | I | 50 | 50 | 100 |

## Preamble

To enable the students to learn various methods to solve systems of linear differential equations and non-linear initial value problems.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the fundamental concepts of power series solution, existence and uniqueness of solutions of systems of linear differential equations and non linear IVPs. | $K_1$ |
| CO2 | Explain series solutions, existence and uniqueness results, oscillations of equations. | $K_2$ |
| CO3 | Apply the various methods to solve linear differential equations. | $K_3$ |
| CO4 | Analyze the applicability of the results in systems of linear differential equations and the oscillations of second order differential equations. | $K_4$ |
| CO5 | Determine the power series solutions, the solutions of systems of linear differential equations and oscillations of second order differential equations. | $K_5$ |

| | | |
|---|---|---|
| **CO6** | formulate the research problem into a model by using differential equations. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 36 | 14 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 5.94 | 3.13 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## COURSE CONTENT:

### UNIT I: SOLUTIONS IN POWER SERIES (15 Hours)

Second order linear equations with ordinary points – Legendre equation and Legendre polynomials – Second order equations with regular singular points – Bessel function

### UNIT II:SYSTEMS OF LINEAR DIFFERENTIAL EQUATIONS (15 Hours)

Systems of first order equations – Existence and uniqueness theorem – Fundamental matrix.

**UNIT III: SYSTEMS OF LINEAR DIFFERENTIAL EQUATIONS(contd..) (15 Hours)**

Non-homogeneous linear systems – Linear systems with constant coefficients – Linear systems with periodic co-efficients.

**UNIT IV:EXISTENCE AND UNIQUENESS OF SOLUTIONS (15 Hours)**

Successive approximations – Picard's theorem - Non-uniqueness of solution – Continuation and dependence on initial conditions, Existence of solutions in the large.

**UNIT V:OSCILLATIONS OF SECOND ORDER EQUATIONS (12 Hours)**

Fundamental results – Sturm's comparison theorem – Elementary linear oscillations. Comparison theorem of Hille-Wintner – Oscillations of $x''+a(t)x=0$.

**TEXT BOOK:**

S.G.Deo,V.Lakshmikanthan and V.Raghavendra "Ordinary Differential Equations", Second Edition- Seventh reprint 2104,Tata McGraw-Hill Publishing company Limited, New Delhi.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | III | 3.1 – 3.5 |
| II | IV | 4.1 – 4.5 |
| III | IV | 4.6 – 4.8 |
| IV | V | 5.1 – 5.7 |
| V | VIII | 8.1 – 8.5 |

**REFERENCE BOOKS:**


1. Coddington.E.A. andLevinson.N., (1955), "Theory of Ordinary Differential Equations", McGraw Hill, New York.
2. George F.Simmons(1974)," Differential Equations with applications And Historical Notes", Tata McGraw Hill, New York.
3. V.Dharmaiah" Introduction to theory of Ordinary Differential Equations", PHI Learning Private Limited.

**BOOKS FOR REFERENCE:**

1. https://nptel.ac.in/courses/111/104/111104031/#

2 https://nptel.ac.in/courses/122/107/122107037/

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - IV | 21MAP04 | CLASSICAL MECHANICS | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | I | 50 | 50 | 100 |

**Preamble :**

To enable the students to learn and gain knowledge about mechanical systems, canonical transformations, Lagrange and Poisson brackets and principles of Hamilton, Jacobi, Euler and Lagrange

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the notions of configuration space, generalized co-ordinates, degrees of freedom, natural system, ignorable co-ordinates, stationary value, canonical transformation, Lagrange and Poisson brackets. | $K_1$ |
| CO2 | Classify Hamilton's principle, Euler-Lagrange equations, Hamilton-Jacobi theory and different types of constraints, work, energy and momentum. | $K_2$ |
| CO3 | Use Jacobi integral, Routhian procedure, Hamiltonian procedure, generating functions to find the differential equations of motion. | $K_3$ |
| CO4 | Critique all the theoretical techniques. | $K_4$ |
| CO5 | Evaluate the equations of Lagrange, Hamilton, Hamilton-Jacobi, | $K_5$ |

| | | |
|---|---|---|
| | linear, rotational and rolling motions and canonical tranformations | |
| **CO6** | Construct brachistochrone problem, geodesic problem , generating function and bilinear covaraint under the canonical transformation. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 7 | 7 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 0 | 0 | 0 |
| **CO6** | 9 | 9 | 3 | 3 | 0 | 0 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 48 | 48 | 18 | 10 | 10 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 3.80 | 4.00 | 2.90 | 1.65 | 2.24 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## COURSE CONTENT:

### UNIT I: INDRODUCTORY CONCEPTS (14 Hours)

Mechanical system – Generalized coordinates –Constraints – Virtual work – Energy and momentum.

**UNIT II: LAGRANGE'S EQUATIONS** **(14 Hours)**

Derivations of Lagrange's Equations– Examples-Integrals of motion.

**UNIT III: HAMILTON'S EQUATIONS** **(12 Hours)**

Hamilton's Principle – Hamilton's equations.

**UNIT IV: HAMILTON – JACOBI THEORY** **(08 Hours)**

Hamilton's principle function – Hamilton – Jacobi equation.

**UNIT V: CANONICAL TRANSFORMATIONS** **(12 Hours)**

Differential forms and generating functions –Lagrange and Poisson brackets.

**TEXT BOOK:**

Greenwood.D.T. (1997) – "Classical Dynamics", Dover Publication, New York.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | 1 | 1.1 - 1.5 |
| II | 2 | 2.1 – 2.3 |
| III | 4 | 4.1 – 4.2 |
| IV | 5 | 5.1 – 5.2 |
| V | 6 | 6.1,6.3 |

**REFERENCE BOOKS:**


1. Gupta.S.C,Kumar.V.Sharma.H.V.(2015)-"Classical Mechanics" K.K Mittal for PragattiPrakashan,Meerut.
2. Gupta.A.S.(2009)-"Calculus of Variation" PHI Learning pvt.ltd.Newdelhi.


**BOOKS FOR REFERENCE:**

1. https://bsc.hcverma.in/course/cm1
2. http://www-f1.ijs.si/~ramsak/KlasMeh/KlasMehA.pdf
3. https://www.youtube.com/watch?v=XEPC8nQsiH8

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - V ELECTIVE - I | 21MAP05A | NUMERICAL ANALYSIS | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | I | 50 | 50 | 100 |

**Preamble :**

To enable the students to learn and gain knowledge about Interpolation,numerical integration and Solution of ordinary differential equations.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the basic definitions of interpolation , numerical integration, Numerical Solution of Ordinary differential equations and Partial differential equations. | $K_1$ |
| CO2 | explain the concepts of interpolation ,numerical integration, Euler methods and predictor –corrector methods | $K_2$ |
| CO3 | apply the different method to solve the problems on interpolation ,numerical integration, Numerical Solution of Ordinary differential equations and Partial differential equations. | $K_3$ |

| | | |
|---|---|---|
| **CO4** | analyze the numerical solution of Euler and modified Euler method and predictor –corrector methods. | **$K_4$** |
| **CO5** | evaluate the problems based on interpolation , numerical integration, Euler methods and modified Euler method. | **$K_5$** |
| **CO6** | Construct the problem and find the solution by using Gauss interpolation formulae. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 3 | 3 | 3 | 0 |
| **CO5** | 3 | 3 | 3 | 3 | 1 | 1 | 1 |
| **CO6** | 3 | 3 | 3 | 1 | 1 | 1 | 1 |
| **Total Contribution of COs to POs** | 42 | 42 | 42 | 34 | 26 | 14 | 11 |
| **Weighted Percentage of COs contribution to POs** | 3.21 | 3.22 | 3.33 | 2.83 | 4.20 | 2.31 | 2.46 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: CENTRAL DIFFERENCE INTERPOLATION FORMULA (10 Hours)**

Central Difference table – Gauss's forward interpolation formula - Gauss's Backward interpolation formula – Stirling's formula- Bessel's formula.

**UNIT II: INTERPOLATION (10 Hours)**

Legrange's Interpolation formula – Inverse Interpolation

**Numerical Integration:** Numerical Integration – The Trapezoidal Rule – Simpson's $1/3^{rd}$ and Simpson's $3/8^{th}$ Rules.

**UNIT III: SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS (15 Hours)**

Taylor series method –Euler and Modified Euler methods –Rungekutta methods (Fourth Order)–Multistep methods –Milne's method –Adams Moulton method.

**UNIT IV: NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (15 Hours)**

(Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations)
Elliptic Equation –Laplace's equation on a rectangular region –Iterative methods for Laplace equation –Parabolic Equation-Hyperbolic Equation .

**UNIT V: CHARACTERISTIC VALUE PROBLEMS (10 Hours)**

Characteristic value problems –Eigen values of a matrix by Iteration –The power method-Jacobi Methods for finding Eigen values & Eigen vectors .

**TEXT BOOK:**

1. Sastry S.S (2005) -"Introductory Methods of Numerical Analysis ", Prentice-Hall of India Private limited, New Delhi-110001.

2.Dr.P.Kandasamy,Dr.K.Thilagavathi,Dr.K.Gunavathi(2005)-"Numerical Methods", S.Chand & Company LTD, New Delhi-110055.

| UNIT | BOOK | CHAPTER | SECTION |
|---|---|---|---|
| I | I | III | 3.7.1-3.7.3 |
| II | II | IX | 8.7-8.9<br>9.7-9.16 |

| | | | |
|---|---|---|---|
| | | | **Omit 9.10,9.12** |
| **III** | **I** | **VII** | **7.2, 7.4, 7.4.2, 7.5-7.6** |
| **IV** | **II** | **XII** | **12.5-12.10** |
| **V** | **II** | **XIII** | **13** |

**REFERENCE BOOKS:**

1. Chapra.S.C. and Raymond.P.C. (2000) – " Numerical Methods for Engineers", Tata McGraw Hill, New Delhi.
2. Burden.R.L. and Douglas Faires.J. (1989) – " Numerical Analysis", Fourth Edition, P.W.S.Kent Publishing Company, Boston .

