# P.K.R. ARTS COLLEGE FOR WOMEN

**(Re-Accredited with 'A' Grade by NAAC)**

**Autonomous Institution-Affiliated to Bharathiar University**

**Gobichettipalayam-638 476**

# DEPARTMENT OF MATHEMATICS

# MASTER OF SCIENCE IN MATHEMATICS

## SYLLABUS

**SCHOLASTIC COURSES**
**AND**
**CO-SCHOLASTIC COURSES**

***For all the candidates admitted from the Academic Year***

***2024-2025 and onwards***

***Under CBCS PATTERN***

# P.K.R ARTS COLLEGE FOR WOMEN

**(Autonomous Institution, Re-Accredited by NAAC with 'A' Grade)**
**Gobichettipalayam-638476**

**M.SC MATHEMATICS – PROGRAMME STRUCTURE**

**CBCS – 2024 – 2025 & Onwards**

***Scholastic Courses:***

| Category | Components | No. Of Courses | Credit(S) / Course | Total Credits | Proposed Semester |
|---|---|---|---|---|---|
| Part - III | Core Courses | 14 | 1 / 2 / 3 / 4 / 5 / 6 | 61 | I - IV |
| | Core Practical | 02 | 01 | 02 | I, III |
| | Core (Open Elective) | 01 | 02 | 02 | III |
| | Core Elective Courses | 04 | 03 | 12 | I - IV |
| | Core Elective Practical | 01 | 01 | 01 | II |
| | Project and Viva-Voce | 01 | 04 | 04 | IV |
| Part – IV | A. Ability Enhancement : Cyber Security | 01 | 02 | 02 | II |
| Part - V | Competency Enhancement :<br>i. Online Course /<br>Learning Object Repository<br>ii. Certificate Course<br>iii. Self study | 01<br>01<br>01 | 02<br>02<br>02 | 06 | I to IV<br>III |
| **Total Marks:2500 & Total Credits:90** | | | | | |

# P.K.R. ARTS COLLEGE FOR WOMEN

**(Autonomous Institution, Re-Accredited by NAAC with 'A' Grade)**
**Gobichettipalayam – 638 476.**
**MASTER OF SCIENCE IN MATHEMATICS**
**Programme Scheme and Scheme of Examinations**
***(For students admitted from 2024-2025 & 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** | | | | | | | | | |
| Part III | Core: I | 24MAP01 | Advanced Algebra | 6 | 3 | 25 | 75 | 100 | 5 |
| Part III | Core :II | 24MAP02 | Real Analysis | 6 | 3 | 25 | 75 | 100 | 5 |
| Part III | Core : III | 24MAP03 | Ordinary Differential Equations | 6 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : IV | 24MAP04 | Python Programming | 5 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : V Elective : I | 24MAP05A / 24MAP05B | Numerical Analysis / Optimization Techniques | 5 | 3 | 25 | 75 | 100 | 3 |
| Part III | Core : VI Practical-I | 24MAP06 | Programming in Python Practical | 2 | 3 | 40 | 60 | 100 | 1 |
| | | | **TOTAL** | **30** | | | | **600** | **22** |
| **SEMESTER - II** | | | | | | | | | |
| Part III | Core :VII | 24MAP07 | Complex Analysis | 6 | 3 | 25 | 75 | 100 | 5 |
| Part III | Core : VIII | 24MAP08 | Partial Differential Equations | 5 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : IX | 24MAP09 | Measure Theory and Integration | 5 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core :X | 24MAP10 | Differential Geometry | 5 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : XI Elective : II | 24MAP11A / 24MAP11B | Mathematical Statistics / Programming in C++ | 5 | 3 | 25 | 75 | 100 | 3 |
| Part III | Core: XII Elective: II Practical | 24MAP12A / 24MAP12B | Mathematical Software – I (SPSS) – Practical / Programming in C++ - Practical | 2 | 3 | 40 | 60 | 100 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Part IV | Ability Enhancement | 24AEP01 | Cyber Security | 2 | 3 | 100 | - | 100 | 2 |
| | | | **TOTAL** | **30** | | | | **700** | **23** |
| **SEMESTER – III** | | | | | | | | | |
| Part III | Core : XIII | 24MAP13 | Topology | 6 | 3 | 25 | 75 | 100 | 5 |
| Part III | Core :XIV | 24MAP14 | Theory of Numbers | 6 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : XV | 24MAP15 | Classical Mechanics | 6 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : XVI Practical-II | 24MAP16 | Mathematical Software – II (R Software) - Practical | 3 | 3 | 40 | 60 | 100 | 1 |
| Part III | Core :XVII Open Elective | ***** | Opted by the students offered by other departments | 3 | 3 | 25 | 75 | 100 | 2 |
| Part III | Core :XVIII Elective : III | 24MAP17A / 24MAP17B | Graph Theory / Integral Transforms | 6 | 3 | 25 | 75 | 100 | 3 |
| Part V | Proficiency Enhancement | 24PEMAP01 | Mathematics for Competitive Examinations (Self Study) | - | 3 | - | 100 | 100 | 2 |
| | | | **TOTAL** | **30** | | | | **700** | **21** |
| **SEMESTER – IV** | | | | | | | | | |
| Part III | Core : XIX | 24MAP18 | Functional Analysis | 6 | 3 | 25 | 75 | 100 | 5 |
| Part III | Core : XX | 24MAP19 | Mathematical Methods | 6 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : XXI | 24MAP20 | Fluid Dynamics | 6 | 3 | 25 | 75 | 100 | 4 |
| Part III | Core : XXII | 24MAP21 | Project Work & Viva Voce | 6 | 3 | 20 | 80 | 100 | 4 |
| Part III | Core : XXIII Elective : IV | 24MAP22A / 24MAP22B | Fuzzy Logic and Fuzzy Sets / Control Theory | 6 | 3 | 25 | 75 | 100 | 3 |
| | | | **TOTAL** | **30** | | | | **500** | **20** |
| Part V | Competency Enhancement | Online Course / Learning Object Repository (LOR) | | SEMESTER I - IV | | | | | **2** |
| | | Certificate Course | | SEMESTER I - IV | | | | | **2** |
| | | | | | | | | | **90** |

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

## LIST OF ELECTIVE COURSES

| Course Code | Semester | Course Title | Contact Hrs/ week | Exam Duration hrs. | Max. Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | CIA | ESE | Total | |
| 24MAP05A | I | Numerical Analysis | 5 | 3 | 25 | 75 | 100 | 3 |
| 24MAP05B | I | Optimization Techniques | 5 | 3 | 25 | 75 | 100 | 3 |
| 24MAP11A | II | Mathematical Statistics | 5 | 3 | 25 | 75 | 100 | 3 |
| 24MAP11B | II | Programming in C++ | 5 | 3 | 25 | 75 | 100 | 3 |
| 24MAP12A | II | Mathematical Software – I (SPSS) – Practical | 2 | 3 | 40 | 60 | 100 | 1 |
| 24MAP12B | II | Programming in C++ - Practical | 2 | 3 | 40 | 60 | 100 | 1 |
| 24MAP17A | III | Graph Theory | 6 | 3 | 25 | 75 | 100 | 3 |
| 24MAP17B | III | Integral Transforms | 6 | 3 | 25 | 75 | 100 | 3 |
| 24MAP22A | IV | Fuzzy Logic and Fuzzy Sets | 6 | 3 | 25 | 75 | 100 | 3 |
| 24MAP22B | IV | Control Theory | 6 | 3 | 25 | 75 | 100 | 3 |

## LIST OF ABILITY ENHANCEMENT COURSES

| Course Code | Semester | Course Title | Contact Hrs/ week | Exam Duration hrs. | Max. Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | CIA | ESE | Total | |
| 24AEP01 | II | CYBER SECURITY | 2 | 3 | 100 | - | 100 | 2 |

## LIST OF PROFICIENCY ENHANCEMENT COURSES

| Course Code | Semester | Course Title | Contact Hrs/ week | Exam Duration hrs. | Max. Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | CIA | ESE | Total | |
| 24PEMAP01 | III | Mathematics for Competitive Examinations (Self Study) | - | 3 | - | 100 | 100 | 2 |

## LIST OF OPEN ELECTIVE COURSES

| Course Code | Semester | Course Title | Contact Hrs/ week | Exam Duration hrs. | Max. Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | CIA | ESE | Total | |
| | **III** | **MATHEMATICAL APTITUDE FOR COMPETITIVE EXAMINATIONS (OPEN ELECTIVE)** | **3** | **3** | **25** | **75** | **100** | **2** |

## LIST OF OPEN ELECTIVE COURSES

| Course Code | Semester | Course Title | Contact Hrs/ week | Exam Duration hrs. | Max. Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | CIA | ESE | Total | |
| Department of English | **III** | English for Career Development | **3** | **3** | **25** | **75** | **100** | **2** |
| Department of Tamil | **III** | தேர்வு நோக்கில் தமிழ் இலக்கிய வரலாறு | **3** | **3** | **25** | **75** | **100** | **2** |
| Department of Physics | **III** | Environmental Physics | **3** | **3** | **25** | **75** | **100** | **2** |
| Department of Computer Science | **III** | Green Computing | **3** | **3** | **25** | **75** | **100** | **2** |
| Department of Commerce | **III** | Net Banking and Practice | **3** | **3** | **25** | **75** | **100** | **2** |
| Department of Management | **III** | Agri-Entrepreneurship | **3** | **3** | **25** | **75** | **100** | **2** |

