# MASTER OF SCIENCE (MATHEMATICS)

## VISION

To produce graduates with analytical and logical thinking and nurture them with the latest developments of mathematical knowledge and to enhancethe talents to meet global needs.

## MISSION

- To transform students into competent and motivated professionals with sound theoretical and practical knowledge.
- To make students aware of technology to explore mathematical concepts through activities and experiments.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

**PEO 1:** To strengthen the knowledge in mathematical concepts and principles for striving towards research.

**PEO 2:** To enhance their professional career through lifelong learning

**PEO 3:** To apply the concepts of mathematics in real life situations and in problem solving

## PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

**PO 1:** Demonstrate the knowledge in the subject of Mathematics and apply the laws and theorems to meet the needs of the society.

**PO 2:**Gain analytical skills in the field of abstract mathematics

**PO 3:** Innovate, invent and solve complex mathematical problems using the knowledge of pure and applied mathematics.

**PO 4:** Explain the knowledge of various facts in the field of Mathematics and applied sciences.

**PO 5:** Crack lectureship and fellowship exams approved by UGC like CSIR-NET and SET.

## PROGRAMME SPECIFIC OUTCOMES (PSO)

After completion of the programme, the graduates will be able to

**PSO 1:** Provide a systematic understanding of core mathematical concepts, principles and theorems along with their applications.

**PSO 2:** Inculcate the problem-solving skillin pure and applied mathematics independently.

**PSO 3:** Develop proficiency in the analysis of complex mathematical problems and the use of mathematical or other appropriate techniques to solve them.

**PSO 4:** Outline exact, approximate, analytical and numerical methods for solving linear and non-linear equations encountered in various fields.

**PSO 5:** Demonstrate an appropriate level of expertise in algebra, analysis and applied mathematics.

## REGULATIONS

### ELIGIBILITY

A candidate who has passed B.Sc., (Mathematics) / B.Sc., (Mathematics with Computer Applications) degree of this University or any of the above degree of any other University accepted by the Syndicate equivalent thereto, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the Master of Science (M.Sc.,) Degree Examination in Mathematics of this University after a course of study of two academic years.

### DURATION OF THE PROGRAMME

The programme shall extend over a period of two years comprising of four semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

### MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 8 semesters.

## SCHEME OF EXAMINATION

| **FirstSemester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Subject Code** | **Subject** | **Hrs of Instruction** | **Exam. Duration (Hours)** | **Max.marks** | | | **Credit Points** |
| | | | | **CA** | **CE** | **Total** | |
| **Part A** | | | | | | | |
| 18PMAM101 | Core I: Linear Algebra | 6 | 3 | 25 | 75 | 100 | 5 |
| 18PMAM102 | Core II: Real Analysis | 5 | 3 | 25 | 75 | 100 | 4 |
| 18PMAM103 | Core III: Mechanics | 6 | 3 | 25 | 75 | 100 | 4 |
| 18PMAM104 | Core IV: Ordinary Differential Equations | 5 | 3 | 25 | 75 | 100 | 4 |
| 18PMAM105 | Core V: Graph Theory | 5 | 3 | 25 | 75 | 100 | 4 |
| 18PMAMP101 | Core Practical I: Mathematical Text Editor Latex | 2 | 3 | 40 | 60 | 100 | 2 |
| **Non – Credit** | | | | | | | |
| 18PLS101 | Career Competency Skills I | 1 | --- | --- | --- | --- | --- |
| | **Total** | **30** | | | | **600** | **23** |
| **Second Semester** | | | | | | | |
| **Part A** | | | | | | | |
| 18PMAM201 | Core VI: Algebra | 6 | 3 | 25 | 75 | 100 | 5 |
| 18PMAM202 | Core VII: Topology | 6 | 3 | 25 | 75 | 100 | 5 |
| 18PMAM203 | Core VIII: Measure Theory and Integration | 5 | 3 | 25 | 75 | 100 | 4 |
| 18PMAM204 | Core IX: Partial Differential Equations | 5 | 3 | 25 | 75 | 100 | 4 |
| | Elective I | 5 | 3 | 25 | 75 | 100 | 4 |
| **Part B** | | | | | | | |
| 18PVE201 | Value Education: Human Rights | 2 | 3 | 25 | 75 | 100 | 2 |
| **Non – Credit** | | | | | | | |
| 18PLS201 | Career Competency Skills II | 1 | --- | --- | --- | --- | --- |
| | **Total** | **30** | | | | **600** | **24** |