**BOOKS FOR REFERENCE:**

1. https://youtu.be/PQfosTWlqC4
2. https://www.slideshare.net/niravbvyas/numerical-methods-oridnary-differential-equations-2
3. https://youtu.be/UWqVvR8SmDA

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – V ELECTIVE - I | 21MAP05B | OPTIMIZATION TECHNIQUES | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | I | 50 | 50 | 100 |

**Preamble :**

To enable the students to learn and gain knowledge about Network Scheduling, Games and Strategies, various kinds of Simulations, Transportation and Assignment models and Information Theory.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the definitions of Activities, Players, Payoff Matrix, Value of the Game, balanced and unbalanced transportation problems, Hungarian Assignment Method, Simulation Models, Network Scheduling and Entropy. | $K_1$ |
| CO2 | Explain the concepts of Activities, Players, Payoff Matrix, Value of the Game, balanced and unbalanced transportation problems, Hungarian Assignment Method, Simulation Models, Network Scheduling and Entropy. | $K_2$ |

| | | |
|---|---|---|
| **CO3** | Apply the concepts of the Maximin or Minimax Principles, tests of optimality, simulation models, Network scheduling, joint and conditional entropies. | **$K_3$** |
| **CO4** | Compare the concepts of Pure Strategies, Mixed Strategies, Looping, Dangling, Joint and Conditional Entropies. | **$K_4$** |
| **CO5** | Evaluate the problems based on Games and strategies, Value of the Game, Critical Path, Event – Type Simulation, MODI Method and Hungarian Assignment Method, Joint and Conditional Probability. | **$K_5$** |
| **CO6** | Construct the Network and Critical Path | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 3 | 3 | 3 | 0 |
| **CO5** | 3 | 3 | 3 | 3 | 1 | 1 | 1 |
| **CO6** | 3 | 3 | 3 | 1 | 1 | 1 | 1 |
| **Total Contribution of COs to POs** | 42 | 42 | 42 | 34 | 26 | 14 | 11 |
| **Weighted Percentage of COs** | 3.21 | 3.22 | 3.33 | 2.83 | 4.20 | 2.31 | 2.46 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **contribution to POs** | | | | | | | |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: GAMES AND STRATEGIES (10 Hours)**

Games and Strategies – Introduction – Two – Person Zero – Sum Games – Some Basic Terms – The Maximin – Minimax Principle – Games Without Saddle Points – Mixed Strategies – Graphical solution of 2xn and mx2 games.

**UNIT II: TRANSPORTATION AND ASSIGNMENT PROBLEM (10 HOURS)**

Solution of a Transportation problem-Finding an IBFS-Test for Optimality-MODI Method.

Assignment problem: Introduction-Mathematical Formulation of the Problem-Solution methods of Assignment Problem-Special Cases in Assignment Problem.

**UNIT III: SIMULATION (15 Hours)**

Simualtion – Introduction – Why Simualtion? – Process of Simualtion – Simualtion Models - Event – Type Simualtion - Generation of Random Numbers – Monte-Carlo simulation.

**UNIT IV: NETWORK SCHEDULING (15 Hours)**

Network Scheduling by PERT/CPM – Introduction – Network: Basic Components – Logical Sequencing – Rules of Network Construction - Concurrent Activities - Critical Path Analysis – Probability considerations in PERT - Distinction between PERT and CPM.

**UNIT V : INFORMATION THEORY (10 HOURS)**

Introduction – A Measure of Information-Entropy –The Expected Information-Entropy as a Measure of Uncertainty-Some properties of entropy Function- The Communication System-Channel Probabilities-Joint and conditional Entropies.

**TEXT BOOK:**

KantiSwarup, Gupta P.K., Man Mohan (2016) – "Operations Research", Fifteenth Thoroughly Revised Edition ,Sultan Chand and Sons, Educational Publishers, New Delhi.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| | | |

| | | |
|---|---|---|
| **I** | **XVII** | **17.1 – 17.6** |
| **II** | **X &**<br><br>**X1** | **10.8-10.13**<br><br>**11.1-11.4** |
| **III** | **XXII** | **22.1 – 22.7** |
| **IV** | **XXV** | **25.1 – 25.8** |
| **V** | **XXX** | **30.1 – 30.8 (omit 30.4 )** |

**REFERENCE BOOK:**

HamdyA.Taha (2008) – "Operations Research – An Introduction", Eighth Edition , PHI Learning Pvt. Ltd, New Delhi.

**BOOKS FOR REFERENCE:**

1. https://youtu.be/xy-x9KGMAlY
2. https://youtu.be/ezSx8OyBZVc
3. https://www.slideshare.net/SonamJain4/game-theory-10323319
4. https://www.slideshare.net/KesavartiniiBalaKrisnain/simulation-powerpoint-lecture-notes

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – VI PRACTICAL | 21MAP06 | PROGRAMMING IN PYTHON - PRACTICAL | 24 | 1 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | I | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Python programming language.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the basic concepts of Python language to solve the mathematical problems | $K_1$ |
| CO2 | Illustrate Python language to get the solution of mathematical concepts | $K_2$ |
| CO3 | Applying Python programming to get the execation of mathematical problems | $K_3$ |
| CO4 | Examine the coding of Python software in cheating the classes and objects, Correlation coefficient Probability Measres of Central tendency, temperature conversion, finding roots ,R-K method, Ordinary differential equations and distance calculation | $K_4$ |
| CO5 | Assess the Python software to find the solution of mathematical problems | $K_5$ |
| CO6 | Develop the Python software to solve the | $K_6$ |

| | | |
|---|---|---|
| | mathematical problems | |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 1 | 1 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 1 | 1 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 1 | 1 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 12 | 12 | 11 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 1.93 | 1.98 | 2.46 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## LIST OF PROGRAMS

**All the following listed programs have to be executed and recorded**

1. Write a program to create a class and object in Python.
2. Write a program to find correlation coefficient between the variables.
3. Write a program to find the probability of a prime number appearing when a 21 sided die is rolled.
4. Write a program to find standard deviation for the given set of values.
5. Write a program to calculate the mean, median and mode using Python.
6. Write a program to convert temperature from Celcius to Fahrenheit and vice versa.
7. Write a program for finding the roots of quadratic function.

8. Write a program to solve the initial value problem using Runge - Kutta method.
9. Write a program to solve ordinary differential equation using Python.
10. Write a Python program to calculate distance between two points using latitude and longitude.

**BOOKS FOR REFERENCE:**


1. https://www.tutorialgateway.org/python-program
2. https://realpython.com/python-math-module/
3. https://www.geeksforgeeks.org/mathematical-functions-python-set-1-numeric-functions/
4. https://www.udemy.com/course/math-with-python/

**SEMESTER – II**

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - VII | 21MAP07 | COMPLEX ANALYSIS | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

**Preamble :**

To enable the students to learn the concepts of analytic function.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the results in conformal mapping, complex integration and series and product developments. | $K_1$ |
| CO2 | explain the concepts of analytic functions, Cauchy's theorem, Cauchy's integral formula, power series expansion and mapping. | $K_2$ |
| CO3 | apply the theorems and results to solve problems involving complex functions. | $K_3$ |
| CO4 | analyze the local properties, zeros, power series expansion for analytic functions and conformal mapping. | $K_4$ |
| CO5 | determine the power series expansion, convergence of infinite products of an analytic function and residues. | $K_5$ |
| CO6 | construct the series and product development of complex functions. | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 1 | 0 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 23 | 13 | 13 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 3.71 | 2.14 | 2.91 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: INTRODUCTION TO THE CONCEPT OF ANALYTIC FUNCTION (20 Hours)**

Limits and continuity – Analytic functions – Polynomials – Rational functions. Conformality: Arcs and closed curves – Analytic functions in regions – Conformal Mapping – Length and Area – Linear Transformations: The Linear group – The Cross ratio – Elementary Riemann Surfaces.

**UNIT II: COMPLEX INTEGRATION (20 Hours)**

Line Integrals - Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's theorem for a rectangle - Cauchy's theorem in a disk- Cauchy's Integral formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives - Removable singularities, Taylor's Theorem – Zeros and Poles – The Local Mapping– The Maximum principle – Chains and cycles.

**UNIT III: THE CALCULUS OF RESIDUES (10 Hours)**

The Residue theorem – The Argument principle – Harmonic functions: Definitions and basic Properties – The Mean value property – Poisson's Formula.

**UNIT IV: SERIES AND PRODUCT DEVELOPMENTS (12 Hours)**

Weierstrass's Theorem – The Taylor Series – The Laurent Series – Partial fractions and Factorization: Partial Fractions – Infinite Products – Canonical Products.

**UNIT V: MAPPING THEOREM (10 Hours)**

The Riemann Mapping Theorem: Statement and Proof – Boundary Behaviour – Use of the reflection principle – Analytic Arcs – Conformal mapping of Polygons: The Behaviour at an angle – The Schwarz – Christoffel Formula – Mapping on a rectangle.

**TEXT BOOK:**

Ahlfors L.V. – (2114), "Complex Analysis" ,4$^{th}$Reprint , McGraw Hill Education (India) Pvt.Ltd New York.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | 2<br>3 | 1.1 – 1.4<br>2.1 – 2.4, 3.1, 3.2 and 3.4 |
| II | 4 | 1.1 – 1.5, 2.1 – 2.3, 3.1 - 3.4,4.1 |
| III | 4 | 5.1 – 5.2, 6.1 – 6.3 |
| IV | 5 | 1.1 – 1.3, 2.1 – 2.3 |
| V | 6 | 1.1 – 1.4, 2.1 – 2.3 |

**REFERENCE BOOK:**

RuelV.Churchill(1990) – "Complex Variables and Applications", Fifth Edition, McGraw – Hill International Editions**.**

**BOOKS FOR REFERENCE:**

1.https://www.coursera.org/learn/complex-analysis

2.https://complex-analysis.com/

3.https://mathworld.wolfram.com/ComplexAnalysis.html

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - VIII | 21MAP08 | PARTIAL DIFFERENTIAL EQUATIONS | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

**Preamble :**

To enable the students to learn and gain knowledge about Initial and boundary- value problems, Methods for solving Partial Differential Equations.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the basic concepts and various types of second order PDE. | $K_1$ |
| CO2 | discuss the classification of second order PDE, Cauchy problem, existence and uniqueness results of initial boundary – value problems, methods to find Green's function. | $K_2$ |
| CO3 | apply the method of separation of variables, method of characteristics, Green's function to solve initial boundary – value problems. | $K_3$ |
| CO4 | analyze the general solutions, existence and uniqueness of solutions of initial boundary – value problems. | $K_4$ |
| CO5 | determine the solutions of second order liner PDE. | $K_5$ |

| | | |
|---|---|---|
| **CO6** | formulate physical problems as PDE and construct the solutions. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

**CO-PO MAPPING (COURSE ARTICULATION MATRIX)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 36 | 12 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 5.94 | 2.69 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: MATHEMATICAL MODEL (12 Hours)**

The Classical equation – The vibrating string – The vibrating membrane – Conduction ofheat in solids. Classification of second order equations: Second order equations in two independent variables – Cannonical forms – Equations with constant coefficients – General solution.

**UNIT II: THE CAUCHY PROBLEM (12 Hours)**

The Cauchy problem – Cauchy – Kowlalewskaya theorem –Homogeneous wave equation – Initial – Boundary value problems – Non-homogeneous boundary conditions – Non-homogeneous wave equation.

**UNIT III: METHOD OF SEPARATION OF VARIABLES (12 Hours)**

Separation of variables – The vibrating string problem – Existence and Uniqueness of solution of the vibrating string problem. The heat conduction problem – Existence and uniqueness of solution of the heat conduction problem – The Laplace and beam equations.