## II. CO-SCHOLASTIC COURSES:

### a) VALUE ADDED COURSES:

| Semester | Course Code | Course Title | Contact Hours / week | Exam Duration Hours | Max. Marks @ annual Exam | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Aptitude | Resume writing | Self Intro | Verbal | Total |
| Course to be taught after regular hours | | | | | | | | | |
| **Value Added Course I** | | | | | | | | | |
| Semester I | | ABSTRACT REASONING AND INTERPERSONAL COMMUNICATION | | | - | - | | - | |
| Semester II | | | | | 25 | 25 | 25 | 25 | 100 |
| **Value Added Course II** | | | | | | | | | |
| Semester III | | QUANTITATIVE LITERACY | | | - | - | | - | |
| Semester IV | | | | | 25 | 25 | 25 | 25 | 100 |
| | | | | | | **TOTAL** | **200** | | |

### b) COURSES WITH CREDIT TRANSFERABILITY

### c) EXTRA CREDIT COURSES (Self-study courses)

1. Courses offered by parent department for ALL STUDENTS OF THE PROGRAMME
2. Courses offered by parent department for ADVANCED LEARNERS OF THE PROGRAMME
3. Courses offered in a department under PART-III for STUDENTS OF OTHER PROGRAMMES – Inter-disciplinary courses
4. Credit transferability for Disciplinary / Inter-disciplinary / Trans-disciplinary / General courses offered in UGC SWAYAM MOOCS
5. Comprehension Courses

**List of courses offered for ADVANCED LEARNERS ONLY (Self-study)**

| Course Code | Department | Courses offered for ADVANCED LEARNERS ONLY |
|---|---|---|
| | Department of Mathematics | 1) **ANALYTIC NUMBER THEORY**<br>2) **QUANTITATIVE TECHNIQUES**<br>3) **COMMUTATIVE ALGEBRA**<br>4) **PROBABILITY AND STATISTICS** |

**CO-SCHOLASTIC COURSES:**

The co-scholastic courses are non-credit and are only counted for the final grading and ranking. However for the award of the degree, completion of co-scholastic courses (Value-added Courses) is also MANDATED.

| Course Code | Category and Course Title | | Marks | Credits |
|---|---|---|---|---|
| Will be given by Coe | VALUE ADDED COURSE - I | ABSTRACT REASONING AND INTERPERSONAL COMMUNICATION | 100 | Will be finalized |
| | VALUE ADDED COURSE - II | QUANTITATIVE LITERACY | 100 | |

**NOTE:**

a). **Credit Transferability:** Course(s) from UGC SWAYAM MOOCS can be completed by students and the credits earned can be transferred under PART-III/PART-IV/PART-V: ANY SEMESTER. (Refer guidelines under other components).

**b). Extra Credit Course(s):**

A student who is interested shall take up any course(s) (one or many, PART-III only) and earn extra credits. There are FOUR categories in this:

**(a). Courses offered by parent department for ALL STUDENTS**

**(b). Courses offered by parent department for ADVANCED LEARNERS**

| Course Code | Department | Courses offered for ADVANCED LEARNERS ONLY |
|---|---|---|
| Will be given by Coe | Department of Mathematics | ➢ **ANALYTIC NUMBER THEORY**<br>➢ **QUANTITATIVE TECHNIQUES**<br>➢ **COMMUTATIVE ALGEBRA**<br>➢ **PROBABILITY AND STATISTICS** |

**(c) Courses offered under PART-III in other programmes**

**(d). General Courses in SWAYAM MOOCS**

**SYLLABUS**
***(For students admitted from 2024-2025 & onwards)***
**SEMESTER - I**

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE : I | **24MAP01** | **ADVANCED ALGEBRA** | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **I** | **25** | **75** | **100** |

**PREAMBLE :**

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

**COURSE OUTCOME:**

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

| COs | 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, polynomials and linear transformations | **$K_5$** |
| **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)**

| COs/POs | 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 | 3.28 | 3.21 | 3.23 | 3.29 | 2.08 |

**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 I 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE : II | **24MAP02** | **REAL ANALYSIS** | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **I** | **25** | **75** | **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 OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 2.35 | 1.49 | 1.25 |

**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.

**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 | 9 | 204-211, 220-221 |
| V | 9 | 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - III | **24MAP03** | **ORDINARY DIFFERENTIAL EQUATIONS** | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **I** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 5.38 | 2.92 |

**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 I 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 | Component | Course Code | Course Title | Contact Hours / Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - IV | **24MAP04** | **PYTHON PROGRAMMING** | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **I** | **25** | **75** | **100** |

**PREAMBLE:**

To enable the students to learn the Python programming concepts like object oriented programming and structured programming. It provides assess to the course outcome describing Python's core data types, lists, dictionaries, execution and applying OOP concepts.

**COURSE OUTCOME:**

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

| COs | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Recall the fundamental concepts of basic features of Python. | **$K_1$** |
| **CO2** | Understand the basics of Python Programming, Operators, Control Statements, functions and data structures. | **$K_2$** |
| **CO3** | Interpret the various concepts of python Programming. | **$K_3$** |
| **CO4** | Analyze the functioning of Python in Operators, Control Statements, functions and data structures. | **$K_4$** |
| **CO5** | Determine the behavior of Python Programming. | **$K_5$** |
| **CO6** | Construct a research platform by Python Programming. | **$K_6$** |

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

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

| COs/POs | 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 | 9 | 9 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO6** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 54 | 54 | 36 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.22 | 4.44 | 7.93 | 8.07 | 7.50 |

**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 BASICS OF PYTHON PROGRAMMING (12 Hours)**

Features of Python – History of Python – Writing and Executing I Python Program – Literal Constants – Variables and Identifiers – Data Types – Input Operation – Comments – Reserved Words – Identation.

**UNIT- II OPERATORS AND EXPRESSIONS: (12 Hours)**

Operators and Expressions – Expressions in Python – Operations on Strings – Other Data Types – Type Conversion.

**UNIT- III DECISION CONTROL STATEMENTS: (12 Hours)**

Introduction to Decision Control Statements – Selection/Conditional Branching Statements – Basic Loop Structures/ Iterative Statements – Nested Loops – The Break Statement – The Continue Statement – The Continuous Statement – The Pass Statement – The else Statement used with Loops.

**UNIT- IV FUNCTIONS AND MODULES: (12 Hours)**

Introduction – Function Definition – Function Call – Variable Scope and Lifetime – The return Statement – Python Strings Revisited: Introduction – Concatenating, Appending and Multiplying Strings – String are Immutable – String Formatting Operator.

**UNIT -V DATA STRUCTURES: (12 Hours)**

Data Structures: Sequence – Lists – Tuple – Dictionaries.

**TEXT BOOK:**

Reema Thareja "Python Programming Using Problem Solving Approach", 11th Impression-2021, Oxford Higher Education, New Delhi.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | III | 3.1, 3.2, 3.4 - 3.11 |
| II | III | 3.12 –3.16 |
| III | IV | 4.1– 4.8 |
| IV | V, VI | 5.1 – 5.5, 6.1 -6.3 |
| V | VIII | 8.1, 8.2.1 – 8.2.6, 8.4.1 -8.4.9, 8.6.1 - 8.6.5 |

**REFERENCE BOOKS:**

1. E. Balaguruswamy, "Introduction to Computing and Problem Solving using Python", McGraw Hill Publications, New Delhi.
2. Mark J. Guzdial and Barbara Ericson, "Introduction to computing and Prpogramming in Python", Pearson India Education Services Pvt Ltd, 4th Edition, 2018.
3. Kenneth A. Lambert, "Fundamentals of Python: I Programe", Cengage publishers, 2nd edition, 2021.

**BOOKS FOR REFERENCE:**

1. https://fliphtml5.com/manzw/rsdl/basic
2. https://fliphtml5.com/manzw/rsdl/basic/51-100
3. https://nibmehub.com/opac-service/pdf/read/Python%20Programming%20for%20the%20Absolute%20Beginner-%203rd%20Edition.pdf

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - V ELECTIVE - I | **24MAP05A** | **NUMERICAL ANALYSIS** | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **I** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Recall the basic definitions of numerical differentiation and integration, Numerical Solution of Ordinary differential equations and Partial differential equations. | **$K_1$** |
| **CO2** | Explain the concepts of numerical integration and differentiation, Euler and Modified Euler methods, Runge kutta methods, Multistep methods, Milne's method, Adams Moulton method. | **$K_2$** |
| **CO3** | Apply the different method to solve the problems on numerical differentiation and integration, Numerical Solution of Ordinary differential equations and Partial differential equations. | **$K_3$** |
| **CO4** | Analyze the numerical solution of Euler and modified Euler method, boundary value problems and characteristic value problems | **$K_4$** |
| **CO5** | Evaluate the problems based on system of equations and partial differential equations | **$K_5$** |
| **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)**

| COs/POs | 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** | 3.20 | 3.22 | 3.28 | 2.80 | 3.82 | 2.09 | 2.29 |

**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 NUMERICAL DIFFERENTIATION AND INTEGRATION: (10 Hours)**

Derivatives from differences tables –Higher order derivatives –Divided difference, Central-Difference formulae –Composite formula of Trapezoidal rule –Romberg integration –Simpson's rules.