| **Third Semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Subject Code** | **Subject** | **Hours/ week** | **Exam. Duration (Hours)** | **Max.marks** | | | **Credit Points** |
| | | | | CA | CE | Total | |
| **Part A** | | | | | | | |
| 18PMAM301 | Core X: Complex Analysis | 6 | 3 | 25 | 75 | 100 | 5 |
| 18PMAM302 | Core XI: Fluid Dynamics | 6 | 3 | 25 | 75 | 100 | 5 |
| 18PMAM303 | Core XII: Optimization Techniques | 6 | 3 | 25 | 75 | 100 | 4 |
| | Elective II | 5 | 3 | 25 | 75 | 100 | 4 |
| 18PCSMAI301 | IDC: Programming in C++ | 4 | 3 | 25 | 75 | 100 | 2 |
| 18PCSMAIP301 | IDC Practical: Programming in C++ | 3 | 3 | 40 | 60 | 100 | 2 |
| | **Total** | **30** | | | | **600** | **22** |
| **Fourth Semester** | | | | | | | |
| **Part A** | | | | | | | |
| 18PMAM401 | Core XIII: Functional Analysis | 6 | 3 | 25 | 75 | 100 | 5 |
| 18PMAM402 | Core XIV: Integral Equations and Calculus of Variations | 6 | 3 | 25 | 75 | 100 | 4 |
| 18PMAM403 | Core XV: Numerical Analysis | 6 | 3 | 25 | 75 | 100 | 4 |
| 18PMAM404 | Core XVI: Fuzzy Sets and Fuzzy Logic | 5 | 3 | 25 | 75 | 100 | 4 |
| 18PMAM405 | Core XVII: MATLAB | 4 | 3 | 25 | 75 | 100 | 2 |
| 18PMAMP401 | Core Practical II: MATLAB | 3 | 3 | 40 | 60 | 100 | 2 |
| | **Total** | **30** | | | | **600** | **21** |
| | | | | | **Grand Total** | **2400** | **90** |

**ELECTIVE SUBJECTS:**

Students shall opt an elective subject from the list of ELECTIVE I **(**SEMESTER II)

**ELECTIVE I (SEMESTER II)**

| S.No | Subject Code | Subject |
|---|---|---|
| **1** | 18PMAEL201 | Design Theory |
| 2 | 18PMAEL202 | Stochastic process |
| 3 | 18PMAEL203 | Difference Equations |

Students shall opt an elective subject from the list of ELECTIVE II (SEMESTER III).

**ELECTIVE II (SEMESTER III)**

| S.No | Subject Code | Subject |
|---|---|---|
| **1** | 18PMAEL301 | Control Theory |
| 2 | 18PMAEL302 | Neural Networks |
| 3 | 18PMAEL303 | Number Theory |

**FOR COURSE COMPLETION**

Students shall

- Complete all Major papers
- Opt any one Elective Subject in each of Second and Third semester.
- Complete one value education in Second semester.
- Career Competency Skills papers as non credit course in I and II semester.
- Complete one IDC in Third semester.

**TOTAL CREDIT DISTRIBUTION**

| Components | Total Marks | | Credits |
|---|---|---|---|
| Core | 100X17 PAPERS | 1700 | 72 |
| Elective | 100X2 PAPERS | 200 | 8 |
| IDC | 100X1 PAPER | 100 | 2 |
| Core Practical | 100X2 PAPERS | 200 | 4 |
| IDC Practical | 100X1 PAPER | 100 | 2 |
| Value Education | 100X1 PAPER | 100 | 2 |
| **Total** | **No. of papers 24** | **2400** | **90** |

| 18PMAM101 | CORE I: LINEAR ALGEBRA | SEMESTER – I |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn about the concepts of Algebra of Linear Transformations and Polynomials.
- Learning about Direct sum and Cyclic Subspaces.
- To learn about Bi-linear forms.

**Credits: 5Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Linear Transformations** - The algebra of linear transformations – Isomorphism – Representations of linear transformations by matrices. **(Chapter - 3 Sections: 3.1 - 3.4)** | **12** | **CO 1** |
| II | **Polynomials**: The algebra of polynomials – Lagrange Interpolation – Polynomial Ideals – The prime factorization of a polynomial. **(Chapter - 4 Sections: 4.1 - 4.5)** | **12** | **CO 2** |
| III | **Determinants**: Commutative Rings – Determinant functions. **Elementary Canonical Forms:** Characteristic Values – Annihilating polynomials - Invariant subspaces. **(Chapter - 5 Sections: 5.1 - 5.2) (Chapter - 6 Sections: 6.1 - 6.4)** | **12** | **CO 3** |
| IV | Simultaneous triangulation and simultaneous Diagonalization – Direct sum Decompositions - Invariant Direct sums – The Primary Decomposition theorem. **(Chapter - 6 Sections: 6.5 - 6.8)** | **12** | **CO 4** |
| V | Bilinear forms – Symmetric Bilinear Forms – Skew-Symmetric Forms – Groups preserving Bilinear Forms. **(Chapter – 10 Sections: 10.1 – 10.4)** | **12** | **CO 5** |

**Text Book**

| | |
|---|---|
| **1.** | *Kenneth Hoffman* and *Ray Kunze.* 1971. **Linear Algebra.** [Second Edition]. Prentice Hall of India Private Limited, New Delhi. |

**Reference Books**

| | |
|---|---|
| **1.** | *Kumaresan, S.* 2000. **Linear Algebra.** Prentice Hall of India Ltd, New Delhi. |
| **2.** | *Krishnamurthy, V., VedPrakashMainra. And JawaharLalArora, Z.* 1985. **Introduction to Linear Algebra.** East West Press Ltd. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Describe the matrix representation of linear transformation |
| **CO 2** | Gain knowledge on factorization of polynomial |
| **CO 3** | Know the properties of determinants and characteristics values |
| **CO 4** | Understand the concepts of triangulation, diagonalization and decomposition |
| **CO 5** | Learn the concepts of various bilinear forms |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | M | H | H |
| CO 2 | H | L | L | L | H |
| CO 3 | H | H | M | H | H |
| CO 4 | H | L | L | L | H |
| CO 5 | H | L | L | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM102 | CORE II: REAL ANALYSIS | SEMESTER – I |
|---|---|---|