**UNIT IV: BOUNDARY VALUE PROBLEMS (12Hours)**

Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorems – Dirichlet problems for a circle – Dirichlet problems for a circular annulus – Neumann problem for a circle Drirchlet problem for a rectangle.

**UNIT V: GREEN'S FUNCTIONS (12 Hours)**

The Dirac delta function – Properties of Green's function – Method of Green's functions –Dirichlet problem for the Laplace operator – Method of images – Method of Eigen functions.

**TEXT BOOK:**

TynMyint. U with Lokenath Debnath (2107) – "Linear Partial Differential Equations for Scientists and Engineers", 4th Edition , Birkhusar Boston, New York.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | III<br>IV | 3.1 – 3.5 (omit 3.4)<br>4.1 – 4.4 |
| II | V | 5.1 – 5.5, 5.7 |
| III | VII | 7.1 – 7.6 |
| IV | IX | 9.1 – 9.7 |
| V | XI | 11.1 – 11.8 (omit 11.6) |

**REFERENCE BOOKS**

1. Evans.L.C., (2103) – "Partial Differential Equations", AMS, Providence, R I.

2. Sneddon.I.N. (1957) - "Elements of Partial Differential Equations", McGraw Hill, London.

**BOOKS FOR REFERENCE:**

1. https://www.youtube.com/watch?v=bPPWp65qpIA
2. https://www.youtube.com/watch?v=BmTFbUAOeec&list=PLGCj8f6sgswntUil8yzohR_
3. https://nptel.ac.in/courses/111/104/111104031/#

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - IX | 21MAP09 | MEASURE THEORY AND INTEGRATION | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

**Preamble :**

To enable the students to learn and gain knowledge about the concepts of measurable sets and measurable spaces.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | recall the concepts of Lebesgue measure in integration, differentiation of measurable sets and product measures. | $K_1$ |
| CO2 | Explain the properties of Lebesgue measurable sets and product measures. | $K_2$ |
| CO3 | apply the Lebesgue measure, integration, differentiation, product measure in measurable sets. | $K_3$ |
| CO4 | Analyze the integration and differentiation of measurable functions over general measure spaces, measurable sets and product measures. | $K_4$ |
| CO5 | Evaluate the Lebesgue measure , Lebesgue Integration, Lebesgue Differentiation and product | $K_5$ |

| | | |
|---|---|---|
| | Measures. | |
| **CO6** | Construct the measurability of Lebesgue measure in integration, differentiation and in product measures. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

**CO-PO MAPPING (COURSE ARTICULATION MATRIX)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 1 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 18 | 16 | 13 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 2.90 | 2.64 | 2.91 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I :Lebesgue Measure** **(12 Hours)**

Introduction – Lebesgue Outer Measure – The $\sigma -$ Algebra of Lebesgue Measurable Sets – Outer and Inner Approximation of Lebesgue Measurable Sets – Countable Additivity, Continuity and the Borel–Cantelli Lemma.

**UNIT II :Lebesgue Integration** **(12 Hours)**

The Riemann Integral – The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure – The Lebesgue Integral of a Measurable Nonnegative Function –The General Lebesgue Integral.

**UNIT III : Differentiation and Integration** **(12 Hours)**

Continuity of Monotone Functions – Differentiability of Monotone Functions: Lebesgue's Theorem – Functions of Bounded Variations: Jordan's Theorem.

**UNIT IV :Integration over General Measure Spaces** **(12 Hours)**

Measurable Functions – Integration of Nonnegative Measurable Functions– The Radon–Nikodym Theorem.

**UNIT V :The Construction of Particular Measures** **(12 Hours)**

Product Measures: The Theorems of Fubini and Tonelli.

**TEXT BOOK :**

H.L. Royden, P.M. Fitzpatrick (2014) - "Real Analysis", 4th Edition, PHI Learning Private Limited, Delhi.

| UNITS | CHAPTER | SECTIONS | PAGE No |
|---|---|---|---|
| I | 2 | 2.1–2.5 | 29-47 |
| II | 4 | 4.1–4.4 | 68-89 |
| III | 6 | 6.1–6.3 | 107-118 |
| IV | 18 | 18.1–18.2, 18.4 | 359-371, 381-385 |
| V | 20 | 20.1 | 414-422 |

**REFERENCE BOOKS :**


1. Bartle R.G (1976) - "Elements of Real Analysis", 2nd Edition, John Wiley and Sons, New York.
2. RudinW(1986) - "Real and complex Analysis" , 3rd Edition,McGraw– Hill, New York.
3. Tom M.Apostal(2002)- "Mathematical Analysis" , 2nd Edition , Narosa Publishing House, New Delhi.

**BOOKS FOR REFERENCE:**


1. http://users.metu.edu.tr/eduard/TEACH/GC/MeasureTheory_II/MTLI.pdf

2. https://library.oapen.org/bitstream/id/ce19d94d-b8b6-420f-9e69-d9f565703c26/1007045.pdf

3. https://www.whitman.edu/Documents/Academics/Mathematics/2017/Wang.pdf

4. https://www.uio.no/studier/emner/matnat/math/MAT2400/v11/RealAnalCh4.pdf

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - X | 21MAP10 | DIFFERENTIAL GEOMETRY | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about the space curves, fundamental forms and geodesic on a surface.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recollect the basic concepts of theory of space curves and surfaces | $K_1$ |
| CO2 | explain the fundamental ideas in differential geometry | $K_2$ |
| CO3 | use the formulae and theoretical ideas of differential geometry in distinct curvatures. | $K_3$ |
| CO4 | analyze the nature of space curves on various surfaces, intrinsic and non-intrinsic properties and Geodesics | $K_4$ |
| CO5 | evaluate the problems on theory of space curve , Fundamental forms , intrinsic and non-intrinsic properties and Geodesics | $K_5$ |
| CO6 | Construct the various cuve Equations ,Fundamental Equations of Surface Theory, Gauss quationsWeingarten equations and Mainardi-Codazzi equations | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

**CO-PO MAPPING (COURSE ARTICULATION MATRIX)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO6** | 9 | 9 | 9 | 9 | 0 | 3 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 15 | 36 | 33 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 2.42 | 5.94 | 7.39 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I : THEORY OF SPACE CURVES (15 Hours)**

Introduction – Representation of space curves – Unique parametric representation of a space curve – Arc-length – Tangent and osculating plane – Principle normal and binormal – Curvature and torsion –Contact between curves and surfaces.

**UNIT II : THEORY OF SPACE CURVES (CONTINUATION) (15 Hours)**

Osculating circle and osculating sphere – Locus of centre of spherical curvature – Tangent surfaces – Involutes and Evolutes –Spherical indicatrix- Intrinsic equations of space curves – Fundamental existence theorem for space curves.

**UNIT III : THE FIRST FUNDAMENTAL FORM (10 Hours)**

The first fundamental form – Local intrinsic properties of a surface: Introduction - Definition of a surface – Nature of points on a surface – Representation of a surface – Curves on

surfaces –Metric on a surface –The first fundamental form– Families of curves – Orthogonal trajectories – Double family of curves.

**UNIT IV : THE SECOND FUNDAMENTAL FORM (10 Hours)**

The Second Fundamental form and local non-intrinsic properties of a surface: Introduction –The Second fundamental form-Classification of points on a surface-Principal curvatures- Lines of curvature.

**UNIT V : GEODESIC ON A SURFACE (10 Hours)**

Normal property of Geodesics –Gaussian curvature-The Fundamental Equations of Surface Theory: Introduction – Tensor notations –Gauss equations –Weingarten equations-Mainardi-Codazzi equations.

**TEXT BOOK:**

Somasundaram.D (2010)– "Differential Geometry", Fourth Reprint , Narosa Publishing House Pvt. Ltd., Chennai.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | I | 1.1 - 1.7, 1.10 |
| II | I | 1.11 - 1.13 , 1.15 – 1.17 |
| III | II | 2.1 - 2.5, 2.9-2.13 |
| IV | IV | 4.1 - 4.5 |
| V | III | 3.5, 3.12, 5.1-5.5 |

**BOOKS FOR REFERENCE:**

1. https://youtu.be/qQr1aTNwwuU

2.https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwijzNC0jZfzAhXk4jgGHZkHDsgQFnoECBkQAQ&url=https%3A%2F%2Fwww.slideserve.com%2Ffawn%2Fdifferential-geometry-for-curves-and-surfaces&usg=AOvVaw01NT_DiB3ovtmR77udV3Tv

3.https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiMg_LyjZfzAhXBwjgGHb_oCTcQwqsBegQIKhAB&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D4fB0VfKZRXM&usg=AOvVaw2uIMJy-UceDwNTEsBVPKuA

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XI ELECTIVE - II | 21MAP11A | MATHEMATICAL STATISTICS | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Probability, Mathematical Expectations, various Probability Distributions and Density Functions.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the definitions of Sample Spaces, Random Variables, Moments, Moment – Generating functions. | $K_1$ |
| CO2 | Explain the concepts of Sample Spaces, Events, Random Variables, Moments, Moment – Generating functions. | $K_2$ |
| CO3 | Apply the concepts of Sample Spaces, Random Variables, moments for solving problems based on it. | $K_3$ |
| CO4 | Compare the concepts of Sample Spaces, Sample Points, Discrete Random Variables and Continuous | $K_4$ |

| | | |
|---|---|---|
| | Random Variables. | |
| **CO5** | Evaluate the Mean, Variance, Moment - Generating Functions for different kinds of distributions. | **$K_5$** |
| **CO6** | Construct the examples for Sample Spaces, Random Variables and for different kinds of distributions like Uniform Distribution, Bernoulli Distribution, Binomial Distribution, Negative Binomial Distribution, Geometric Distribution, gamma Distribution, Exponential Distribution and Chi – Square Distribution. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 3 | 1 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 0 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 0 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 12 | 10 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 1.98 | 2.24 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I : THEORY OF PROBABILITY (12 Hours)**

Introduction – Sample spaces – Sample point – Discrete and Continuous sample spaces - Events – Venn diagrams – The probability of an Event – Rules of Probability.

**UNIT II : PROBABILITY DISTRIBUTIONS (12 Hours)**

Random variables – Discrete and Continuous Random Variables – Probability Distributions – Distribution function – Continuous Random Variables – Probability density functions.

**UNIT III : MATHEMATICAL EXPECTATION (12 Hours)**

Introduction – The expected value of a Random Variable – Moments - Chebyshev's theorem – Related Examples.

**UNIT IV : SPECIAL PROBABILITY DISTRIBUTIONS (12 Hours)**

Introduction – The Discrete Uniform Distribution – The Bernoulli Distribution – Bernoulli trial (Repeated trials ) – The Binomial Distribution – Moment Generating function of Binomial Distribution – The Negative Binomial and Geometric Distributions.

**UNIT V: SPECIAL PROBABILITY DENSITIES (12 Hours)**

Introduction – The Uniform Distribution – Mean and Variance – The Gamma Distribution – Exponential Distribution – The Chi-Square Distribution.