**UNIT- II SOLVING SET OF EQUATIONS (10 Hours)**

The Elimination method –Gaussian Elimination and Gauss Jordan methods –LU Decomposition method –Matrix inversion by Gauss-Jordan method –Methods of Iteration –Jacobi and Gauss Seidal Iteration –Relaxation method –Systems of Nonlinear equations.

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

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

**UNIT- IV BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS (15 Hours)**

The shooting method –solution through a set of equations –Derivative boundary conditions –Characteristic value problems –Eigen values of a matrix by Iteration –The power method.

**UNIT- V NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (10 Hours)**

(Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations)

Types of Partial differential Equations- The Heat equation and the Wave equation- Solving the vibrating string problem-Parabolic equation in Two or Three Dimension – The Wave equation in Two Dimensions.

**TEXT BOOK:**

Gerald.C.F. and Wheatley.P.O.- (1998 Fifth Edition). "Applied Numerical Analysis", Addison Wesley.

| UNIT | Section | Page number |
|---|---|---|
| **I** | **5.1-5.8** | **354-387** |
| **II** | 2.3-2.5<br>2.10-2.12 | **123-146**<br>**164-177** |
| **III** | 6.1-6.7 | **448-474** |
| **IV** | **7.1-7.5** | **525-549** |
| **V** | **8.1-8.6** | **600-626** |

**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 Fourth Edition) – " Numerical Analysis", P.W.S.Kent Publishing Company, Boston .
3. Sastry.S.S.(1998) – " Introductory methods of Numerical Analysis", Prentice Hall of India, New Delhi.
4. Kandasamy.P.(2003) – "Numerical Methods", S.Chand & Co.Ltd., New Delhi.

**BOOKS FOR REFERENCE:**

1. https://youtu.be/5ZArZy3h7T4
2. https://www.slideshare.net/niravbvyas/numerical-methods-oridnary-differential-equations
3. https://youtu.be/UWqVvR8SmDA

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – V ELECTIVE - I | **24MAP05B** | **OPTIMIZATION TECHNIQUES** | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **I** | **25** | **75** | **100** |

**PREAMBLE:**

To enable the students to learn and gain knowledge about Network Scheduling, Games and Strategies, various kinds of Simulations, Queuing theory and decision analysis.

**COURSE OUTCOME:**

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

| COs | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Recall the definitions of Activities, Players, Payoff Matrix and Value of the Game, Poisson process, Simulation Models, Network Scheduling and decision tree. | **$K_1$** |
| **CO2** | Explain the concepts of Activities, Players, Payoff Matrix and Value of the Game, queuing system, Simulation Models, Network Scheduling and decision making environment. | **$K_2$** |
| **CO3** | Apply the concepts of the Maximin or Minimax Principles, queuing models, simulation models, Network scheduling, decision under uncertainty. | **$K_3$** |
| **CO4** | Compare the concepts of Pure Strategies, Mixed Strategies, Looping, Dangling, decision making environments, queuing systems. | **$K_4$** |
| **CO5** | Evaluate the problems based on Games and strategies, Critical Path, Event – Type Simulation, decision under risk, Poisson queuing systems. | **$K_5$** |
| **CO6** | Construct the Network and Critical Path ,Formulate Games and strategies | **$K_6$** |

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

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

| COs/POs | 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** | 3.20 | 3.22 | 3.28 | 2.80 | 3.82 | 2.09 | 2.29 |

**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 QUEUING THEORY (14 Hours)**

Queuing Theory: General Concepts and Definitions – Classification of queues – Poisson Process, Properties of Poisson Process – Queuing Models: 1.(M/M/1):(∞/FCFS), 2. (M/M/1):(N/FCFS),
3. (M/M/c):( ∞/FCFS).

**UNIT- III SIMULATION (10 Hours)**

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

**UNIT - IV NETWORK SCHEDULING (14 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 DECISION ANALYSIS (12 Hours)**

Decision making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

**Text Book:**

Kantiswarup, P. K. Gupta, Man Mohan ( 2017) –" Operations Research", 18th Revised edition, S. Chand & Sons Education Publications, New Delhi.

| UNIT | Section | Page number |
|---|---|---|
| **I** | **17.1 – 17.6** | **443-456** |
| **II** | 21.1-21.10 | **589-621** |
| **III** | **22.1 – 22.7** | **639-646** |
| **IV** | **25.1 – 25.8** | **763-791** |
| **V** | **16.1-16.7** | **415-435** |

**REFERENCE BOOKS**

1. Dharani Venkata Krishnan .S – " Operations Research Principles and Problems" Keerthi publishing house PVT Ltd.
2. Prem Kumar Gupta D. S. Hira – "Operations Research " , S. Chand & Company Ltd, Ram Nagar, New Delhi.

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – VI PRACTICAL - I | **24MAP06** | **PROGRAMMING IN PYTHON - PRACTICAL** | 24 | 1 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **I** | **40** | **60** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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 mathematical problems | **$K_6$** |

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

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

| COs/POs | 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 | 9 | 9 | 3 |
| **CO5** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **CO6** | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| **Total Contribution of COs to POs** | 54 | 54 | 54 | 54 | 54 | 54 | 36 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.22 | 4.44 | 7.93 | 8.07 | 7.50 |

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - VII | **24MAP07** | **COMPLEX ANALYSIS** | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 28 | 13 | 13 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.22 | 4.44 | 4.11 | 1.94 | 2.71 |

**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.

***Riemann Surfaces and Topological Data Analysis in Industry 5.0***

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - VIII | **24MAP08** | **PARTIAL DIFFERENTIAL EQUATIONS** | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 5.38 | 2.50 |

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - IX | **24MAP09** | **MEASURE THEORY AND INTEGRATION** | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COS | 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 Measures. | **$K_5$** |
| **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)**

| COs/POs | 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 | 4.22 | 4.44 | 2.64 | 2.39 | 2.71 |

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - X | **24MAP10** | **DIFFERENTIAL GEOMETRY** | 60 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 2.20 | 5.38 | 6.88 |

**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 I FUNDAMENTAL FORM (10 Hours)**

The I 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 I 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XI ELECTIVE - II | **24MAP11A** | **MATHEMATICAL STATISTICS** | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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 Random Variables. | **$K_4$** |
| **CO5** | Evaluate the Mean, Variance and 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)**

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 1.79 | 2.08 |

**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 – Events –The probability of an Event – Rules of Probability – Conditional Probability –Independent Events.

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

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

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

Introduction – The expected value of a Random Variable – Moments - Chebyshev's theorem – Moment-Generating Functions – Product Moments.

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

Introduction – The Discrete Uniform Distribution – The Bernoulli Distribution – The Binomial Distribution –The Negative Binomial and Geometric Distributions – The Hyper geometric Distribution – The Poison Distribution .

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

Introduction – The Uniform Distribution –The Gamma, Exponential and Chi-Square Distributions – The Beta Distribution – The Normal Distribution – The Normal Approximation to the Binomial Distribution – The Bivariate Normal Distribution.

**TEXT BOOK:**

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

| UNIT | CHAPTER | SECTION |
|---|---|---|
| I | II | 2.1 – 2.7 |
| II | III | 3.1 – 3.5 |
| III | IV | 4.1 – 4.6 |
| IV | V | 5.1 – 5.7 |
| V | VI | 6.1 – 6.7 |

**REFERENCE BOOK:**

Kapur.J.N and Saxena.H.C. (2011)- "Mathematical Statistics", 20$^{th}$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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XI ELECTIVE - II | **24MAP11B** | **PROGRAMMING IN C++** | 60 | 3 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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 destructors. | **$K_5$** |
| **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)**

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 1.79 | 2.08 |

**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/
1. https://www.udemy.com/course/introduction-to-programming-c-cpp/
2. https://developerinsider.co/introduction-to-cpp-cpp-programming/

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XII ELECTIVE - II PRACTICAL | **24MAP12A** | **MATHEMATICAL SOFTWARE – I (SPSS) - PRACTICAL** | 24 | 1 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **40** | **60** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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 straight line and plot the exponential curves. | **$K_6$** |

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

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

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 4.78 | 6.67 |

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XII<br>ELECTIVE - II<br>PRACTICAL | **24MAP12B** | **PROGRAMMING IN C++** | 24 | 1 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **40** | **60** | **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 OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 4.78 | 6.67 |

**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 I 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART IV | ABILITY ENHANCEMENT | **24AEP01** | **CYBER SECURITY** | 24 | 2 |

**Contact Hours per Week: 2**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **I** | **II** | **100** | **-** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 5.08 | 5.83 |

**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-Face book- 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - XIII | **24MAP13** | **TOPOLOGY** | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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, connected spaces and regular spaces. | **$K_5$** |
| **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)**

| COs/POs | 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 | 3.28 | 3.21 | 3.23 | 2.24 | 2.08 |

**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 –Components and path components -Local connectedness.

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

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

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - XIV | **24MAP14** | **THEORY OF NUMBERS** | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **100** |

**PREAMBLE :**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 2.64 | 5.08 | 6.25 |

**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 Niven, Herberts Zucherman and Hugh L. Montomery (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 | 2.8-2.11 |
| IV | III | 3.1 - 3.3 |
| V | IV | 4.1-4.3 |

**REFERENCE BOOKS:**

1. Apostol.T.M.(1995)– "Introduction to Analytic Number Theory",IeditionSpringer 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - XV | **24MAP15** | **CLASSICAL MECHANICS** | 72 | 4 |

**Contact Hours per Week: 5**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **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 OUTCOME:**

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

| COs | 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, linear, rotational and rolling motions and canonical tranformations | **$K_5$** |
| **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)**

| COs/POs | 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 | 3.75 | 3.95 | 2.64 | 1.49 | 2.08 |

**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 (15 Hours)**

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

**UNIT -II LAGRANGE'S EQUATIONS (15 Hours)**

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

**UNIT -III HAMILTON'S EQUATIONS (15 Hours)**

Hamilton's Principle – Hamilton's equations.