**Course Objectives:**

The Course aims

- To understand the functions of bounded variations
- To learn about the Riemann Stieltjes integral
- To know the importance of mean value theorem and Taylor's formula

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Derivatives:**Definition of derivative - Derivatives and Continuity – The Chain rule – Rolle 's Theorem – The Mean Value theorem for derivatives – Taylor's formula with remainder<br>**Functions of Bounded Variation:** Functions of Bounded variation – Total variation.<br>**(Chapter – 5 Sections: 5.1, 5.2, 5.3, 5.5, 5.9, 5.10, 5.12)**<br>**(Chapter – 6 Sections: 6.3, 6.4)** | **10** | **CO 1** |
| II | **Riemann- Stieltjes Integral**: The definition of the Riemann-Stieltjes integral – Linear properties – Integration by parts – Change of variable in a Riemann-Stieltjes integral – Reduction to a Riemann integral – Step functions as integrators – Reduction of a Riemann-Stieltjes integral to a finite sum – Euler's Summation formula – Monotonically increasing integrators –Riemann's condition - Sufficient conditions for existence of Riemann-Stieltjes integrals - Necessary conditions for the existence Riemann-Stieltjes integrals –Mean value theorems Riemann-Stieltjes integrals – The integral as a function of the interval - Second fundamental theorem of Integral calculus.<br>**(Chapter - 7 Sections: 7.1 - 7.11, 7.13, 7.16 – 7.20)** | **10** | **CO 2** |
| III | **Sequences of Functions:** Pointwise convergence of sequences of functions – Examples of sequences of real value-valued functions – Definition of uniform convergence – Uniform convergence and continuity – The Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions – A space-filling curve – Uniform convergence and Riemann-Stieltjes integration – Nonuniformly convergent sequences that can be integrated term by term – Uniform convergence and differentiation – Sufficient condition for uniform convergence of a series.<br>**(Chapter – 9 Sections: 9.1 - 9.11)** | **10** | **CO 3** |

| | | | |
|---|---|---|---|
| **IV** | **Multivariable Differential Calculus:** Introduction – The directional derivatives - Directional derivatives and continuity – The total derivative – The total derivative expressed in terms of partial derivatives – An Application to complex valued functions – The Jacobian matrix – The Chain rule – The Mean value theorem for differentiable functions – Taylor's formula for functions from $R^n$ to $R^1$. **(Chapter – 12 Sections: 12.1 – 12.6, 12.8, 12.9, 12.11, 12.14)** | **10** | **CO 4** |
| **V** | **Implicit Functions:** Introduction – Functions with non-zero Jacobian determinant –The Inverse function theorem – The Implicit function theorem. **(Chapter - 13 Sections: 13.1 – 13.4)** | **10** | **CO 5** |
| **Text Book** | | | |
| **1.** | *Tom M. Apostol*. 1985. **Mathematical Analysis.** [Second Edition]. Narosa Publishing House, New Delhi. | | |
| **Reference Book** | | | |
| **1.** | *Walter Rudin.* 1976. **Principles of Mathematical Analysis**. [Third Edition]. McGraw Hill, New Delhi | | |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the concepts of derivatives and theorems based on derivatives |
| **CO 2** | Discuss the fundamental theorems of integral calculus |
| **CO 3** | Understand pointwise convergence, uniform convergence and conditions for uniform convergence |
| **CO 4** | Gain knowledge on directional derivatives and Jacobian matrix |
| **CO 5** | Know about inverse function theorem and implicit function theorem |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | M | L | H |
| CO 2 | H | L | M | L | H |
| CO 3 | H | M | H | L | H |
| CO 4 | H | M | M | L | H |
| CO 5 | H | L | L | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM103 | CORE III: MECHANICS | SEMESTER – I |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn the concepts of Mechanical system, Lagrange's and Hamilton's Equations.
- To introduce the concepts of Hamilton – Jacobi Theory and Canonical Transformations.
- To enable the learner to apply the principles of Mechanics in Scientific situations and daily life.

**Credits: 4** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introductory Concepts:** The Mechanical System – Generalized Co-ordinates – Constraints – Virtual work – Energy and Momentum. **(Chapter - 1 Sections: 1.1 - 1.5)** | 12 | CO 1 |
| II | **Lagrange's Equations:** Derivation of Lagrange's Equations – Examples – Integrals of motion. **(Chapter - 2 Sections: 2.1 - 2.3)** | 12 | CO 2 |
| III | **Hamilton's Equations:** Hamilton's Principle – Hamilton's Equations. **(Chapter - 4 Sections: 4.1 - 4.2)** | 12 | CO 3 |
| IV | **Hamilton-Jacobi Theory:** Hamilton's Principal Function – The Hamilton – Jacobi Equation – Separability. **(Chapter - 5 Sections: 5.1 - 5.3)** | 12 | CO 4 |
| V | **Canonical Transformations:** Differential forms and generating functions – Special Transformations – Lagrange and Poisson brackets. **(Chapter - 6 Sections: 6.1 - 6.3)** | 12 | CO 5 |