**TEXT BOOK :**

Irwin Miller and Marylees Miller(2012) - "Mathematical Statistics ", Seventh Edition, Pearson Publications, New Delhi.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | II | 2.1 – 2.5 |
| II | III | 3.1 – 3.4 |
| III | IV | 4.1 – 4.4 |

| | | |
|---|---|---|
| **IV** | **V** | **5.1 – 5.5** |
| **V** | **VI** | **6.1 – 6.3** |

**REFERENCE BOOK :**

Kapur.J.N and Saxena.H.C. (2011)- "Mathematical Statistics", 20th Edition, S.Chand&company, Ram Nagar, New Delhi.

**BOOKS FOR REFERENCE:**

1. https://libguides.reading.ac.uk

2. https://stats.stackexchange.com

3. https://zu.libguides.com

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XI ELECTIVE - II | 21MAP11B | PROGRAMMING IN C++ | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about C++ Programming such as Tokens, Expressions, Control Structure, Classes and Objects.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the basic concepts of programming in C++ | $K_1$ |
| CO2 | discuss the concepts of Object Oriented Programming, Functions, Classes, Operators, Constructors and Destructors. | $K_2$ |
| CO3 | identify the syntax of declaration of variable, reference variable, control structure, inline function, function prototyping, functions, operators, classes, Constructors and Destructors. | $K_3$ |
| CO4 | analyze the concepts OOPs, functions, classes and object, operators, constructor and destructors. | $K_4$ |
| CO5 | evaluate the values of mathematical function by using various functions, classes, constructor and | $K_5$ |

| | | |
|---|---|---|
| | destructors. | |
| **CO6** | construct the program by using inline function, friend function, control structure, functions, operators, classes, Constructors and Destructors. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 3 | 1 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 0 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 0 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 12 | 10 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 1.98 | 2.24 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## COURSE CONTENT:

### UNIT - I : TOKENS, EXPRESSIONS AND CONTROL STRUCTURE (12 HOURS)

**Basic Concept of Object Oriented Programming :** Basic Concept of OOPS - Benefits of OOP – Application of OOP.

**Tokens, Expressions and Control Structure:** Introduction – Tokens – Keywords – Identifiers and Constants – Basic Data Types – User Defined Data Types – Derived Data Types –

Declaration of Variables – Dynamic Initialization of Variables – Reference Variables – Operators - Control Structures.

**UNIT- II : FUNCTIONS IN C++ (12 HOURS)**

**Functions in C++:** Introduction – The Main Function – Function Prototyping – Call by Reference– Return by Reference – Inline Functions – Default Arguments – const Arguments – Recursion – Function Over Loading – Friend and Virtual Functions – Math Library Functions.

**UNIT – III : CLASSES AND OBJECTS (12 HOURS)**

**Classes and Objects:** Introduction – C Structures Revisited – Specifying a Class – Defining Member Functions – A C++ Program with Class – Making An Outside Function Inline –Nesting Of Member Functions – Private Member Functions – Arrays Within A Class –Arrays of Objects – Objects as Function Arguments – Friend Functions.

**UNIT – IV : CONSTRUCTORS AND DESTRUCTORS (12 HOURS)**

**Constructors and Destructors:** Introduction – Constructors – Parameterized Constructors – Multiple Constructors in a Class – Constructors with Default Arguments – Dynamic Initializations of Objects – Copy Constructor – Destructors.

**UNIT – V : OPERATOR OVERLOADING (12 HOURS)**

**Operator Overloading:** Introduction – Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Overloading Binary Operators Using Friends – Manipulating of Strings Using Operators – Rules for Overloading Operators.

**TEXT BOOK**

E. Balaguruswamy, Object–Oriented Programming with C++, Seven Edition, Tata McGrawHill Publishing Company Limited.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | 1 & 3 | 1.5 – 1.8, 3.1 – 3.8, 3.11 - 3.14 and 3.25 |
| II | 4 | 4.1 – 4.12 |

| | | |
|---|---|---|
| **III** | **5** | **5.1 – 5.15** |
| **IV** | **6** | **6.1 –6.11** |
| **V** | **7** | **7.1 – 7.8** |

**REFERENCE BOOKS :**


1. Programming with C++ by D. Ravichandran, -Tata McGraw Hill publishing company limited, New Delhi.
2. Object Oriented Programming with C++ by S.S.Vinod Chandra, New age.


**BOOKS FOR REFERENCE:**


1. https://www.w3schools.com/cpp/cpp_getstarted.asp
2. https://www.doc.ic.ac.uk/~wjk/c++Intro/
3. https://www.udemy.com/course/introduction-to-programming-c-cpp/
4. https://developerinsider.co/introduction-to-cpp-cpp-programming/

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XII ELECTIVE - II PRACTICAL | 21MAP12A | MATHEMATICAL SOFTWARE – I (SPSS) - PRACTICAL | 24 | 1 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about SPSS such as Mean, Median, Mode, different types of distributions.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recognize the commands provided in the SPSS environment | $K_1$ |
| CO2 | demonstrate the charts and diagrams in statistics | $K_2$ |
| CO3 | classify the various kinds of distribution such as binomial distribution, Poisson distribution and normal distribution | $K_3$ |
| CO4 | analyze the data which is used to find the mean, median, mode, standard deviation, variance and range | $K_4$ |
| CO5 | estimate the probability distribution by using various types of distributions. | $K_5$ |
| CO6 | create the SPSS database which is used to fit the | $K_6$ |

| | | |
|---|---|---|
| | straight line and plot the exponential curves. | |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 32 | 32 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 5.28 | 7.17 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## LIST OF PROGRAMS

**All the following listed programs have to be executed and recorded**

1. Create a SPSS database and to find Mean.
2. Create a SPSS database and to find Median and Mode.
3. Find the Standard deviation, Variance and Range by using SPSS database.
4. Find the Standard error of Mean, Maximum and Minimum by using SPSS database.
5. Create a SPSS database and to find both Pearson's and Spearman's correlation in both 1- Tailed and 2-Tailed tests.
6. Create the SPSS database to fit the Straight line and plot the Exponential curve using

Regression.

7. Create a SPSS database and present that data through charts and diagrams.
8. Find the probability distribution by using Binomial distribution in SPSS.
9. Find the probability distribution by using Poisson distribution in SPSS.
10. Find the probability distribution by using Normal distribution in SPSS.

**BOOKS FOR REFERENCE:**

1. https://www.ibm.com/in-en/analytics/spss-statistics-software
2. https://www.lib.sfu.ca/find/research-tools/spss-resources
3. https://libguides.muw.edu/psychandfamilyscience/spss

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XII ELECTIVE - II PRACTICAL | 21MAP12B | PROGRAMMING IN C++ | 24 | 1 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about C++ Programming such as finding the values for data, different types of functions.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recognize the commands provided in the C++ environment | $K_1$ |
| CO2 | demonstrate the data values | $K_2$ |
| CO3 | classify the various kinds of function | $K_3$ |
| CO4 | analyze the data which is used to find the different function values. | $K_4$ |
| CO5 | estimate the data values by using different function | $K_5$ |
| CO6 | create the C++ program which is used find values of data | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 32 | 32 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 5.28 | 7.17 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## LIST OF PROGRAMS

**All the following listed programs have to be executed and recorded**

### 1. DISTANCE CONVERSION PROBLEM:

Create two classes DM and DB which store the value of distances. DM store the value of distances. DM stores distances in meters and centimeters in DB in feet and inches. Write a Program that can create the values of the class objects and add one object DM with another object DB. Use a friend function to carry out addition operation. The object that stores the result may be DM object or DB object depending on the units in which results are required. The display should be in the order of meter and centimeter and feet or inches depending on the order of display.

### 2. OVERLOADING OBJECTS:

Create a class FLOAT that contains one float data member overload all the four arithmetic operators so that operate on the objects of FLOAT.

**3. OVERLOADING CONVERSIONS:**

Design a class polar which describes a pant in a plane using polar Co-ordinates radius and angle. A point in polar Co-ordinates is as shown below. Use the overloader + operator to add two objects of polar. Note that we cannot add polar values of two points directly. This requires first the conversion. Points into rectangular Co-ordinates and finally converting the result into polar Co-ordinates. You need to use following trigonometric formulas. *X= r * cos (a); Y= r * sin (a);* a=$\tan^{-1}(\frac{Y}{X})$ ; r= *sqrt (X * X +Y * Y);*

**4. OVRELOADING MATRIX:**

Create a class MAT of size M*N. Define all possible matrix operations for MAT type objects. Verify the identity. *(A-B)^2 = A^2+B^2 – 2*A*B*

**5. REA COMPUTATION USING DERIVED CLASS:**

Area of rectangle = *X*Y*

Area of triangle = ½ * *X* * *Y*

**6. VECTOR PROBLEM:**

Define a class for vector containing scalar values. Apply overloading concepts for vector addition, Multiplication of a vector by a scalar quantity, replace the values in a position vector.

**7. INHERITANCE:**

Create three classes alpha, beta and gamma, each containing one data member. The class gamma should be inherited from both alpha and beta. Use a constructor function in the class gamma to assign values to the data members of all the classes. Write a program to print the data members of all the three classes.

**8. INLINE FUNCTION:**

Create two inline functions that can return the multiplication and division for two data members.

**9. STATIC DATA MEMBER:**

Write a program to illustrate the use of static data member.

10. **ARRAY OF OBJECT**:

Create a class employee and illustrate the use of object array.

**BOOKS FOR REFERENCE:**

1. http://biet.ac.in/pdfs/C++%20LAB%20MANUAL.pdf

2. http://www.cppforschool.com/assignments.html

3. https://www.programiz.com/cpp-programming/library-function/cstdlib/labs

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART IV | ABILITY ENHANCEMENT | 21AEPMA01 | CYBER SECURITY | 24 | 2 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| First | II | - | 100 | 100 |

**Preamble:**

To understand the basics of cyber security and the security threats in day-to-day activities.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recall the basic concepts of information security and its types | K1 |
| CO2 | Explain cyber space issues and cyber security measures | K2 |
| CO3 | Apply security measures to prevent ourselves from threats in social media | K3 |
| CO4 | Identify various risks and threats in cyber space | K4 |
| CO5 | Appraise the performance of social media, security issues and their measures | K5 |
| CO6 | Compose the real time examples using case studies | K6 |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; $K_6$ – **Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | **9** | **9** | **9** | **9** | **9** | **9** | **9** |
| **CO2** | **9** | **9** | **9** | **9** | **9** | **9** | **9** |
| **CO3** | **9** | **9** | **9** | **9** | **9** | **9** | **3** |
| **CO4** | **9** | **9** | **9** | **9** | **3** | **3** | **3** |
| **CO5** | **9** | **9** | **9** | **9** | **3** | **3** | **3** |
| **CO6** | **9** | **9** | **9** | **9** | **3** | **1** | **1** |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 34 | 28 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 5.61 | 6.27 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT: I INFORMATION SECURITY (5 Hours)**

History of Information Security - Need for Security-**Types of Security:** Physical Security – Network Security –Personal Security –Operation Security –Communication Security - Information Security Threats.