**UNIT- IV HAMILTON – JACOBI THEORY (12 Hours)**

Hamilton's principle function – Hamilton – Jacobi equation.

**UNIT- V CANONICAL TRANSFORMATIONS (15 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XVI PRACTICAL- II | **24MAP16** | **MATHEMATICAL SOFTWARE – II (R SOFTWARE) - PRACTICAL** | 36 | 1 |

**Contact Hours per Week: 3**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **40** | **60** | **100** |

**PREAMBLE:**

To enable the students to get experienced about R Software.

**COURSE OUTCOME:**

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

| COs | 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, probability 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)**

| COs/POs | 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 | 26 | 26 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.22 | 2.80 | 3.82 | 3.89 | 5.42 |

**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 | Component | Course Code | Course Title | Contact Hours / Semester | Credit |
|---|---|---|---|---|---|
| Part – III | Core : XVIII Open Elective | **24TAPOE1** | **தேர்வு நோக்கில் தமிழ் இலக்கிய வரலாறு** | 36 | 2 |

**Contact hours per week: 3**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **50** | **50** | **100** |

**முகப்புரை :**

தமிழ் இலக்கியங்களின் வரலாற்றினை,சிறப்புகளைதேர்வுநோக்கில் கற்பர்.

**COURSE OUTCOME:**

தேர்வுநோக்கில் தமிழ்இலக்கியம்கற்பதன் வழி கீழ்க்காணும் அறிவினைப் பெறுவர்.

| COs | CO Statement | Knowledge Level |
|---|---|---|
| **CO1** | தமிழ் இலக்கியம், இலக்கணம், வரலாறு,பண்பாடு சார்ந்த அடிப்படைநிலைகளை அறிவர். | **K1** |
| **CO2** | சொல் உருவாக்கம், வாக்கிய அமைப்பு முறைகளைக் கற்பர். | **K2** |
| **CO3** | தமிழ் இலக்கியவரலாற்றினை அறிவதன் மூலம் போட்டித் தேர்வுகளை அணுகுவர். | **K3** |
| **CO4** | பண்டைய இலக்கியம் மற்றும் நவீன இலக்கியங்களுக்கான தொடர்பை வேறுபடுத்தி பார்ப்பர். | **K4** |
| **CO5** | இலக்கிய வகைமைகளை மதிப்பிடுவர் | **K5** |
| **CO6** | மொழிபெயர்ப்பு, புத்தகம் மற்றும் பத்திரிகை பிழைத்திருத்தம் செய்தல் உருவாக்கம் போன்றவேலைவாப்பினைப் பெறுவர | **K6** |

**K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create.**

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

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 3 | 3 | 9 | 9 |
| **CO3** | 9 | 9 | 9 | 3 | 3 | 9 | 9 |
| **CO4** | 3 | 9 | 9 | 3 | 3 | 9 | 9 |
| **CO5** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO6** | 9 | 9 | 9 | 3 | 9 | 9 | 3 |
| **Total contribution of COs to POs** | 48 | 54 | 54 | 30 | 36 | 54 | 48 |
| **Weighted Percentage of COs contribution to POs** | 3.3 | 6.0 | 3.3 | 2.8 | 4.0 | 7.8 | 7.0 |

**Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs**

## COURSE CONTENT

**அலகு 1** **7மணிநேரம்**

தமிழ் இலக்கியம் ஒருபார்வை –சங்க இலக்கியம் முதல் இக்கால இலக்கியம் வரை.

**அலகு 2** **8மணிநேரம்**

பிழைதிருத்தம்,சந்திப்பிழைகளைநீக்குதல். ஒருமை,பன்மைத் தொடர்களைஅறிதல்,ஆங்கிலத் தொடருக்குநிகரானதமிழ்ச் சொல்லைக் கண்டறிதல்.ஒலிவேறுபாடுகளைக் கண்டறிதல். வேர்ச்சொல்லை இனம் காணல். ஓரெழுத்துஒருமொழி.

**அலகு 3** **7மணிநேரம்**

பொருத்துதல் - பொருத்தமானபொருளைத் தேர்வுசெய்தல்.புகழ் பெற்ற நூல்கள் - நூலாசிரியர்கள் வ.வே.சு. ஐயர்முதல் தற்போதுவரையிலானபடைப்புக்கள்.

**அலகு 4** **7மணிநேரம்**

வினையெச்சம்,வினையாலணையும்

பெயர்,வாக்கியஅமைப்புக்கள்,அகரவரிசைப்படிசொற்களைஎழுதுதல். எதுகை,மோனை, இயைபு,

**அலகு 5** **7மணிநேரம்**

கவிதை,புதினம்,நாடகம்,சிறுகதை,சாகித்தியஅகாதமிவிருதுபெற்றஎழுத்தாளர்கள்.

**பார்வை நூல்கள்**

1) பரந்தாமனார்அ.கி.நல்லதமழ் எழுதவேண்டுமா? பாரிநிலையம்,சென்னை -108.
2) தமிழ்நாடு அரசு பணியாளர் தேர்வாணைய (TNPSC) தேர்வு மாதிரிவினாத்தாள்கள்.
3) தமிழ் இலக்கிய வரலாற்று நூல்கள்.
4) புதுக்கவிதையின் தோற்றமும் வளர்ச்சியும் - வல்லிக்கண்ணன்

**இணையக்குறிப்பு**

1.http://amudhavan.blogspot.com/2010/12/%E0%AE%A4%E0%AE%B1%E0%AE%95%E0%AE%B2%E0%AE%A4-%E0%AE%A4%E0%AE%AE%E0%AE%B4-%E0%AE%87%E0%AE%B2%E0%AE%95%E0%AE%95%E0%AE%AF%E0%AE%AE-%E0%AE%A4%E0%AE%B5-%E0%AE%AA%E0%AE%A4%E0%AE%AF-%E0%AE%AA%E0%AE%B0%E0%AE%B5.html

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credit |
|---|---|---|---|---|---|
| Part – III | Core : XVII Open Elective | **24ENPOE1** | **ENGLISH FOR CAREER DEVELOPMENT** | 36 | 2 |

**Contact hours per week: 3**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **100** |

**PREAMBLE:**

To make the students competent in their job-seeking, job-getting and job- holding needs.

**COURSE OUTCOME:**

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

| COs | CO Statement | Knowledge Level |
|---|---|---|
| **CO1** | Relate the vocabulary that is specific to the context. | **KI** |
| **CO2** | Illustrate the ideas clearly in the given situations. | **K2** |
| **CO3** | Experiment with vowels and consonants for better pronunciation | **K3** |
| **CO4** | Examine the effective communication with public relations and telephonic skill | **K4** |
| **CO5** | Select the spoken and written skills in the professional setting. | **K5** |
| **CO6** | Adapt the soft skills for team building. | **K6** |

**K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.**

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

| COs / POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | **9** | **9** | **9** | **9** | **9** | **9** | **9** |
| **CO2** | **9** | **9** | **9** | **9** | **9** | **9** | **3** |
| **CO3** | **9** | **9** | **9** | **9** | **3** | **3** | **3** |
| **CO4** | **9** | **9** | **9** | **3** | **1** | **1** | **1** |
| **CO5** | **9** | **3** | **3** | **1** | **1** | **1** | **1** |
| **CO6** | **3** | **3** | **1** | **0** | **1** | **1** | **1** |
| **Total contribution of COs to POs** | **48** | **42** | **40** | **31** | **24** | **24** | **18** |
| **Weighted Percentage of Cos contribution to POs** | **2.8** | **2.9** | **3.2** | **2.8** | **4.2** | **5.3** | **6.5** |

**Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs.**

# Course Content

**UNIT I: CORRECTNESS OF LANGUAGE USAGE** **8 Hours**

Functional Vocabulary
Grammar for Grown-ups
Common errors in communication
Asking questions and responses using be forms and Do forms, Information Questions

**UNIT -II BASICS OF PHONETICS** **7 Hours**

The Vowels of English
The Consonants of English

**UNIT III ORAL SKILLS FOR JOBS** **7 Hours**

Presentations
Effective communication
Public Relations and Telephone skills
Group Discussion

**UNIT IV WRITTEN SKILLS FOR JOBS** **7 Hours**

Applying for jobs
Preparing Résumé
Writing cover letter

**UNIT V INTERVIEW SKILLS & KEEPING THE JOBS** **7 Hours**

Interview Skills
Relationships in the Professional world
Soft skills for Team Building

**TEXT BOOK:**

English for Careers – Pearson

**REFERENCE BOOKS:**

Modern English, A Book of Grammar, Usage and Composition by N.KrishnaswamyA Textbook of English Phonetics for Indian students by T.Balasubramanian
Oxford Guide to Effective Writing & Speaking by John Seely.3rd edition, OUP.