**Text Book**


| | |
|---|---|
| **1.** | *Greenwood, T.* 1985. **Classical Dynamics.** Prentice Hall of India, New Delhi. |

**Reference Books**

| | |
|---|---|
| **1.** | *Goldstein, H.* 2001. **Classical Mechanics.** Narosa Publishing House, New Delhi. |
| **2.** | *Synge, J.L. andGriffth, B.A.* 1970. **Principles of Mechanics.** McGraw Hill Book Company, New York. |
| **3.** | *Rane, N.C.and Joag, P.S.* 1991. **Classical Mechanics.** Tata McGraw Hill, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Understand the basic concepts of a mechanical system |
| **CO 2** | Derive the equation of motion for various system |
| **CO 3** | Describe Hamilton's principle |
| **CO 4** | Learn the concepts of separable system |
| **CO 5** | Gain knowledge on canonical transformations, Lagrange and Poisson brackets |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | H | H | M |
| CO 2 | H | H | H | H | M |
| CO 3 | H | M | H | H | M |
| CO 4 | H | H | H | H | M |
| CO 5 | H | H | H | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM104 | CORE IV: ORDINARY DIFFERENTIAL EQUATIONS | SEMESTER – I |
|---|---|---|

**Course Objectives:**

The Course aims

- To describe Linear equations with constant and variable coefficients.
- To study the methods of solving Ordinary Differential Equations.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Solutions in Power Series:** Introduction – Second order Linear equations with ordinary points – Legendre Equation and Legendre polynomials – Second order equation with regular singular point – Properties of Bessel functions. **(Chapter – 3 Sections: 3.1 – 3.5)** | 10 | CO 1 |
| II | **Systems of Linear Differential Equations:** Introduction – Systems of first order equations – Existence and Uniqueness theorem – Fundamental matrix.**(Chapter - 4 Sections: 4.1 – 4.2, 4.4 – 4.5)** | 10 | CO 2 |
| III | **Systems of Linear Differential Equations:** Non-homogeneous linear systems – Linear systems with constant coefficients – Linear systems with periodic coefficient. **(Chapter - 4 Sections: 4.6 – 4.8)** | 10 | CO 3 |
| IV | **Existence and Uniqueness of Solutions:** Successive approximations - Picard's theorem – Some Examples – Continuation and dependence on initial conditions – Existence of solutions in the large – Existence and Uniqueness of solutions of systems.**(Chapter - 5Sections: 5.3 – 5.8)** | 10 | CO 4 |
| V | **Oscillations of Second Order Equations:** Fundamental results – Sturm's comparison theorem – Elementary linear oscillations – Comparison theorem of Hille-Wintner – Oscillations of $x''+a(t)x = 0$.**(Chapter- 8Sections: 8.1 – 8.5)** | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Deo, S.G., Lakshmikantham,V. and Raghavendra,V.*1997. **Ordinary Differential Equations.** [Second Edition]. Tata Mcgraw Hill Publishing Company Ltd., New Delhi. |


**Reference Books**


| | |
|---|---|
| 1. | *Somasundram, D.* 2002. **Ordinary Differential Equations.** Narosa Publishing House, Chennai. |
| 2. | *Agarwal, R. P.* and *Ramesh C.Gupta* 1991. **Essential of Ordinary Differential Equations.** McGraw Hill, New York. |
| 3. | *Coddington, E.A. and Norman Levinson.* 1972. **Theory of Ordinary Differential Equations.** Tata McGraw Hill Education Private Ltd., New York. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Find power series solutions about ordinary points and singular points |
| **CO 2** | Derive particular solution to initial value problem |
| **CO 3** | Solve basic application problems described by first order differential equations |
| **CO 4** | Understand the concepts of existence and uniqueness solutions |
| **CO 5** | Gain knowledge on oscillations of second order equations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | H | H | H | H |
| CO 2 | M | H | H | H | H |
| CO 3 | M | H | H | H | H |
| CO 4 | M | H | H | H | H |
| CO 5 | M | H | H | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM105 | CORE V: GRAPH THEORY | SEMESTER – I |
|---|---|---|

**Course Objectives:**

The Course aims

- To introduce the concepts of Graph.
- To learn fundamental properties and some special types of Graph.
- To introduce Digraphs

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Graphs and Subgraphs:** Graphs and Simple Graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles. **Trees:** Trees – Cut Edges and Bonds – Cut vertices – Cayley'sFormula. **(Chapter - 1 Sections: 1.1 – 1.7)(Chapter - 2 Sections: 2.1 – 2.4)** | **10** | **CO 1** |
| II | **Connectivity**: Connectivity and Blocks. **Euler Tours and Hamilton Cycles**: Euler Tours – Hamilton Cycles. **(Chapter - 3 Sections: 3.1 – 3.2)(Chapter - 4 Sections: 4.1 – 4.2)** | **10** | **CO 2** |
| III | **Matchings**: Matchings- Matchings and Coverings in Bipartite Graphs – Perfect Matchings. **Edge Colourings**: Edge Chromatic Number. **(Chapter - 5 Sections: 5.1 - 5.3)(Chapter - 6 Sections: 6.1)** | **10** | **CO 3** |
| IV | **Independent Sets and Cliques**: Independent Sets – Ramsey's Theorem. **Vertex Colourings:** Chromatic Number. **(Chapter - 7 Sections: 7.1 – 7.2 )(Chapter - 8 Sections: 8.1)** | **10** | **CO 4** |
| V | **Planar Graphs**: Plane and Planar Graphs – Dual Graphs – Euler's Formula – Five colour theorem and the Four Colour Conjecture. **Directed Graphs**: Directed Graphs – Directed Paths. **(Chapter - 9 Sections: 9.1 – 9.3, 9.6 )(Chapter - 10 Sections: 10.1 – 10.2)** | **10** | **CO 5** |