**UNIT: II INTRODUCTION TO CYBER SECURITY (5 Hours)**

**Cyber Security:** Objectives- Roles- Differences between Information Security and Cyber Security. **Cyber Security Principles:** Confidentiality- Integrity – Availability.

**UNIT: III RISKS & VULNERABILITIES (5 Hours)**

**Risk Meaning:** Risk Management –Problems of Measuring Risk -Risk Levels-Risk Analyzes-Risk Assessment –Response to Risk Terminology- **Threats:** Components of Threats-Types of Threats- **Vulnerabilities:** Computing System Vulnerabilities –Hardware Vulnerabilities-Software Vulnerabilities-Data Vulnerabilities-Human Vulnerabilities.

**UNIT: IV SOCIAL MEDIA (5 Hours)**

Introduction to social media: What, Why –Pros and cons- Security issues in social media: Mail-Facebook-Whatsapp-Twitter-Preventive and control measures.

**UNIT: V CASE STUDY (4 Hours)**

Impact of social media: Education -Business- Banking-Mobile –Human Life- Present generation-Indian scenario.

**BOOKS FOR REFERENCE:**


1. https://m.youtube.com/watch?v=o6pgd8gLFHg
2. https://m.youtube.com/watch?v=3rl4ZjZpcHU
3. https://blog.barkly.com/10-fundamental-cybersecurity-lessons-for-beginners
4. https://5social media security risk and how to avoid them.html
5. https://10 cyber security twitter profiles to watch.html
6. https://cyber security in banking 4 trends to watch in 2017.html
7. https://gmail hacking security tips-indian cyber security solutions.html
8. https://why social media sites are the new cyber weapons of.html
9. EBook:A complete guide to Staying Ahead in the Cyber Security Game

**SEMESTER – III**

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - XIII | 21MAP13 | TOPOLOGY | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | III | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Topological spaces, connectedness, Compact Spaces, Countability and Completely regular spaces.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the basic definitions of Topological spaces, connectedness, Compact Spaces, Countability and Completely regular spaces. | $K_1$ |
| CO2 | explain the concepts of Topological spaces, connectedness, Compact Spaces, Countability and Completely regular spaces. | $K_2$ |
| CO3 | apply the concepts of Continuous Functions, Compact Spaces, Urysohn Metrization Theorem and Tychonoff Theorem in topological spaces. | $K_3$ |
| CO4 | analyze the separation properties, convergent sequence, metric space in the general theory of topological space. | $K_4$ |
| CO5 | justify the relationship between compact spaces, | $K_5$ |

| | | |
|---|---|---|
| | connected spaces and regular spaces. | |
| **CO6** | construct the examples for Topological spaces, connectedness, Compact Spaces, and Countability. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 1 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 1 | 1 | 1 |
| **CO5** | 9 | 9 | 3 | 3 | 0 | 1 | 0 |
| **CO6** | 9 | 9 | 3 | 0 | 0 | 0 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 42 | 39 | 22 | 15 | 10 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 3.33 | 3.25 | 3.55 | 2.47 | 2.24 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: TOPOLOGICAL SPACE (15 Hours)**

Topological spaces – Basis for a Topology – The Order Topology – Product Topology – Closed sets and Limit Points – Continuous Functions.

**UNIT II: CONNECTEDNESS (15 Hours)**

Metric Topology-Connected Spaces –Connected sets in the real line –Componentsand path components -Local connectedness.

**UNIT III:COMPACT SPACE** **(15 Hours)**

Compact Spaces –Compact subspaces of the real line-Limit Point Compactness – Localcompactness.

**UNIT IV: COUNTABILITY** **(12 Hours)**

The Countability Axioms – The Separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn Metrization Theorem .

**UNIT V: THE TYCHONOFF THEOREM** **(15 Hours)**

The Tychonoff Theorem – Completely regular spaces – The stone-Cech Compactification.

**TEXT BOOK:**

James R. Munkres (2005) - "Topology" ,2nd edition, Prentice Hall of India Private Limited, New Delhi.

| UNIT | CHAPTER | PAGE NUMBER |
|---|---|---|
| I | II | 75 - 111 |
| II | II,III | 119 – 133,147 - 162 |
| III | III | 163 - 185 |
| IV | IV | 189 - 218 |
| V | V | 230 - 241 |

**REFERENCE BOOKS:**

1. J. Dugundji, (1966) –"Topology", Allyn and Bacon, (Reprinted in India by Prentice Hall of India Private Limited)
2. George F. Simmons,(1963) - " Introduction to Topology and Modern Analysis", McGraw Hill Book Company.

**BOOKS FOR REFERENCE:**


1. https://youtu.be/PytSjbqDizE
2. https://en.m.wikipedia.org/wiki/Topology
3. https://youtu.be/WjbTliK734g

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - XIV | 21MAP14 | THEORY OF NUMBERS | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | III | 50 | 50 | 100 |

**Preamble :**

To enable the students to learn and gain knowledge about Number theory.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | bring back all the concepts in theory of numbers | $K_1$ |
| CO2 | demonstrate Congruences,Quadratic reciprocity and Arithmetic functions. | $K_2$ |
| CO3 | apply conceptual knowledge and formulae in number theory to solve the problems. | $K_3$ |
| CO4 | critique the proof and context of theorems in Divisibility,Primes, Congruences,Quadratic reciprocity and Arithmetic functions. | $K_4$ |
| CO5 | evaluate the solutions of congruences ,Jacobi symbol problems and Arithmetic functions. | $K_5$ |
| CO6 | manipulate simple research problems on Divisibility,Primes, Congruences,Quadratic reciprocity and Arithmetic functions | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO4** | 9 | 9 | 9 | 9 | 1 | 3 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 1 | 3 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 1 | 1 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 18 | 34 | 30 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 2.90 | 5.61 | 6.72 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: INTRODUCTION TO THE CONCEPT OF NUMBERS (15 Hours)**

Introduction- Divisibility-Primes.

**UNIT II: CONGRUENCES (15 Hours)**

Congruences-Solutions of congruences- Congruences of Degree 1- The functions $\phi(n)$ -Congruences of higher degree-Prime power moduli-Prime modulus.

**UNIT III: CONGRUENCES (15 Hours)**

Primitive roots and power residues-Congruences degree 2- Prime modulus-Power Residues-Number theory from an algebraic view point - Multiplicative groups-Rings and fields.

**UNIT IV:QUADRATIC RECIPROCITY (15 Hours)**

Quadratic residues- Quadratic reciprocity – The Jacobi Symbol.

**UNIT V:ARITHMETIC FUNCTIONS** **(12 Hours)**

Greatest integer function - Arithmetic functions – The Moebius Inversion formula – The multiplication of arithmetic functions .

**TEXT BOOK:**

Ivan Nivan and HerbertsZucherman (2013) – "An Introduction to Theory of Numbers",Fifth edition, Wiley Indian PvtLtd., New Delhi-110002.

| UNIT | CHAPTER | SECTIONS |
|---|---|---|
| I | I | 1.1-1.3 |
| II | II | 2.1-2.3,2.6 & 2.7 |
| III | II,III | 2.8-2.11 |
| IV | III,IV | 3.1 - 3.3 |
| V | IV | 4.1-4.3 |

**REFERENCE BOOKS:**


1. Apostol.T.M.(1995)– "Introduction to Analytic Number Theory",FirsteditionSpringer Verlag.
2. Gareth Jones .A. & Mary Jones J.(1998) – " Elementary Number Theory" -Springer publications.


**BOOKS FOR REFERENCE:**

1.https://youtu.be/19SW3P_PRHQ

2.https://www.youtube.com/watch?v=xQfsIBj5ZZg

3.https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjVjJi2hpfzAhU_gtgFHbj5AeIQFnoECCUQAQ&url=https%3A%2F%2Fhome.sandiego.edu%2F~aboocher%2Fwritings%2FNumberTheoryNotes.pdf&usg=AOvVaw34q6dy78kdn49fprv3iIJq

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - XV | 21MAP15 | OPERATOR THEORY | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | III | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Hilbert spaces, Spectral Theory and Banach Algebra.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the basic definitions of Spectral theory , infinite dimensional spectral theory,Banach Algebra, Hilbert spaces and operators. | $K_1$ |
| CO2 | explain the basic concepts of Spectral theory, infinite dimensional spectral theory, Banach Algebra, Hilbert spaces and operators. | $K_2$ |
| CO3 | apply the concepts of operator theory in Hilbert space and operator, spectral theory, Infinite Dimensional Spectral Theory and banach algebra. | $K_3$ |
| CO4 | examine the properties Hilbert space and operator, spectral theory, Infinite Dimensional Spectral Theory and banach algebra. | $K_4$ |
| CO5 | establish the adjoint Operator-Self adjoint operator, The adjoint Operator-Self adjoint operator, Spectrum of an Operator on a finite dimensional Hilbert Space | $K_5$ |
| CO6 | construct the examples for Hilbert space, the adjoint | $K_6$ |

| | | |
|---|---|---|
| | Operator-Self adjoint operator and Normal operator | |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**.

**CO-PO MAPPING (COURSE ARTICULATION MATRIX)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 3 | 3 | 1 | 1 |
| **CO5** | 9 | 9 | 3 | 3 | 1 | 1 | 1 |
| **CO6** | 3 | 3 | 3 | 1 | 1 | 1 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 22 | 22 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 3.63 | 4.93 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: HILBERT SPACE (15 Hours)**

Introduction- Definitions and Examples-Hilbert space and its basic properties-Applications of the parallelogram law-Orthogonal Complements-The Orthogonal Decomposition Theorem- Orthonormal sets.

**UNIT II: OPERATORS ON HILBERT SPACES (15 Hours)**

Introduction-The adjoint Operator-Self adjoint operator-Normal operator-Unitary operator-Projection operators.

**UNIT III: SPECTRAL THEORY (15 Hours)**

Introduction-Linear operators and Matrices on a Finite Dimensional Hilbert Space-Spectrum of an Operator on a finite dimensional Hilbert Space H-The finite Dimensional Spectral Theorem-Compact Operators.

**UNIT IV: INFINITE DIMENSIONAL SPECTRAL THEORY (15 Hours)**

Infinite Dimensional Spectral Theory-Normal and Self- Adjoint operators(Spectral Theory)-Compact Self –Adjoint and Normal Operators (Spectral Theory)- The Infinite Dimensional Spectral Theorem(Compact Normal Operator).

**UNIT V: BANACH ALGEBRA (12 Hours)**

Introduction-Definitions and Examples-Regular and Singular Elements-Topological Divisors of zero-The Spectrum-Important Consequences of the Non-emptiness of the Spectrum-Spectral Mapping Theorem for Polynomials Radius Formula.