**WEB REFERENCES:**

1. https://archive.org/details/ABCOfCommonGrammaticalError50p.

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credit |
|---|---|---|---|---|---|
| Part – III | Core : XVII Open Elective | **24PHPOE1** | **ENVIRONMENTAL PHYSICS** | 45 | 2 |

**Contact hours per week: 3**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| II | III | 25 | 75 | 100 |

**PREAMBLE:**

The aim is to provide the students to gain knowledge and understanding the Environmental Pollution and Control Techniques.

**COURSE OUTCOME:**

After completion of the course, the learners will be able to

| COs | COURSE OUTCOME | Knowledge Level |
|---|---|---|
| CO1 | recall the basic terms involved in Environmental Pollution and Pollution Control Techniques | K1 |
| CO2 | outline the basic Principles involved in Pollution Control Techniques & Conservation of renewable &non renewable energy resources | K2 |
| CO3 | apply Pollution Control Techniques to reduce pollution | K3 |
| CO4 | Analyze the different types of Pollution | K4 |
| CO5 | evaluate control measures for different types of pollution | K5 |
| CO6 | create new techniques to control Pollution | K6 |

**K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.**

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

| COS - POS | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| **CO2** | 9 | 9 | 9 | 9 | 3 | 3 | 3 |
| **CO3** | 9 | 9 | 3 | 3 | 3 | 1 | 3 |
| **CO4** | 9 | 9 | 3 | 3 | 3 | 1 | 3 |
| **CO5** | 9 | 3 | 3 | 1 | 3 | 1 | 1 |
| **CO6** | 9 | 3 | 3 | 1 | 1 | 1 | 1 |
| **Total Contribution of COs to COS - POS** | 54 | 42 | 30 | 26 | 22 | 16 | 20 |
| **Weighted Percentage of COs Contribution to COS - POS** | 6.3 | 5.5 | 5.1 | 5.3 | 5.0 | 4.2 | 7.6 |

**Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs.**

## COURSE OUTCOME

**UNIT I** **(9 hours)**

Introduction - Environmental pollution – Sources of pollution – types of pollutants – Carbon Monoxide, Nitrogen Oxides, Sulphurdioxide – Particulates – Toxic Chemicals in the Environment - Effects of pollution – Preventive Measures of pollution.

**UNIT II** **(9 hours)**

Types of pollution – Air Pollution ,Causes and its effects – Water pollution ,Causes and its Effects - Soil Pollution , Causes and its Effects , Thermal pollution ,Causes and its effects ,Noise pollution - Causes and its Effects.

**UNIT III** **(9 hours)**

Pollution Control Techniques - Solid Waste Management - Solid Waste DisCOS - POSal – Solid Waste Ocean Dumping – Solid Waste Management by Bio Technology – Organic Waste Management by comCOS - POSting process.

**UNIT IV** **(9 hours)**

Waste Water Treatment – Water quality Parameters – Sludge Treatment – Reverse Osmosis – Water Reuse and Recycling – Domestic Water Treatment- Disinfection methods- UV Treatment and Ozonolysis.

**UNIT V** **(9 hours)**

Natural Energy Sources – Renewable Energy Sources – Solar Energy , Natural gases ,Wind Energy and Tidal Energy – Non Renewable Energy Sources – Coal , Minerals and Petroleum products.

**Text Books:**

1. **Environmental Chemistry** (7$^{th}$Edition by A.K. DE) New Age International Publishers.
2. **Environmental Studies** Published by Bharathiar University.

**WEB REFERENCES:**

1. http://pdf.wri.org/environmentalpollution_bw.pdf
2. https://www.researchgate.net/publication/323944189_Environmental_Pollution_Causes_and_Consequences_A_Study
3. https://www.slideshare.net/VivekJain68/waste-management-70027829
4. http://www.tezu.ernet.in/denvsc/IDC/Waste%20Management.ppt
5. https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=522265&Lab=NRMRL
6. https://www.slideshare.net/pallabipriyadarsini25/solid-waste-management-ppt

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credit |
|---|---|---|---|---|---|
| PART – III | CORE : XXIV Open Elective | **24CAPOE1** | **GREEN COMPUTING** | 36 | 2 |

**Contact hours per week: 3**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **100** |

**PREAMBLE:**

To acquire knowledge to adopt green computing practices to minimize negative impacts on the environment, skill in energy saving practices in their use of hardware, examine technology tools that can reduce paper waste and carbon footprint by user.

**COURSE OUTCOME:**

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

| COs | CO Statement | Knowledge Level |
|---|---|---|
| **CO1** | Label the problems concerning with e-waste and its consequences on environment | **K1** |
| **CO2** | Describe the components involved and how effectively we can achieve cost saving without harming environment | **K2** |
| **CO3** | Inspect the procedural aspects towards going green. | **K3** |
| **CO4** | Categorize the means of green compliance | **K4** |
| **CO5** | Specify the certifications necessary for hardware devices | **K5** |
| **CO6** | Assess the green metrics adopt for the entire organization | **K6** |

**K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.**

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

| COs / POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | **9** | **9** | **9** | **9** | **3** | **9** | **3** |
| **CO2** | **9** | **9** | **3** | **9** | **3** | **9** | **3** |
| **CO3** | **9** | **9** | **9** | **9** | **3** | **9** | **3** |
| **CO4** | **9** | **6** | **9** | **6** | **3** | **6** | **3** |
| **CO5** | **9** | **6** | **3** | **3** | **3** | **3** | **3** |
| **CO6** | **3** | **3** | **3** | **6** | **3** | **6** | **3** |
| **Total contribution of COs to POs** | **48** | **42** | **36** | **42** | **18** | **42** | **18** |
| **Weighted Percentage COs Contribution to POs** | **3.7** | **3.2** | **2.8** | **3.3** | **3.0** | **3.6** | **4.5** |

**Level of correlation: 0–No correlation; 1–Low correlation; 3–Medium correlation; 9-High correlation between COs and POs.**

## COURSE CONTENT:

**UNIT- I** **Green Computing Essentials** **(6 Hours)**

**Overview and Issues:** Introduction - green Computing - Problems – Your Company's Carbon Footprint – Cost Savings. **Initiatives and Standards**: Global Initiatives.

**UNIT- II** **Green Computing Tribulations and Optimizations** **(8 Hours)**

**Minimizing Power Usage:** Power problems - Monitoring power Usage – Reducing Power Usage – Low power Computers – Components. **Cooling:** Cooling Costs – Reducing Cooling Costs – Adding Cooling – Datacenter Design.

**UNIT -III** **Green Enterprise Transforming** **(7 Hours)**

**Changing the Way of Work:** Old Behaviour – Steps – Teleworkers and Outsourcing. **Going Paperless:** Paper Problems – Paper and Office – Going Paperless – Intranets – Electronic Data Interchange (EDI).

**UNIT- IV** **Green Compliance** **(7 Hours) Recycling:** Problems – Means of Disposal – Life Cycle – Hard Drive Recycling. **Hardware Considerations**: Certification Programs – Energy Star.

**UNIT- V** **Green Accomplishment** **(8 Hours)**

**Greening Your Information Systems:** Initial Improvement Calculations – Change Business Process – Improve Technology Infrastructure. **Staying Green:** Organizational Check-ups – Equipment Check-ups – Certifications – Helpful Organizations.

**TEXT BOOK:**

1. Tushar Sambare , Sonali Sambare: Green Computing, Himalaya Publishing House, First Edition 2008.

**REFERENCE BOOKS:**

1. Carl Speshocky, Empowering Green Initiatives with IT, John Wiley & Sons, 2010.
2. Jason Harris, Green Computing and Green IT- Best Practices on regulations & Industry, Lulu.com, 2008.

**WEB REFERENCE:**

1. https://www.himpub.com/documents/Chapter1765.pdf
2. https://studymaterialspdf.com/cs8078-green-computing-cse/

| Category | Component | Course Code | Course Title | Contact Hours / Semester | Credit |
|---|---|---|---|---|---|
| PART – III | CORE :XVIII Open Elective | **24CGPOE1** | **APPLIED E-COMMERCE** | 36 | 2 |

**Contact hours per week: 3**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **100** |

**PREAMBLE:**

To enable the students to learn the basics of electronic commerce and application knowledge on electronic commerce

**COURSE OUTCOME:**

After completion of the course, the learners will be able to:

| COs | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | To provide an analytical framework to understand the emerging world of e-commerce | K1 |
| CO2 | To make the learners familiar with current challenges and issues in e-commerce | K2 |
| CO3 | To develop the understanding of the learners towards various business models | K3 |
| CO4 | To enable to understand the Web- based Commerce and equip the learners to assess e-commerce requirements of a business | K4 |
| CO5 | To develop understanding of learners relating to Legal and Regulatory Environment and Security issues of E-commerce | K5 |
| CO6 | Analyze the impact of E-commerce on business models and strategy. | K6 |

**K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.**

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

| COs / POs | 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 | 3 | 3 | 3 | 1 | 1 |
| **CO5** | 9 | 9 | 3 | 3 | 3 | 1 | 1 |
| **CO6** | 9 | 9 | 3 | 3 | 3 | 1 | 3 |
| **Total Contribution of COs to POs** | **54** | **54** | **36** | **36** | **18** | **15** | **16** |
| **Weighted Percentage of COs contribution to POs** | **3.88** | **4.32** | **3.25** | **3.56** | **3.44** | **2.42** | **3.50** |

**Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs.**

## COURSE CONTENT

**UNIT I :**

**Introduction to e-Commerce: (7 Hrs)**

Electronic Commerce and its Benefits– Impact of Electronic Commerce – Classification of Electronic

Commerce – Applications of Electronic Commerce Technologies – Business Models – Architectural Framework.