**Text Book**


| | |
|---|---|
| **1.** | *Bondy, J.A. andMurty, U.S.R.* 1976. **Graph Theory with Applications.** North Holland, New York. |

**Reference Books**

| | |
|---|---|
| **1.** | *Balakrishnan, R. andRanganathan, K. A.* 1999. **Text Book of Graph Theory.** Springer Verlag, New York. |
| **2.** | *Frank Harary.* 1988. **Graph Theory**. Narosa Publishing House, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Explain the concepts of graphs and trees |
| **CO 2** | Illustrate connectivity and tours through Euler graphs and Hamiltonian cycles investigate perfect matching |
| **CO 3** | Discuss matching and edge colourings for graphs |
| **CO 4** | Characteristics independent sets and find chromatic number for graphs |
| **CO 5** | Derive some properties of planarity and explain basic properties of directed graphs |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | L | L | L | H |
| CO 2 | H | L | M | L | H |
| CO 3 | H | L | L | L | H |
| CO 4 | H | L | L | L | H |
| CO 5 | H | L | H | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAMP101 | CORE PRACTICAL I: MATHEMATICAL TEXT EDITOR – LATEX | SEMESTER – I |
|---|---|---|

**Course Objective:**

The Course aims

- To enable the students to prepare research articles in LaTeX format

**Credits: 2** **Total Hours: 30**

| PROGRAM | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **1** | Creation of documents using itemization, enumeration and description | **03** | **CO 1** |
| **2** | Creation of Mathematical Statements | **03** | **CO 1** |
| **3** | Creation of Tables | **03** | **CO 1** |
| **4** | Creation of Matrices | **03** | **CO 1** |
| **5** | Creation of Differential equations | **03** | **CO 2** |
| **6** | Creation of Integral equations | **03** | **CO 2** |
| **7** | Preparing a question paper | **03** | **CO 3** |
| **8** | Inserting pictures | **03** | **CO 4** |
| **9** | Creation of Powerpoint presentation | **03** | **CO 5** |
| **10** | Article preparation | **03** | **CO 5** |

**Reference Book**

**1.** *Nambudiripad, K.B.M.,* 2014. **LaTeX for begineers.**Narosa Publishing House private limited, New Delhi.

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Create mathematical statements, tables and matrices |
| **CO 2** | Demonstrate Differential equations and Integral equations |
| **CO 3** | Prepare question papers in LaTeX format |
| **CO 4** | Gain knowledge of inserting pictures |
| **CO 5** | Prepare PowerPoint presentation and Article in LaTeX |

| 18PLS101 | CAREER COMPETENCY SKILLS – I | SEMESTER – I |
|---|---|---|

**Course Objectives:**

The Course aims

- To impart knowledge on the Aptitude
- To enhance employability skills and to develop career competency

**Total Hours: 15**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Solving Simultaneous Equations Faster – Number System : HCF, LCM – Square roots and Cube roots - Averages | **03** | **CO 1** |
| **II** | Problems on Numbers –Problems on Ages | **03** | **CO 1** |
| **III** | Calendar – Clocks – Pipes and Cisterns | **03** | **CO 1** |
| **IV** | Time and Work – Time and Distance | **03** | **CO 2** |
| **V** | Ratio and Proportion – Partnership – Chain Rule | **03** | **CO 3** |

**Text Book**

**1.** *Aggarwal R.S. 2013.* **Quantitative Aptitude**. [Seventh Revised edition].S.Chand& Co., New Delhi.

**References Book**

**1.** *AbhijithGuha,* **Quantitative Aptitude for Competitive Examinations**, 5th Edition, Tata McGraw Hill, 2015, New Delhi.

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Understand the basic mathematical functions. |
| **CO 2** | Calculate Problems on Ages with shortcuts. |
| **CO 3** | Understand the core concepts of Pipes & Cisterns, Calendar & Clocks. |
| **CO 4** | Obtain knowledge on shortcuts to Time & Work and Time & Distance. |
| **CO 5** | Calculate Ratio & Proportion, Partnership with shortcuts. |

| 18PMAM201 | CORE VI: ALGEBRA | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To introduce the concept of Field Theory
- To learn about Galois Theory