**TEXT BOOK:**

D.Somasundaram( 2013 ) - "A First Course in Functional Analysis ",Third Re-Print , Narosa Publishing House,New Delhi.

| Unit | Chapter | Sections |
|---|---|---|
| **I** | **IV** | **4.1 -- 4.7** |
| **II** | **V** | **5.1 – 5.6** |
| **III** | **VI** | **6.1-6.5** |
| **IV** | **VI** | **6.6-6.9** |
| **V** | **VII** | **7.1-7.7** |

**REFERENCE BOOKS:**


1. John B. Conway (1999)-"A Course in Functional AnalysisSecond Edition", Second Edition,AMS,GSM VOL.21.

2 . C. Goffman and G. Pedrick (1987) - "A First Course in Functional Analysis", Prentice Hall of India, New Delhi.

3. G.F. Simmons (1963) - "Introduction to Topology and Modern Analysis", McGraw –Hill Book Company, London.

**BOOKS FOR REFERENCE:**

1. https://www.slideshare.net/SanjaySharma1025/some-fundamental- theorems-in-banach-spaces-and-hilbert-spaces

2. https://www.imsc.res.in/~sunder/fa.pdf

3. https://www.slideshare.net/leingang/lesson-16-the-spectral-theorem-and-applications

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XVI PRACTICAL | 21MAP16 | MATHEMATICAL SOFTWARE – II (R SOFTWARE)- PRACTICAL | 36 | 1 |

**Contact Hours per Week: 3**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | III | 50 | 50 | 100 |

**Preamble :**

To enable the students to get experienced about R Software.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recognize the commands provided in R Software | $K_1$ |
| CO2 | Demonstrate the graphs and diagrams inn statistics | $K_2$ |
| CO3 | Classify statistical methods using numerical data | $K_3$ |
| CO4 | Analyze the data using various statistical methods | $K_4$ |
| CO5 | Estimate measures of central tendency, probabiliy distributions, standard deviation, variance, correlation, regression and one and two sample 't' test | $K_5$ |
| CO6 | Formulate functions, data frames, diagrams and graphs | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 3 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 3 | 1 | 1 | 1 |
| **CO6** | 9 | 9 | 9 | 1 | 1 | 1 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 34 | 26 | 25 | 25 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 2.83 | 4.20 | 4.12 | 5.60 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## LIST OF PROGRAMS

**All the following listed programs have to be executed and recorded**

1. To use R software as a calculator.
2. To enter, manipulate and retrieval of data from gedit and Libre Office Calc to R.
3. To create data frame directly in R.
4. To display data using pie diagram, box plot, histogram and bar plot.
5. To define and call the functions in R environment.
6. To find mean, median, geometric mean, harmonic mean of numerical data.
7. To find the standard deviation, variance of the given data.
8. To find Correlation co-efficient and linear regression line for Bivariate data.
9. To find multiple linear regression models.
10. To compute probabilities in various distributions.

11. To draw the graph of probability mass and density functions.
12. To analyse the data using one and two sample ‘t’ test and paired ‘t’ test.

**BOOKS FOR REFERENCE:**


1. https://www.youtube.com/watch?v=eDrhZb2onWY
2. https://www.youtube.com/watch?v=KlsYCECWEWE
3. https://www.tutorialspoint.com/r/index.htm

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART V | PROFICIENCY ENHANCEMENT (SELF STUDY) | 21PEPMA01 | INDUSTRIAL MATHEMATICS (SELF STUDY) | - | 2 |

**Contact Hours per Week: -**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | III | - | 100 | 100 |

## Preamble

To enable the students to learn decision making problems based on operations research and gain the knowledge about numerical methods.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | understand the meaning, purpose, and tools of operations research. | $K_2$ |
| CO2 | gain the knowledge about simulation, Inventory control and Numerical Methods. | $K_1$ |
| CO3 | apply the concepts of Inventories to find EOQ. | $K_3$ |
| CO4 | Analyze the concept of Interpolation with equal and unequal integrals and find the solution to the problems by using various methods. | $K_2$ & $K_4$ |
| CO5 | evaluatethe problems based on types of inventory control. | $K_5$, $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 1 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 1 | 1 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 1 | 0 | 0 |
| **Total Contribution of COs to POs** | 42 | 42 | 42 | 42 | 10 | 25 | 25 |
| **Weighted Percentage of COs contribution to POs** | 3.21 | 3.22 | 3.33 | 3.50 | 1.61 | 4.12 | 5.60 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## COURSE CONTENT:

### UNIT I: INTRODUCTION TO OPERATIONS RESEARCH

Scientific methods in O.R –Modeling in operations research – Advandages and limitations of models – Methodology of operations research – O.R and Decision Making – Applications of
operations research -Opportunities and short comings of operations research.

### UNIT II: SIMULATION

Introduction – Process of simulation – Simulation models – Eevent–type simulation – generation of random numbers Mmonte-carlosimulation .

**UNIT-III:INVENTORY CONTROL**

Types of inventories - Objectives of scientific Inventory control-Inventory costs – EOQ Problem with no shortages .

**UNIT IV : INFORMATION THEORY**

Introduction – Measure of information – Entropy-The expected information –Joint conditional entropies .

**UNIT V: INTERPOLATION**

**Interpolation with equal integrals: (Central Diffrence Interpolation Formulae)**

Gauss Forward formula – Gauss Backward formula - Stirling's Formula.

**Interpolation with unequal integrals:**

Lagrange's Interpolation – Inverse interpolation.

**TEXT BOOK:**


1. KantiSwarup, P. K. Gupta, Man Mohan ( 2017) –" Operations Research" 18th Revised Edition , S. Chand & Sons Education Publications, New Delhi.
2. Dr.Venkataraman.M.K.(2013) – "Numerical Methods in Science and Engineering", The National Publishing Company, Chennai.


| UNIT | BOOK | CHAPTER | PAGE |
|---|---|---|---|
| I | 1 | 1 | 27-35 |
| II | 1 | 22 | 639-646 |
| III | 1 | 19 | 507-524 |
| IV | 1 | 30 | 885-889, 901-903 |
| V | 2 | 7<br>8 | 216-225, 253-259, 262-263 |

**REFERENCE BOOKS:**


1. DharaniVenkata Krishnan .S – " Operations Research Principles and Problems" Keerthi publishing house PVT Ltd.

2. Kandasamy. P, Thilagavathi. K and Gunavathi. K (2007) - “Numerical methods” S. Chand and Company Ltd, New Delhi – Revised Edition.

**BOOKS FOR REFERENCE:**

1. https://www.optimalworkshop.com/learn/ebooks/the-ultimate-researchops-checklist/?utm_source=google&utm_medium=cpc&utm_campaign=row-alpha-researchops&keyword=research%20ops&match_type=e&network=g&gclid=EAIaIQobChMIuMDqycPE8wIVFDUrCh0anQBDEAAYASAAEgKXlPD_BwE

2. https://pubsonline.informs.org/journal/opre

3. https://implementationscience.biomedcentral.com/articles/10.1186/s13012-016-0444-0

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XVIII ELECTIVE - III | 21MAP17A | GRAPH THEORY | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | III | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Graphs, Euler tours, Hamiltonian cycles, Matching and Colourings of edges as well as vertices.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the basic concepts of graph theory. | $K_1$ |
| CO2 | illustrate various types of graph,matchings,coverings and colourings. | $K_2$ |
| CO3 | apply the preliminaries of graph theory in well – named theorems and Conjectures. | $K_3$ |
| CO4 | analyze the proof of theorems on graphs,matchings,coverings and colourings. | $K_4$ |
| CO5 | determine the path ,cycle, Chromatic Number,. | $K_5$ |
| CO6 | construct graphs with Euler tours, Hamiltonian cycles, and four and five Colour concepts. | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 9 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 3 | 3 | 3 | 1 |
| **CO5** | 9 | 9 | 9 | 3 | 3 | 3 | 1 |
| **CO6** | 9 | 9 | 9 | 3 | 1 | 1 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 36 | 22 | 28 | 11 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 3.00 | 3.55 | 4.62 | 2.46 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: FUNDAMENTAL CONCEPTS OF GRAPHS AND TREES ( 15 Hours)**

Graphs - Simple Graphs – Graph Isomorphism – The Incidence and Adjacency matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles and trails. Trees – Cut edges and Bonds – Cut vertices – Cayley's formula.

**UNIT II: CONNECTIVITY AND PATHS ( 15 Hours)**

Connectivity – Blocks. Euler tours and Hamilton Cycles: Euler tours – Hamilton Cycles.

**UNIT III: MATCHINGS ( 15 Hours)**

Matchings and coverings in Bipartite Graphs – Perfect Matchings. Edge colourings: Edge Chromatic number – Vizing's theorem.

**UNIT IV: INDEPENDENT SETS AND VERTEX COLOURINGS ( 15 Hours)**

Independent sets – Chromatic Number – Brook's Theorem – Hajo's Conjecture.

**UNITV: PLANAR GRAPHS ( 12 Hours)**

Plane and planar Graphs – Dual Graphs – Euler's formula – Bridges – Kuratowski's theorem (Proof omitted) – Five Colour Theorem and Four colour Conjecture.

**TEXT BOOK:**

J.A.Bondy and U.S.R.Murty(1976), "Graph Theory with Applications", American Elsevier Publishing company., Inc., New York.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | 1 | 1.1-1.7 |
| | 2 | 2.1-2.4 |
| II | 3 | 3.1-3.2 |
| | 4 | 4.1-4.2 |
| III | 5 | 5.1-5.3 |
| | 6 | 6.1-6.2 |
| IV | 7 | 7.1 |
| | 8 | 8.1-8.3 |
| V | 9 | 9.1-9.6 |

**REFERENCE BOOKS:**

1. Narsinghdeo (1987) "Graph Theory", Prentice Hall of India Private Limited, New Delhi.

2. Frank Harary, "Graph Theory", Narosa Publishing House, New Delhi.

3. R.Balakrishnan and K.Ranganathan, Springer (2008), "A Text Book of Graph Theory", New Delhi.

4. V.K. Balakrishnan, Tata Mcgrawhill (2004), " Graph Theory", Schaum's outlines, New Delhi.

**BOOKS FOR REFERENCE:**

1.https://www.youtube.com/watch?v=sWsXBY19o8I

2.https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjkzq-5jJfzAhW6yjgGHZX7CbsQFnoECAwQAQ&url=https%3A%2F%2Fwww.slideshare.net%2Fehamzei%2Fgraph-theory-70229068&usg=AOvVaw1B86S7CGufOtRuwX4_T7Mq

3.https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjkzq-

5jJfzAhW6yjgGHZX7CbsQFnoECCQQAQ&url=https%3A%2F%2Fwww.slideshare.net%2FManashKumarMondal%2Fgraph-theory-108809072&usg=AOvVaw204o8DeJSq9IMoD7UZ3lSv

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XVIII ELECTIVE - III | 21MAP17B | INTEGRAL TRANSFORMS | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | III | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Fourier Cosine and Sine Transforms and Hankel transforms.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the concepts based on Fourier Sine and Cosine transforms, Hankel transforms. | $K_1$ |
| CO2 | Explain the concepts of Fourier Transforms, Hankel transforms and diffusion equations. | $K_2$ |
| CO3 | apply the Fourier Transforms, Hankel transforms in Laplace Equation and PDE. | $K_3$ |
| CO4 | analyze the properties on Fourier and Hankel Transforms. | $K_4$ |
| CO5 | evaluate the problems based on Fourier Cosine and sine Transforms and Hankel Transforms. | $K_5$ |
| CO6 | construct the solution of Laplace and linear diffusion equations. | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 9 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 3 | 3 | 3 | 1 |
| **CO5** | 9 | 9 | 9 | 3 | 3 | 3 | 1 |
| **CO6** | 9 | 9 | 9 | 3 | 1 | 1 | 0 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 36 | 22 | 28 | 11 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 3.00 | 3.55 | 4.62 | 2.46 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: FOURIER TRANSFORMS: (15 Hours)**

Fourier sine and cosine transforms –Fourier transforms of derivatives -Fourier transforms of simple functions

**UNIT II** : **FOURIER TRANSFORMS (cont..) (15 Hours)**

Convolution integral – Parseval's Theorem-Solution of PDE by Fourier transform –Laplace equation in half plane - Laplace equation in infinite strip.