**UNIT II :** **(7 Hrs)**

Network Infrastructure: Network Infrastructure – Local Area Networks – Wide Area Network – Intranet, Extranet and Internet – TCP/IP Reference Model – Domain Name Systems – Internet Industry Structure. Information Distribution and Messaging: File Transfer Protocol Applications – Electronic Main – World Wide Web Server – HTTP – Web servers Implementations.

**UNIT III :** **(8 Hrs)**

**Consumer Oriented Applications:** Consumer Oriented Application, Mercantile Models from the Consumer's perspective – Types of Electronic Payment System, Digital Token based Electronic Payment Systems, Smart Cards Electronic Payments, and Designing Electronic Payment system.

**UNIT IV :** **(7 Hrs)**

**Securing the Business on Internet:** Security Policy, Procedures and Practices – Site Security – Protecting the Network – Firewalls – Securing the Web Service - Security Network Transaction – Transaction Security – Cryptology – Cryptology Algorithms –Public Key Algorithm – Authentication Protocols – Digital Signatures – Electronic Mail Security – Security Protocols for Web Commerce.

**UNIT V :** **(7 Hrs)**

**Search Engines and Directory Services:** Search Engines and Directory Services – Information Directories – Internet Advertising – Electronic commerce Applications - Cyber Law – Introduction – Concept of Cyberspace – Cyber Law in electronic commerce contract Aspects – Electronic Governance – Drupal.

**BOOKS FOR REFERENCE:**

| S. No | Authors | Course Title | Publishers | Year of Publication |
|---|---|---|---|---|
| 1 | Bhasker, B. | Electronic Commerce Framework, Technologies and Applications | McGraw Hill Educations, New Delhi | 2017 |
| 2 | Jaiswal.S. | E-Commerce(Electronic Communication for Business) | Galgotia Publications Pvt. Ltd. New Delhi | 2000 |
| 3 | Kalakota, R., & Whinston, A. B. | Frontiers of Electronic Commerce | Pearson Education India, New Delhi | 2002 |
| 4 | Rayudu, C | E-Commerce and E-Business | Himalaya Publishing House, Mumbai | 2010 |
| 5 | Rayport, & Jaworeski, B. J. | Introduction to E-Commerce | McGraw Hill Publishing Company Limited, Noida, UP. | 2009 |

**WEB REFERENCES:**

1. https://rccmindore.com/wp-content/uploads/2015/06/E-CommerceHonsAll-MS1.pdf
2. https://mu.ac.in/wp-content/uploads/2021/11/E-COMMERCE-English-Version.pdf
3. https://www.vssut.ac.in/lecture_notes/lecture1428551057.pdf
4. https://oms.bdu.ac.in/ec/admin/contents/387_P16MCE4A_2020051801071611.pdf
5. https://mrcet.com/pdf/Lab%20Manuals/IT/E-COMMERCE%20(R17A1212).pdf

| Category | Component | Course Code | Course Title | Contact Hours / Semester | Credit |
|---|---|---|---|---|---|
| PART - III | Core : XVIII Open Elective | **24BAPOE1** | **AGRI-PRENEURSHIP** | 48 | 3 |

**Contact hours per week*:* 4**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| II | III | 25 | 75 | 100 |

**PREAMBLE:**

This course is designed to commercialize agriculture to revitalize Indian agriculture and to make more attractive and profitable ventures.

**COURSE OUTCOME:**

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

| COs | CO Statement | Knowledge Level |
|---|---|---|
| CO 1 | Remember the concepts of Entrepreneurship. | K1 |
| CO 2 | Explain the agri-preneurship concepts and the ways to develop successful agri-entrepreneurs. | K2 |
| CO3 | Apply the skills in adding value agricultural inputs and pricing strategies in agri-preneurship. | K3 |
| CO4 | Analyse the role of agriculture in price commission and the equipments used for agriculture | K4 |
| CO5 | Interpret and explain the outputs in value additional product development in fruits and milk. | K5 |
| CO6 | Formulate new recipes for value added products from Millets, Pulses, Milk and Fruits | K6 |

**K1- Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate, K6 – Create;**

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

| COs / POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 9 | 9 | 9 | 9 | 0 | 0 | 0 |
| **CO2** | 9 | 9 | 9 | 9 | 0 | 3 | 3 |
| **CO3** | 9 | 9 | 9 | 9 | 3 | 0 | 1 |
| **CO4** | 9 | 9 | 9 | 3 | 3 | 3 | 3 |
| **CO5** | 9 | 3 | 3 | 1 | 9 | 9 | 3 |
| **CO6** | 3 | 3 | 1 | 0 | 9 | 9 | 9 |
| **Total Contribution of COs to POs** | **43** | **42** | **40** | **31** | **24** | **24** | **18** |
| **Weighted Percentage of COs contribution to POs** | **3.9** | **3.9** | **4.0** | **3.8** | **4.7** | **4.9** | **4.1** |

**Level of Correlation: 0 - No Correlation; 1 - Low Correlation; 3 - Medium Correlation; 9-High Correlation between COs and POs.**

## Course Content

**UNIT I: INTRODUCTION (6 Hours)**

Entrepreneurship: Meaning - Concept of Entrepreneur- Characteristics of successful Entrepreneurs – Charms of becoming an Entrepreneur- Functions of Entrepreneurs- Types of Entrepreneurs – Entrepreneurship—Women Entrepreneurship- Concept- Functions.

**UNIT II: AGRI – PRENEURSHIP (6 Hours)**

Agri-Preneurship - Need for developing Agri-Preneurship in India- Opportunities for developing Agri-Preneurship - Suggestions for developing Agri-Preneurship.

**UNIT III: PRICING STRATEGIES AND AGRICULTURAL INPUTS (12 Hours)**

Agricultural price terminology – Factors influencing pricing decisions – Pricing strategies - Role of agriculture in price commission. Agricultural inputs: Meaning - Agricultural inputs with special reference to fertilizers – seeds – pesticides and other agricultural inputs (farm machinery, irrigation system equipment)

**UNIT IV: MILLETS AND PULSES (12 Hours)**

Practical session – Value addition - Scope – Value addition in cereals, pulses and millets

**UNIT V: FRUITS AND MILK (12 Hours)**

Practical session – Value added products in fruits – Value added products in vegetables – Value added products in milk.

**Note: Refer Guidelines**

**Books for References:**

| S. No. | Authors | Title | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | S. S. Khanka | Entrepreneurial Development | S. Chand Publishing | 1999 |

**Web References:**

1. https://agritech.tnau.ac.in/
2. https://byjus.com/free-ias-prep/agricultural-costs-and-prices-commission/
3. https://cacp.dacnet.nic.in/
4. https://www.manage.gov.in/RKVY/AboutAOP.aspx
5. https://www.nestle.com/csv/global-initiatives/global-youth-initiative/agripreneurship

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XVIII ELECTIVE - III | **24MAP17A** | **GRAPH THEORY** | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 2.96 | 3.23 | 4.19 | 2.29 |

**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.

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

**REFERENCE BOOKS:**

2. Narsinghdeo (1987) "Graph Theory", Prentice Hall of India Private Limited, New Delhi.
3. Frank Harary, "Graph Theory", Narosa Publishing House, New Delhi.
4. 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XVIII ELECTIVE - III | **24MAP17B** | **INTEGRAL TRANSFORMS** | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 2.96 | 3.23 | 4.19 | 2.29 |

**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:**

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

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - V | PROFICIENCY ENHANCEMENT (SELF STUDY) | **24PEMAP01** | **MATHEMATICS FOR COMPETITIVE EXAMINATIONS (SELF STUDY)** | - | 2 |

**Contact Hours per Week: -**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **III** | **-** | **100** | **100** |

**PREAMBLE:**

To enable the students to learn and gain knowledge about Algebra, Real Analysisand Complex Analysis.