**Credits: 5** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Group Theory**: Another Counting Principle –Sylow's Theorem. **(Chapter - 2 Sections: 2.11 and 2.12)** | 12 | CO 1 |
| II | **Ring Theory**: Euclidean Rings –A Particular Euclidean Ring – Polynomial Rings –Polynomials over the Rational Field. **(Chapter - 3 Sections: 3.7 – 3.10)** | 12 | CO 2 |
| III | **Fields**: Extension Fields –Roots of Polynomials. **(Chapter - 5 Sections: 5.1, 5.3)** | 12 | CO 3 |
| IV | **Fields**: The Elements of Galois Theory – Finite Fields. **(Chapter - 5 Section: 5.6 ) (Chapter - 7 Section: 7.1)** | 12 | CO 4 |
| V | Wedderburn's theorem on finite division rings – A theorem of Frobenius – Integral quaternions and the four square theorem. **(Chapter - 7 Sections: 7.2 – 7.4)** | 12 | CO 5 |

**Text Book**

| | |
|---|---|
| 1. | *I.N.Herstein*, 2009**. Topics in Algebra.** [Second Edition]. John Wiley and sons, New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *J.B.Fraleigh*, 1988. **A First Course in Abstract Algebra**, Narosa Publishing House, New Delhi. |
| 2. | *M.Artin*, 1991. **Algebra**, Prentice-Hall, Englewood Cliff. |
| 3. | *David S.Dummit and Richard M.Foote*, 2004. **Abstract Algebra** [Third Edition]. John Wiley and Sons Publications, India. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the Sylow's theorems and its applications |
| **CO 2** | Discuss the concepts of roots of polynomials |
| **CO 3** | Gain knowledge on polynomial rings |
| **CO 4** | Know about Galois Theory and finite fields |
| **CO 5** | Learn the Wedderburn's and four square theorems |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | H | H | L | H |
| CO 2 | H | M | H | L | H |
| CO 3 | H | H | H | L | H |
| CO 4 | H | H | H | L | H |
| CO 5 | H | M | H | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM202 | CORE VII: TOPOLOGY | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To study about Topological spaces.
- To learn the concepts of continuity, connectedness and compactness.

**Credits: 5** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | Topological Spaces – Basis for a topology – The order topology – The product topology on X x Y – The subspace topology - Closed sets and Limit Points. **(Chapter - 2 Sections: 12 - 17)** | 12 | CO 1 |
| II | The Metric topology – Continuous functions – The product topology. **(Chapter - 2 Sections: 18 – 20)** | 12 | CO 2 |
| III | Connected spaces – Connected subspaces of the real line – Components and Local Connectedness. **(Chapter - 3 Sections: 23 – 25)** | 12 | CO 3 |
| IV | Compact Spaces – Compact subspaces of the real line - Limit Point Compactness - Local compactness. **(Chapter - 3 Sections: 26 – 29)** | 12 | CO 4 |
| V | Countability axioms - The separation axioms - Normal Spaces - The Urysohn lemma – Tietz's Extension Theorem . **(Chapter - 4 Sections: 30 – 33, 35)** | 12 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Munkers, R. James.* 2003. **Topology.** [Second Edition]. Prentice Hall of India Pvt. Ltd., New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *Dugundji J. Allyn*and *Bacon*. 1966. **Topology.** Prentice Hall of India Pvt. Ltd., New Delhi. |
| 2. | *Simmons, F. George.* 1963. **Introduction to Topology and Modern Analysis**. McGraw Hill Book Company, New Delhi. |
| 3. | *Sze-Tsen Hu*. 1965. **Elements of General Topology**. Holden – Day. Inc. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Know about basis and order of topology |
| **CO 2** | Understand the concepts of metric and product topology |
| **CO 3** | Discuss about connected spaces and components |
| **CO 4** | Gain knowledge on limit point compactness and local compactness |
| **CO 5** | Learn the method of extending functions on subsets to the whole space |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | L | L | H |
| CO 2 | H | M | M | L | H |
| CO 3 | H | M | M | L | H |
| CO 4 | H | M | L | L | H |
| CO 5 | H | L | L | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM203 | CORE VIII: MEASURE THEORY AND INTEGRATION | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide a basic knowledge in Lebesgue measure and integration
- To study inequalities and $L^p$ Spaces.
- To study signed measures and decomposition theorems.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Measure on the Real Line:** Lebesgue Outer Measure - Measurable Sets – Regularity -Measurable Functions. **(Chapter – 2 Sections: 2.1 - 2.4)** | 10 | CO 1 |
| II | **Integration of Functions of a Real Variable**: Integration of Non-Negative Functions - The General Integral - Integration of Series - Riemann and Lebesgue Integrals. **(Chapter - 3 Sections: 3.1 - 3.4)** | 10 | CO 2 |
| III | **Abstract Measure Spaces**: Measures and Outer Measures - Extension of Measure -Uniqueness of the Extension - Completion of a Measure - Measure Spaces. **(Chapter – 5 Sections: 5.1 - 5.5)** | 10 | CO 3 |
| IV | **Inequalities and the $L^p$ Spaces**: The $L^p$ Spaces - Convex Functions - Jensen's Inequality - The Inequalities of Holder and Minkowski - Completeness of $L^p(\mu)$ **(Chapter - 6 Sections: 6.1 - 6.5)** | 10 | CO 4 |
| V | **Signed Measures and their Derivatives**: Signed Measures and The Hahn Decomposition - The Jordan Decomposition - The Radon-Nikodyn Theorem **(Chapter - 8 Sections: 8.1 - 8.3)** | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *De.Barra.* 1981. **Measure Theory and Integration.** [First Edition]. New Age International Publishers, New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *Munroe,M.E.* 1953. **Introduction to Measure and Integration**. Addison Wesley, Mascow. |
| 2. | *Natanson, I.P.* 1955. **Theory of Functions of a Real Variable.** Frederick Ungar Publishing Company, New York. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the concepts of measure on real line |
| **CO 2** | Understand the concepts of Riemann integrals and Lebesgue integrals |
| **CO 3** | Know about integration on abstract measure space |
| **CO 4** | Discuss convex functions and inequalities |
| **CO 5** | Gain knowledge on signed measures and their derivatives |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | M | M | H |
| CO 2 | H | M | M | M | H |
| CO 3 | H | L | L | L | H |
| CO 4 | H | L | L | L | H |
| CO 5 | H | L | L | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM204 | CORE IX: PARTIAL DIFFERENTIAL EQUATIONS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To describe the physical systems in terms of Partial Differential Equations by using Mathematical Modeling.
- To learn analytical methods used to solve Partial Differential Equations.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **First Order, Quasi-Linear Equations and Method of Characteristics:** Introduction- Classification of First order equations – Construction of a First Order Equation – Method of Characteristics and General Solution – Canonical Forms of First Order Linear Equations. **(Chapter – 2 Sections : 2.1 – 2.3, 2.5, 2.6)** | **10** | **CO 1** |
| II | **Mathematical Models**: Classical Equation – The Vibrating String – Thevibrating Membrane - Waves in Elastic Medium. **Classification of Second Order Linear Equations:** Second Order Equations in Two Independent Variables – Canonical Forms – Equations with Constant Coefficients – General Solution. **(Chapter - 3 Sections: 3.1 – 3.4)(Chapter - 4 Sections: 4.1 – 4.4)** | **10** | **CO 2** |
| III | **The Cauchy Problem and Wave Equation**: The Cauchy Problem – Cauchy – KowalewskayaTheorem –Homogeneous Wave Equation – Initial – Boundary Value Problems –Equations with Non-Homogeneous Boundary Conditions – Vibration of Finite String with Fixed Ends – Non-Homogeneous Wave Equations. **(Chapter - 5 Sections: 5.1 - 5.7)** | **10** | **CO 3** |
| IV | **Method of Separation of Variables**: Introduction - Separation of Variables –TheVibrating 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. **(Chapter - 7 Sections: 7.1 – 7.7)** | **10** | **CO 4** |
| V | **Boundary value problems and Applications**: Boundary Value Problems – Maximum and MinimumPrinciples - Uniqueness and Continuity Theorems – DirichletProblems for a Circle – DirichletProblems for a Circular Annulus – Neumann Problem for Circle – Dirichlet Problem for a Rectangle – The Neumann Problem for a Rectangle.**(Chapter - 9 Sections: 9.1 – 9.7, 9.9)** | **10** | **CO 5** |