**UNIT III: DIFFUSION EQUATION** **(15 Hours)**

Laplace equation in semi infinite strip. The Linear diffusion equation on a semi infinite line –The two dimensional diffusion equation. Solution of the diffusion equation $\frac{\partial^2 u}{\partial x^2} = \frac{1}{k}\frac{\partial u}{\partial t}$ with the boundary condition $u_x(0,t) = f(t)$, $t \geq 0$ and the initial condition u(x,0) = 0 - Solution of diffusion equation on a semi infinite line.

**UNIT IV: HANKEL TRANSFORMS:** **(15 Hours)**

Properties of Hankel Transforms – Hankel inversion theorem – Hankel Transform of derivative of functions - The Parseval's relation for Henkel Transforms –Axisymmetric Dirichlet problem for a half space.

**UNIT V: HANKEL TRANSFORMS (cont..)** **(12 Hours)**

Axisymmetric Dirichlet problem for a thick plate. Relation between Fourier and Hankel Transforms – Problems.

**TEXT BOOKS:**

Sneddon.I.N.(1974) – "The Use of Integral Transforms", Tata McGraw Hill, New Delhi.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| **I** | **2** | **2.4 – 2.7** |
| **II** | **2** | **2.9 – 2.10** |
| **III** | **2** | **2.16- 1(a),(b),(c), 2.16 – 2 (a), (b)** |
| **IV** | **5** | **5.2 – 5.4, 5.6 & 5-10-1** |
| **V** | **5** | **5-10-2, 5.7** |

**BOOKS FOR REFERENCE:**


1. https://www.maths.ed.ac.uk/~jmf/Teaching/MT3/IntegralTransforms.pdf
2. https://www.britannica.com/science/integral-transform
3. http://www.hep.caltech.edu/~fcp/math/integralEquations/integralEquations.pdf

**SEMESTER – IV**

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - XIX | 21MAP18 | FUNCTIONAL ANALYSIS | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | IV | 50 | 50 | 100 |

**Preamble**

To enable the students to learn and gain knowledge about Banach space and normed linear space.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the basic concept of Banach spaces, quotient space, Continuous linear functional, Hahn banach theorem and Bounded linear operator. | $K_1$ |
| CO2 | Explain the concepts of linear space, normed linear space and banach space. | $K_2$ |
| CO3 | apply the knowledge of functional analysis in linear space, normed linear space and in banach space. | $K_3$ |
| CO4 | analyze the properties of Banach spaces, quotient space, Continuous linear functional, Hahn banach theorem and Bounded linear operator. | $K_4$ |
| CO5 | Evaluate the properties of Banach spaces, quotient space, Continuous linear functional, Hahn banach theorem and Bounded linear operator. | $K_5$ |

| | | |
|---|---|---|
| **CO6** | Construct the vector space in Banach spaces, quotient space, Continuous linear functional, Hahn banach theorem and in Bounded linear operators. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 9 | 9 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 9 | 9 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 54 | 54 | 14 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 8.72 | 8.91 | 3.13 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: BANACH SPACES (15 Hours)**

Introduction- Basic inequalities –Metric Space and its properties –Vector space – Normed linear spaces, Definitions and properties-Examples of Banach spaces.

**UNIT II: QUOTIENT SPACES (15 Hours)**

Quotient spaces-Direct sum of subspace-Continuous linear transformations.

**UNIT III: CONTINUOUS LINEAR FUNCTIONALS: (15 Hours)**

Introduction- continuous linear functional-Representation theorems for functional.

**UNIT IV: HAHN BANACH THEOREM (15 Hours)**

The Hahn Banach Theorem-Some consequences of the Hahn Banach Theorems.

**UNIT V: BOUNDED LINEAR OPERATORS (12 Hours)**

Introduction-The open mapping theorem-The closed graph theorem-The banach Steinhaus theorem-The Weak and Weak* Convergence-The conjugate of an operator.

**TEXT BOOK:**

D.Somasundaram( 2013 ) - "A First Course in Functional Analysis ",Third Re-Print , Narosa Publishing House,New Delhi.

| Unit | Chapter | Sections |
|---|---|---|
| I | I | 1.1 – 1.6 |
| II | I | 1.7 – 1.9 |
| III | II | 2.1 –2.3 |
| IV | II | 2.4, 2.5 |
| V | III | 3.1 – 3.7 |

**REFERENCE BOOKS:**

1 .C. Goffman and G. Pedrick(1987) - "A First Course in Functional Analysis", Prentice Hall of India, New Delhi.

2. G.F. Simmons(1963) - "Introduction to Topology and Modern Analysis", McGraw –Hill Book Company, London.

**BOOKS FOR REFERENCE:**

1. https://www.maths.usyd.edu.au/u/athomas/FunctionalAnalysis/daners-functional-analysis-2017.pdf
2. https://docs.ufpr.br/~eidam/2019/2/CM075/Kreyszig.pdf
3. https://people.math.ethz.ch/~salamon/PREPRINTS/funcana.pdf
4. http://www.ddegjust.ac.in/2019/4/mal%20641_19042019.pdf

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - XX | 21MAP19 | MATHEMATICAL METHODS | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | IV | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about Integral Equations and Calculus of Variations.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the concepts based on Various types of integral equations and Calculus of Variations. | $K_1$ |
| CO2 | explain various types of integral equations, extremals, Euler equations, Euler – Poisson equation, and Ostrogradsky equation. | $K_2$ |
| CO3 | apply various methods for finding the solutions of Fredhlom Integral Equation, Volterra Integral equation and Calculus of Variation. | $K_3$ |
| CO4 | analyze the concepts of Fredhlom Integral Equation and Volterra Integral equation, Calculus of Variation. | $K_4$ |
| CO5 | evaluate the problems based on Fredhlom Integral Equation, Volterra Integral equation and Calculus of Variation. | $K_5$ |

| | | |
|---|---|---|
| **CO6** | Construct initial, boundary value problems, minimum surface of revolution problem, Brachistochrome problem, problem on geodesics. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO2** | 9 | 9 | 9 | 9 | 1 | 3 | 1 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 1 | 1 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 3 | 1 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 16 | 14 | 6 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 2.58 | 2.31 | 1.34 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: INTEGRAL EQUATIONS (15 HOURS)**

Types of Integral equations –Integral Fredholm Alternative–Equation with separable Kernel.

**UNIT II: METHOD OF SUCCESSIVE APPROXIMATIONS (15 HOURS)**

Method of successive Approximations – Iterative Scheme - Volterra integral equations – examples.

**UNIT III: SINGULAR& ABEL INTEGRAL EQUATIONS (15 HOURS)**

Application of Integral equation to ordinary differential equation –Initial value problems –Boundary value problems –Singular integral equations –Abel Integral equation.

**UNIT IV**: **CALCULUS OF VARIATIONS (15 HOURS)**

Variation and its properties – Fundamental lemma of calculus of variations - Euler's equation – Functionals of the integral forms -Functional dependent on higher order derivatives – Euler poisson equations.

**UNIT V:CALCULUS OF VARIATIONS(Con…) (12 HOURS)**

Functionals dependent on the functions of several independent variables – Ostrogradsky equation - Variational problems in parametric form –Applications.

**TEXT BOOKS:**

**For Units I, II and III:**

Kanwal.R.P. (1971) – "Linear Integral Equations Theory and Technique", Academic press, New York.

**For Unit IV and V:**

Elsgolts.L. (1970) – "Differential Equations and Calculus of Variations", Mir publishers, Moscow.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | I<br>II | 1.1 – 1.6<br>2.3 – 2.5 |
| II | III | 3.1 – 3.4 |
| III | V<br>VIII | 5.1 – 5.2<br>8.1 – 8.2 |
| IV | VI | 6.1 – 6.4 |
| V | VI | 6.5 – 6.7 |

**BOOKS FOR REFERENCE:**

1. https://home.iitk.ac.in/~dasgupta/MathBook/lmastertrans.pdf

2. https://onlinelibrary.wiley.com

3. https://nptel.ac.in/courses/111/107/111107098/

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - XXI | 21MAP20 | FLUID DYNAMICS | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | IV | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about the concept of stream lines, path lines, energy equation, two dimensional motion, Navier stokes equations and boundary layer in compressible and incompressible flow.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the concepts based on stream lines, path lines, energy equation, two dimensional motion, Navier stokes equations and boundary layer equations. | $K_1$ |
| CO2 | illustrate stream lines, path lines, energy equation, two dimensional motion, Navier stokes equations and boundary layer equations. | $K_2$ |
| CO3 | apply the concepts of fluid dynamics in equations of continuity , momentum theorem, Blasius theorem, Navier Strokes equations and boundary layer equations. | $K_3$ |
| CO4 | analyze the solutions of energy equations Navier Strokes equations and boundary layer equations. | $K_4$ |
| CO5 | evaluate the problems based on stream lines, path lines and two – dimensional motion. | $K_5$ |

| | | |
|---|---|---|
| **CO6** | construct the energy equations, Navier Strokes equations and boundary layer equations. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 9 | 9 |
| **CO4** | 9 | 9 | 9 | 9 | 1 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 0 | 1 | 1 |
| **CO6** | 3 | 3 | 3 | 3 | 0 | 0 | 0 |
| **Total Contribution of COs to POs** | 42 | 42 | 42 | 42 | 10 | 31 | 31 |
| **Weighted Percentage of COs contribution to POs** | 3.21 | 3.22 | 3.33 | 3.50 | 1.61 | 5.11 | 6.95 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**COURSE CONTENT:**

**UNIT I: STREAM LINES AND PATH LINES (15 Hours)**

Introductory Motions – Velocity – Stream Lines and Path Lines – Stream Tubes and Filaments – Fluid Body – Density – Pressure. Differentiation following the Fluid – Equation ofcontinuity – Boundary conditions – Kinematical and physical – Rate of change of linear momentum – Equation of motion of an inviscid fluid.