**COURSE OUTCOME:**

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

| COs | CO -STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Recall the fundamental concepts in sequence and series, Group Theory, Complex numbers, Analytic function. | **$K_1$** |
| **CO2** | Illustrate the contexts in sequence and series, Group Theory, Complex numbers , Analytic function | **$K_2$** |
| **CO3** | Apply the basic lemmas and theorems to solve the problems on sequence and series, Group Theory, Complex numbers , Analytic function | **K3** |
| **CO4** | Analyze the various problems on sequence and series, Group Theory, Complex numbers , Analytic function | **$K_4$** |
| **CO5** | Evaluate the various methods and problems on sequence and series, Group Theory, Complex numbers , Analytic function | **$K_5$** |
| **CO6** | Construct simple analytical and numerical examples in sequence and series, Group Theory, Complex numbers , Analytic function | **$K_6$** |

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

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

| COs/POs | 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** | 54 | 54 | 54 | 54 | 18 | 25 | 25 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.22 | 4.44 | 2.64 | 3.74 | 5.21 |

**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 SEQUENCES AND SERIES**

Sequence and Series – Convergence - Lim sup

**UNIT-II SEQUENCES AND SERIES**

Lim inf - Bolzano weierstrass theorem - Heine Borel theorem

**UNIT-III GROUP THEORY**

Groups – Subgroups - Normal subgroups - Quotient groups – Homomorphism - Cyclic groups - Permutation groups.

**UNIT-IV GROUP THEORY**

Homomorphism - Cyclic groups -Permutation groups.

**UNIT-V COMPLEX NUMBERS, ANALYTIC FUNCTION**

Power series - Analytic functions – Cauchy Riemann equations.

**TEXT BOOK**

UGC CSIR NET/SET -Mathematical Analysis- 'Pawansharma, Neha Sharma and Suraj singh'-Arihant publications(India)Ltd.

| UNIT | CHAPTER | PAGE NUMBER |
|---|---|---|
| I,II | II | 37-58 |
| III,IV | XV | 522-541 |
| V | XI | 391-404 |

**REFERENCE BOOK:**

UGC CSIR NET/SET-MathematicalAnalysis, Akilesh Mmani Thirupathi and Sunil Kushwaha, Kanika publishing company.

**SEMESTER – IV**

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - XIX | 24MAP18 | FUNCTIONAL ANALYSIS | 72 | 5 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| II | IV | 25 | 75 | 100 |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 7.93 | 8.07 | 2.92 |

**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 I 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 I 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - XX | **24MAP19** | **MATHEMATICAL METHODS** | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **IV** | **25** | **75** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 2.35 | 2.09 | 1.25 |

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - XXI | 24MAP20 | FLUID DYNAMICS | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| II | IV | 25 | 75 | 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 OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 3.20 | 3.22 | 3.28 | 3.46 | 1.47 | 4.63 | 6.46 |

**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 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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE - XXII | **24MAP21** | **PROJECT WORK AND VIVA - VOCE** | 72 | 4 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **IV** | **20** | **80** | **100** |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 4.22 | 4.44 | 5.29 | 5.38 | 7.50 |

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

| Category | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XXIII ELECTIVE - IV | **24MAP22A** | **FUZZY LOGIC AND FUZZY SETS** | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| **II** | **IV** | **25** | **75** | **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 OUTCOME:**

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

| COs | 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 fuzziness in real life | **$K_5$** |
| **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)**

| COs/POs | 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 | 54 | 54 | 18 | 18 | 18 |
| **Weighted Percentage of COs contribution to POs** | 4.12 | 4.14 | 4.22 | 4.44 | 2.64 | 2.69 | 3.75 |

**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 | Component | Course Code | Course Title | Contact Hours/ Semester | Credits |
|---|---|---|---|---|---|
| PART - III | CORE – XXIII ELECTIVE - IV | 24MAP22B | CONTROL THEORY | 72 | 3 |

**Contact Hours per Week: 6**

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| II | IV | 25 | 75 | 100 |

**PREAMBLE:**

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

**COURSE OUTCOME:**

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

| COs | 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)**

| COs/POs | 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 | 54 | 54 | 18 | 18 | 18 |
| Weighted Percentage of Cos contribution to POs | 4.12 | 4.14 | 4.22 | 4.44 | 2.64 | 2.69 | 3.75 |

**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 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.

# SYLLABUS FOR VALUE ADDED COURSES OFFERED BY DEPARTMENT OF MATHEMATICS

| Category | Course Code | Course Title | Contact Hours/ Semester | Class |
|---|---|---|---|---|
| Value Added Course | **** | **ABSTRACT REASONING AND INTERPERSONAL COMMUNICATION** | 75 | I – M.SC MATHEMATICS |

## COURSE CONTENT

**UNIT I: Simplification and Calendar (15 Hours)**

BODMAS Rule- Ascending Problems- Descending Problems- Formulas- Problems Based on Formulas- Square Root Problems- Cube Root Problems- Finding the Value of X- Calendar Introduction- Problems Based on Calendar

**Unit II: Profit & Loss, Interest Calculation and Data Arrangements (15 Hours)**

Profit & Loss Basics- Profit & Loss Word Problems- Mixtures & Alligations- Simple Interest- Compound Interest- Problems Based on Difference between SI & CI- Linear Arrangements- Circular Arrangements.

**Unit III: Verbal Ability (15 Hours)**

Parts of Speech- Tenses- Verbs- Articles- Prepositions- Voices and Speech- Sentence Correction

**Unit IV: Professional Etiquette (15 Hours)**

Body Language- Professionalism- Time Management- Letter Writing- Debate- Presentation Skills 1-Team Building

**Unit V: General Communication (15 Hours)**

Communication (Based on General Topics)- Resume Writing- Self Introduction Practice

**RULES AND REGULATION:**

The value-added course follows a non-semester pattern, with assessment conducted at the end of the year by the Training and Placement cell, totaling 100 marks. A minimum attendance of 70% is required to be eligible for the examination. The evaluation criteria for the course are as follows:

**Split up for 100 Marks**

| | |
|---|---|
| Aptitude | 25 |
| Resume Writing | 25 |
| Self Introduction & Presentation Skill 1 | 25 |
| Verbal | 25 |

| Category | Course Code | Course Title | Contact Hours/ Semester | Class |
|---|---|---|---|---|
| Value Added Course | **** | **QUANTITATIVE LITERACY** | 75 | II – M.SC MATHEMATICS |

## COURSE CONTENT

**UNIT I: Reasoning 1** **(15 Hours)**

Syllogisms- Boats and Streams Problems- Races and Games- Data Sufficiency- Statements & Conclusions- Imaginary Number Questions- Data Interpretation

**Unit II: Reasoning 2, Mensuration and Trigonometry** **(15 Hours)**

Coding & Decoding- Quadratic Equations- Image Interpretation- Mensuration- Trigonometry

**Unit III: Writing and Presentation Skills** **(15 Hours)**

Email Writing- Report Writing- Role play- Presentation Skills 2

**Unit IV: Training Interview 1** **(15 Hours)**

Communication (Based on Current Affairs and Technology)- Group Discussion Basics- Group Discussion Mock

**Unit V: Training Interview 2** **(15 Hours)**

HR Interview Questions- Stress Interview Questions- Personal Interview Mock

**RULES AND REGULATION:**

The value-added course follows a non-semester pattern, with assessment conducted at the end of the year by the Training and Placement cell, totaling 100 marks. A minimum attendance of 70% is required to be eligible for the examination. The evaluation criteria for the course are as follows:

**Split up for 100 Marks**

| | |
|---|---|
| Aptitude | 25 |
| Writing & Presentation Skill 2 | 25 |
| Self Introduction & Group Discussion | 25 |
| Personal Interview | 25 |

# SYLLABUS FOR CORE EXTRA CREDIT COURSES
## COURSES FOR ADVANCED LEARNERS

| Category | Course Code | Title Of The Course | Credit |
|---|---|---|---|
| EXTRA CREDIT | | **ANALYTIC NUMBER THEORY** | 4 |

**PREAMBLE:**

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

**COURSE OUTCOMES**

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

| COs | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Bring back the concepts of analytic Number theory. | **$K_1$** |
| **CO2** | Demonstrate Dirichlet multiplication and averages of Arithmetic functions and distribution of primes. | **$K_2$** |
| **CO3** | Apply conceptual knowledge and formulae in analytic number theory to solve the problems. | **$K_3$** |
| **CO4** | Analyze the proof and context of theorems in distribution of Primes, Arithmetic functions. | **$K_4$** |
| **CO5** | Evaluate the solutions of Arithmetic functions. | **$K_5$** |
| **CO6** | Manipulate simple research problems on Arithmetic functions | **$K_6$** |

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

**COURSE CONTENT:**

**UNIT- I ARITHMETICAL FUNCTIONS**

Introduction-The Mobious function $\mu$-The euler totient function $\phi$-Arelation connecting $\phi$ and $\mu$- the product formula for $\phi$(n).

**UNIT –II DIRICHLET MULTIPLICATION**

Dirichlet product of arithmetical functions - Dirichlet and Mobious inversion formula –The mangold function- Multiplicative functions and dirichlet multiplication – the inverse of completely multiplicative function-Liovilli's function –the divisors function

**UNIT- III AVERAGES OF ARITHMETICAL FUNCTIONS**

Introduction – The big oh notion-Euler summation formula-some elementary asymptotic formula-the average of order d(n),the average order of the divisor functions .

**UNIT- IV AVERAGES OF ARITHMETICAL FUNCTIONS**

Average of order $\varphi$ (n) - average of order $\mu$(n) and of $\Lambda$(n)- The partial sums of a Dirchlet product-Application to $\mu$(n) and $\Lambda$(n)-Another identity for the partial sums of a Dirchlet product.