| **Text Book** | |
|---|---|
| **1.** | *TynMyint, U. andLokenathDebnath.* 2007. **LinearPartial Differential Equations for Scientists and Engineers.** [Fourth Edition]**.** Birkhauser publishers, Boston. |
| **Reference Books** | |
| **1.** | *Sneddon, I.N.* 1957. **Elements of Partial Differential Equations.** Tata McGraw Hill Company, New Delhi. |
| **2.** | *SankarRao, K.* 2008. **Introduction to Partial Differential Equations.**[Second Edition]. Prentice Hall of India, New Delhi. |
| **3.** | *Raisinghania, M.D.* 2016. **Advanced Differential Equations.** S.Chand and Company Ltd., New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Classify partial differential equations and transform into canonical form |
| **CO 2** | Understand the concepts of class equations |
| **CO 3** | Determine the solution of Cauchy problem and wave equation |
| **CO 4** | Know the concepts of methods of separation variables |
| **CO 5** | Understand how solutions of partial differential equations determined by conditions at the boundary of the domain and initial conditions at time zero |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | H | H | H | M |
| CO 2 | M | H | H | H | M |
| CO 3 | M | H | H | H | M |
| CO 4 | M | H | H | H | M |
| CO 5 | M | H | H | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAEL201 | ELECTIVE I: DESIGN THEORY | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To study about Steiner triple systems
- To Introduce mutually orthogonal Latin squares

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Steiner Triple Systems:** The existence problem – The Bose construction – Skolen construction – The 6n+5 construction – The Wilson construction – Cyclic Steiner triple systems. **(Chapter - 1 Section: 1.1 – 1.4, 1.6, 1.7)** | 10 | CO 1 |
| II | λ-**Fold Triple Systems:** Triple system of index λ > 1 – The existence of idempotent Latin squares – 2 fold triple systems – Mendelsohn triple systems –λ=3 and 6 – λ-fold triple systems in general. **(Chapter - 2 Sections: 2.1– 2.6)** | 10 | CO 2 |
| III | **Maximum Packings and Minimum Coverings:** The general problem – Maximum packings – Minimum coverings. **(Chapter - 4 Sections: 4.1 – 4.3)** | 10 | CO 3 |
| IV | **Kirkman Triple Systems:** A recursive construction – Constructing pairwise balanced designs. **(Chapter - 5 Sections: 5.1 – 5.2)** | 10 | CO 4 |
| V | **Mutually Orthogonal Latin Squares:** Introduction – The Euler and MacNeish Conjectures – Disproof of the MacNeish Conjecture – Disproof of Euler conjecture – Orthogonal Latin Squares of order $n \equiv 2 \ (mod\ 4)$. **(Chapter - 6 Sections: 6.1 –6.5)** | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Rodger, C.A. and Charles C. Lindner,* 2009. **Design Theory**, [Second Edition]. CRC Press, New York. |