**Unit II:ENERGY EQUATION FOR INVISCID FLUID: (15 Hours)**

Euler's momentum Theorem – Conservative forces – Bernoulli's theorem in steady

motion – Energy equation for inviscid fluid – circulation – Kelvin's theorem – Vortex motion – Helmholtz equation.

**Unit III:TWO DIMENSIONAL MOTION: (15 Hours)**

Two Dimensional Motion – Two Dimensional Functions – Complex Potential – Basic singularities – Source – Sink – Vortex – Doublet – Circle theorem. Flow past a circular cylinder with circulation – Blasius Theorem – Lift force. (Magnus effect)

**Unit IV:NAVIER-STOKES EQUATIONS: (15 Hours)**

Viscous flows – Navier-Stokes equations – Vorticity and circulation in a viscous fluid – Steady flow through an arbitrary cylinder under pressure – StaedyCouettc flow between cylinders in relative motion .

**Unit V:BOUNDARY LAYER EQUATIONS (12 Hours)**

Laminar Boundary Layer in incompressible flow: Boundary Layer concept – BoundaryLayer equations – Displacement thickness, Momentum thickness – Kinetic energy thickness –Integral equation of boundary layer – Flow parallel to semi infinite flat plate – Blasius equationand its solution in series.

**TEXT BOOKS:**

**For Units I and II:**

Milne Thomson.L.M. (1968) –"Theoretical Hydro Dynamics", 5th Edition, McMillanCompany.

**For Units III, IV and V:**

Curle.Nand Davies.H.J (1968) – "Modern Fluid Dynamics" – (Volume I) DVan Nostrand Company Limited, London.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| **I** | **I** | **1.0 – 1.3., 3.10-3.41 (omit 3.32)** |
| **II** | **III** | **3.42 – 3.53 (omit 3.44)** |
| **III** | **III** | **3.1 – 3.7.5 (omit 3.3.4, 3.4, 3.5.3,3.6 )** |
| **IV** | **V** | **5.1 – 5.3.2** |
| **V** | **VI** | **6.1 – 6.3.1(omit 6.2.2., 6.2.5)** |

**BOOKS FOR REFERENCE:**

1. https://youtu.be/0VEDeLU2JJs

2. https://www.slideshare.net/muhsenbd/twodimensional-ideal-flow-chapter-6

3. https://www.slideshare.net/Haroonmechno/fm2-35616441

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE - XXII | 21MAP21 | PROJECT WORK AND VIVA - VOCE | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | IV | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about their principal areas of study.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the fundamental disciplinary concepts and methods appropriate to their principal areas of study. | $K_1$ |
| CO2 | illustrate the depth knowledge about their principal areas of study | $K_2$ |
| CO3 | apply the knowledge of principles, theories, and concepts to project situations. | $K_3$ |
| CO4 | analyze the problems creatively through sustained critical investigation | $K_4$ |
| CO5 | evaluate the consequences of project and their implications for project objectives. | $K_5$ |
| CO6 | construct the solutions of contemporary issues in their chosen field of research. | $K_6$ |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 36 | 36 | 36 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.28 | 4.50 | 5.81 | 5.94 | 8.07 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XXIII ELECTIVE - IV | 21MAP22A | FUZZY LOGIC AND FUZZY SETS | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | IV | 50 | 50 | 100 |

## Preamble

To enable the students to learn and gain knowledge about fuzzy sets, fuzzy relations, fuzzy measures, uncertainty and information and also their applications.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | recall the basic concepts of fuzzy sets theory, types of fuzzy sets, standard operations of fuzzy sets, fuzzy relations, fuzzy graphs and real life applications | $K_1$ |
| CO2 | express the basic concepts of fuzzy set theory with fuzzy logic, fuzzy relations, fuzzy measures, measures of fuzziness, fuzzy graphs and real life applications | $K_2$ |
| CO3 | apply the concepts of fuzzy sets, operations of fuzzy sets, fuzzy relations, fuzzy measures in real life applications | $K_3$ |
| CO4 | analyze the standard fuzzy operations, types of fuzzy relations, different fuzzy measures, types of fuzzy controller. | $K_4$ |
| CO5 | evaluate fuzzy set, fuzzy relations, fuzzy measures, measures of | $K_5$ |

| | | |
|---|---|---|
| | fuzziness in real life | |
| **CO6** | design fuzzy models in real life situations. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **Total Contribution of COs to POs** | 54 | 54 | 45 | 45 | 15 | 15 | 15 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 3.56 | 3.75 | 2.42 | 2.47 | 3.36 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

## COURSE CONTENT:

### UNIT – I: FUZZY SETS AND EXTENSIONS (12 Hours)

Basic definitions- Set-theoretic Operations for fuzzy sets- Types of Fuzzy sets- Algebraic operations- Criteria for selection appropriate aggregation operators.

### UNIT – II : FUZZY MEASURES AND EXTENSION PRINCIPLE (15 Hours)

Fuzzy measures- Measures of fuzziness- The extension principle- Operations of type 2 fuzzy sets – Special extended operations- LR-representation of fuzzy sets

**UNIT – III : FUZZY RELATIONS AND FUZZY GRAPHS ( 15Hours)**

Fuzzy relations on sets and fuzzy sets – Composition of fuzzy relations- Properties of the max-min composition- Fuzzy graphs- Special fuzzy relations.

**UNIT –IV : FUZZY CONTROL (15 Hours)**

Origin and objectives- Automatic control- The fuzzy controller- Types of fuzzy controller- Mamdani controller- Defuzzification- Sugeno controller- Applications

**UNIT – V : APPLICATIONS ( 15 Hours)**

General discussion – Natural, life and social sciences – Management and decision making – Computer Science.

**TEXT BOOK:**


1. H.J.Zimmermann (2006) -"Fuzzy set theory and its applications" (Fourth edition), Springer International Edition
2. GeoregeJ.Klir and Tina A. Folger, (1995) - "Fuzzy Sets, Uncertainity and Information", Prentice-Hall of India Private Limited.


| UNIT | BOOK | CHAPTER | SECTION | PAGE NUMBER |
|---|---|---|---|---|
| I | 1 | 2<br>3 | 2.1-2.2<br>3.1-3.2.3 | 11-20<br>23-44 |
| II | 1 | 4<br>5 | 4.1-4.2<br>5.1-5.3.2 | 47-52<br>55-68 |
| III | 1 | 6 | 6.1-6.3 | 71-89 |
| IV | 1 | 11 | 11.1-11.4.3<br>11.7-11.7.4 | 223-240<br>244-254 |
| V | 2 | 6 | 6.1 – 6.6 | 231-264 |

**REFERENCE BOOK:**


George J.Klir and Boyuan, "Fuzzy Sets and Fuzzy Logic – Theory and Applications", Prentice-Hall of India Private Limited.

**BOOKS FOR REFERENCE:**


1. https://en.wikipedia.org/wiki/Fuzzy_set
2. https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_set_theory.htm
3. https://youtu.be/LUz-FbwPh3Q

| CATEGORY | COURSE TYPE | COURSE CODE | COURSE TITLE | CONTACT HOURS | CREDIT |
|---|---|---|---|---|---|
| PART - III | CORE – XXIII ELECTIVE - IV | 21MAP22B | CONTROL THEORY | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| Second | IV | 50 | 50 | 100 |

## Preamble

To enable the students to gain the knowledge about modeling the control systems using difference equations.

## Course Outcomes

On the successful completion of the course, students will be able to

| CO NUMBER | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| CO1 | Recall the concept of observability, controllability, Stability in Control theory. | $K_2$ |
| CO2 | Explain about linear and non-linear equations in control theory. | $K_2$ |
| CO3 | Applying the knowledge of differential equations in linear and non-linear systems. | $K_3$ |
| CO4 | Analyze the properties of linear and non- linear equations in observability, Controllability and stability. | $K_4$ |
| CO5 | Evaluate obsevability, Controllability, stability in different equations. | $K_5$ |

| | | |
|---|---|---|
| **CO6** | Construct a knowledge in observability, Controllability abd stability of linear and non- linear equations. | **$K_6$** |

**$K_1$ - Remember; $K_2$ – Understand; $K_3$ - Apply; $K_4$ - Analyze; $K_5$ – Evaluate**; **$K_6$ – Create**.

## CO-PO MAPPING (COURSE ARTICULATION MATRIX)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO4** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO6** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **Total Contribution of Cos to POs** | 54 | 54 | 45 | 45 | 15 | 15 | 15 |
| **Weighted Percentage of Cos contribution to POs** | 4.12 | 4.14 | 3.56 | 3.75 | 2.42 | 2.47 | 3.36 |

**Level of Correlation: 0-No Correlation; 1-Low Correlation; 3-Medium Correlation; 9-High Correlation between CO's and PO's.**

**Unit I: OBSERVABILITY: (15 Hours)**

Linear Systems –Observability Grammian –Constant coefficient systems –Reconstruction kernel –Nonlinear Systems.

**Unit II: CONTROLLABILITY: (14 Hours)**

Linear systems –Controllability Grammian – Adjoint systems –Constant coefficient systems –steering function –Nonlinear systems.

**Unit III: STABILITY: (15 Hours)**

Stability –Uniform Stability –Asymptotic Stability of Linear Systems.

**Unit IV: STABILITY (Continuation)** **(14 Hours)**

Perturbed linear systems –Nonlinear systems – OPTIMAL CONTROL: Linear time varying systems.

**Unit V: STABILIZABILITY:** **(14 Hours)**

Stabilization via linear feedback control –Bass method –Controllable subspace – Stabilization with restricted feedback.

**TEXT BOOK :**

Balachandran.K and Dauer.J.P.(2012)– "Elements of Control Theory", 2nd edition, Narosa, New Delhi.

| UNIT | CHAPTER | PAGE NO. |
|---|---|---|
| I | 2 | 21 - 38 |
| II | 3 | 40 – 56 |
| III | 4 | 75 - 81 |
| IV | 4, 6 | 82 – 91, 119 – 128, 130 -131, |
| V | 5 | 100 - 117 |

**REFERENCE BOOKS:**


1. Conti .R (1976) – "Linear Differential Equations and Control", Academic Press, London.
2. Curtain.R.F. and Pritchard.A.J.( 1977) – " Functional Analysis and Modern Applied Mathematics", Academic Press, New York.
3. Klamka.J (1991) – "Controllability of Dynamical Systems", Kluwer Academic Publisher, Dordrecht.
4. Russell.D.L. (1979) – "Mathematics of Finite Dimensional Control Systems" , Marcel Dekker, New York.


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