**UNIT- V ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIMES**

Introduction-Chebyshev's function $\psi$ (x) and $\phi$(x)-Relation connecting $\phi$(x) and $\pi$(x)-Some equivalent forms of the prime number theorem.

**TEXT BOOK**

Apostol.T.M.(1995)– "Introduction to Analytic Number Theory",IeditionSpringer Verlag.

| UNIT | CHAPTER | SECTIONS |
|---|---|---|
| **I** | **II** | **2.1-2.5** |
| **II** | **II** | **2.6 - 2.13** |
| **III** | **III** | **3.1 - 3.6** |
| **IV** | **III** | **3.7 ,3.9-3.12** |
| **V** | **IV** | **4.1-4.4** |

**REFERENCE BOOKS**

1. Ivan Nivan and HerbertsZucherman (2013) – "An Introduction to Theory of Numbers",Fifth edition,Wiley Indian PvtLtd.,New Delhi-110002.
2. Gareth Jones .A. & Mary Jones J.(1998) – " Elementary Number Theory" -Springer publications.

| Category | Course Code | Title Of The Course | Credits |
|---|---|---|---|
| EXTRA CREDIT | | **QUANTITATIVE TECHNIQUES** | 4 |

**PREAMBLE:**

To enable the students to learn decision making problems based on deterministic and probabilistic models.

**COURSE OUTCOME:**

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

| COs | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Recall the meaning, purpose and tools of Transportation, Sequencing, Replacement, Non Linear programming and Queuing models. | **$K_1$** |
| **CO2** | Explain the procedures and steps for Transportation, Sequencing, Replacement, Non Linear programming and Queuing Theory. | **$K_2$** |
| **CO3** | Illustrate the methodologies to get the optimal solution and the period of replacement, NLP and Queuing Theory. | **$K_3$** |
| **CO4** | Measure the mathematical background of minimum Transportation cost, Sequencing, the mechanism behind the sudden failure of systems, | **$K_4$** |
| **CO5** | Evaluate the problems based on Transportation, Sequencing, Replacement, Non Linear programming and Queuing models. | **$K_5$** |
| **CO6** | Construct the sequencing tables and Replacement tables for various type of problems | **$K_6$** |

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

## COURSE CONTENT:

**UNIT- I TRANSPORTATION PROBLEM**

General Structure; Various methods for finding initial solution: Maximization and Minimisation problems North West Corner Method, Least Cost Method, Vogel‟s Approximation Method; Finding Optimal Solution: Modified Distribution method; Variations: Unbalanced Transportation Problem.

**UNIT-II SEQUENCING PROBLEMS**

Introduction-Problem of sequencing - Basic terms used in sequencing- Processing n-jobs through 2 machines - Processing n –jobs through k machines - Processing 2 jobs through k machines (Problems only).

**UNIT –III REPLACEMENT**

Introduction - Replacement of equipment / assets that deteriorates gradually - Replacement of equipment that fails suddenly and problems.

**UNIT- IV NON LINEAR PROGRAMMING**

Quadratic programming – WOLFE'S modified simplex method- BEALE'S method.

**UNIT- V QUEUING THEORY**

Queuing Theory -Definition of waiting line model -Queue discipline -Traffic intensity -Poisson arrival –Birth death process -Problem from single server: finite and infinite population model.

**TEXT BOOK:**

Kantiswarup, P. K. Gupta, Man Mohan ( 2017) –" Operations Research", 18th Revised edition, S. Chand & Sons Education Publications, New Delhi.

| UNIT | CHAPTER | PAGE |
|---|---|---|
| **I** | **10** | **247-258** |
| **II** | **12** | **327-341** |
| **III** | **18** | **477-495** |
| **IV** | **28** | **853-861** |
| **IV** | **21** | **589-621** |

**REFERENCE BOOKS**

1. DharaniVenkata Krishnan .S – "Operations Research Principles and Problems" Keerthi publishing house PVT Ltd.
2. Prem Kumar Gupta D. S. Hira – "Operations Research " , S. Chand & Company Ltd, Ram Nagar, New Delhi.

| Category | Course Code | Title Of The Course | Credits |
|---|---|---|---|
| EXTRA CREDIT | | **COMMUTATIVE ALGEBRA** | 4 |

**PREAMBLE:**

To enable the students to learn and gain knowledge about Modules and Rings.

**COURSE OUTCOME:**

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

| COs | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Recall the definitions of Localization , Modules and rings. | **$K_1$** |
| **CO2** | Explain the Localization concepts of Modules and rings. | **$K_2$** |
| **CO3** | Apply the theoretical ideas of group theory in Modules and rings. | **$K_3$** |
| **CO4** | Analyze the properties and proposition on Modules, Noetherian rings and Artinian rings. | **$K_4$** |
| **CO5** | Evaluate the simple problems on Modules and rings. | **$K_5$** |
| **CO6** | Construct simple examples for Modules and rings. | **$K_6$** |

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

## COURSE CONTENT:

**UNIT – I MODULES**

Introduction – modules – free modules.

**UNIT – II PROJECTIVE MODULES**

Introduction - Projective Modules – Shanuel's lemma

**UNIT – III LOCALIZATION**

Introduction – ideals – Prime avoidance theorem – Chinese remainder theorem.

**UNIT – IV NOETHERIAN RINGS**

Introduction - Hilbert's basis theorem.

**UNIT –V ARTINIAN MODULES**

Introduction - Artinian modules – structure of Artinian rings.

**TEXT BOOK**

N.S. Gopala Krishnan - **Commutative Algebra,** 2nd Edition, University Press (India) Private Limited.

| UNIT | CHAPTER | SECTION |
|---|---|---|
| **I** | **1** | **1.1 - 1.1.29** |
| **II** | **1** | **1.2 – 1.2.20** |
| **III** | **2** | **2.1 – 2.1.32** |
| **IV** | **3** | **3.1 – 3.1.13** |
| **V** | **3** | **3.3 – 3.3.14** |

**REFERENCE BOOK:**

Sharp. R. Y. , "Step in Commutative Algebra", Cambridge University Press, Cambridge, 2000.

| Category | Course Code | Title Of The Course | Credit |
|---|---|---|---|
| EXTRA CREDIT | | **PROBABILITY AND STATISTICS** | 4 |

**PREAMBLE:**

To enable the students to gain the knowledge about probability and statistics.

**COURSE OUTCOME:**

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

| COs | CO STATEMENT | KNOWLEDGE LEVEL |
|---|---|---|
| **CO1** | Recall the basic terms and concepts of probability, random variables, sampling, time series, test of hypothesis and significance. | **$K_1$** |
| **CO2** | Classify the distribution functions of discrete and continuous random variables, sampling attributes and probability. | **$K_2$** |
| **CO3** | Apply various theorems and tests to solve statistical problems. | **$K_3$** |
| **CO4** | Analyze time series, probability, distribution functions and test of hypothesis. | **$K_4$** |
| **CO5** | Evaluate the problems on distribution functions, probability and time series. | **$K_5$** |
| **CO6** | Predict the values in time series. | **$K_6$** |

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

**COURSE CONTENT:**

**UNIT -I THEORY OF PROBABILTY**

Introduction to probability – History of probability – Basic Terminologies – Mathematical probability – Limitations – Statistical probability – Limitations – Simple examples.

**UNIT- II THEROMS ON PROBABILITY**

Some theorems on probability – Addition Theorem on probability – Boole's inequality – Conditional probability – Multiplication theorem on probability – independent events – Multiplication theorem for independent events

**UNIT -III RANDOM VARIABLE**

Introduction to random variable – Distribution function – Discrete random variable – Continuous random variable – Continuous distribution function

**UNIT -IV SAMPLING THEORY**

Introduction to Sampling – Types of sampling – Parameter and statistics – Test of significance – Procedure of test of hypothesis – Test of significance of sampling theory – Large sampling – Sampling of Attributes

**UNIT -V TIME SERIES**

Definition of Time Series - Components of Time Series-Methods of estimating trend – Graphic, Semi-average, Moving average and Method of Least squares –Advantages and Disadvantages

**TEXT BOOK:**

1. Guptha, S.C & Kapoor, V.K.,(2007) - "Fundamentals of Mathematical statistics", Sultan chand & Sons.

| UNIT | CHAPTER | SECTION | PAGE NUMBER |
|---|---|---|---|
| **I** | **3** | **3.1-3.5** | **3.1-3.18** |
| **II** | **3** | **3.9 – 3.13** | **3.30 – 3.45** |
| **III** | **5** | **5.1 – 5.4** | **5.1 – 5.30** |
| **IV** | **14** | **14.1 – 14.7** | **14.1 – 14.23** |

2. Navnitham. PA. ( 2012) - **"**Business Mathematics and Statistics**"**, Jai publishers, Trichy.

| UNIT | CHAPTER | PAGE NUMBER |
|---|---|---|
| **V** | **14** | **579-601** |

**REFERENCE BOOKS**

1. Gupta. S.P. (2016) - "Statistical Methods", Sultan Chand & Sons, New Delhi.
2. Vittal. P.R. (2013) - "Mathematical Statistics", Margham Publishers, Chennai.