**Reference Books**

| | |
|---|---|
| 1. | *Ian Anderson,* 1998.**Combinatorial Designs and Tournaments,** Clarendon Press, Oxford. |
| 2. | *Yury J. Lonin and Mohan S, Shrikande.* 2006. **Combinatorics of Symmetric Designs**, Cambridge University Press. |
| 3. | *Wallis, W.D.,* 2007. **Introduction to Combinatorial Designs**, [Second Edition]. Chapman and Hall/CRC, New York. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the concepts of construction of triple system |
| **CO 2** | Design Latin squares for various triple system |
| **CO 3** | Understand the concepts of maximum packing and minimum covering |
| **CO 4** | Construct pairwise balanced design for Kirkman triple system |
| **CO 5** | Gain knowledge on Euler conjecture |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | M | H | M |
| CO 2 | M | H | M | H | M |
| CO 3 | M | H | M | H | M |
| CO 4 | M | H | M | H | M |
| CO 5 | M | H | M | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAEL202 | ELECTIVE I: STOCHASTIC PROCESS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To give a good grip on concepts in Stochastic Process (Random Process).
- To provide a sound knowledge about rare events occurrence problems.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Stochastic Processes:** Introduction – Specification of stochastic processes – Stationary processes - Second order process – Stationarity – Gaussian processes. **Markov chains:** Definition and Examples - Transition matrix - Order of Markov Chain – Higher Transition probabilities. **(Chapter - 2 Sections: 2.1, 2.2, 2.3, 2.3.1, 2.3.2, 2.3.3) (Chapter – 3 Sections: 3. 3.1, 3.1.1, 3.1.2, 3.2)** | **10** | **CO 1** |
| II | **Markov Chains:**Classification of states and Chains: Communication Relations – Class property – Classification of chains – Classification of states – Determination of higher transition probabilities – Aperiodic chain. **(Chapter - 3 Sections: 3.4, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.5, 3.5.1)** | **10** | **CO 2** |
| III | **Markov Processes with discrete state space:** Poisson process – Introduction – Postulates for Poisson process – Properties of Poisson process – Poisson process and related distributions – Inter arrival time – Pure Birth process – Birth and Death process. **(Chapter - 4 Sections: 4.1, 4.1.1, 4.1.2, 4.1.3, 4.2, 4.2.1, 4.3.3, 4.4)** | **10** | **CO 3** |
| IV | **Markov Processes with continuous state space**: Introduction - Brownian motion - Wiener Process - Differential equations for a Wiener process - Kolmogorov equations - First passage time distribution for Wiener process – Distribution of maximum of a Wiener process - Distribution of the first passage time to a fixed point.**(Chapter - 5 Sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.5.1, 5.5.2)** | **10** | **CO 4** |
| V | **Renewal Processes and Theory**: Renewal Process –Renewal process in discrete time – Relation between *F(S)* and *P(S)* - Renewal processes in continuous time – Renewal function and Renewal density –Renewal theorems (Statement of Black Well's and Smith's theorems) - Residual and excess lifetimes – Poisson Process as a Renewal Process- Distribution of *Y(t)* and *Z(t)* – Moments of the Asymptotic Distributions. **(Chapter – 6 Sections: 6.1, 6.1.1, 6.1.2, 6.2, 6.2.1, 6.5.4, 6.7, 6.7.1, 6.7.2, 6.7.3)** | **10** | **CO 5** |

| **Text Book** | |
|---|---|
| **1.** | *Medhi, J.* 2006. **Stochastic Processes.** [Second Edition]. New Age International Publications, New Delhi |
| **Reference Books** | |
| **1.** | *Karlinand Taylor, H.M.* 1975. **First Course in Stochastic Processes. [Volume 1]**. Academic Press. |
| **2.** | *Bhat*, *B.R.* 2000, **Stochastic Models: Analysis and Applications.** New Age International Publications, India. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn about Gaussian processes and Markov chain |
| **CO 2** | Understand the classification of chains |
| **CO 3** | Gain knowledge on Poisson processes and birth-death process |
| **CO 4** | Know Kolmogorov and Wiener process |
| **CO 5** | Learn the well known theorems on renewal process |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | M | L | L |
| CO 2 | M | H | M | L | L |
| CO 3 | M | M | M | L | L |
| CO 4 | M | M | M | L | L |
| CO 5 | M | M | M | L | L |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAEL203 | ELECTIVE I: DIFFERENCE EQUATIONS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide knowledge for solving difference equations.
- To learn about Stability theory.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Difference Calculus:** Difference Operator - Summation – Generating Function and Approximate Summation. **(Chapter - 2 Sections: 2.1 – 2.3)** | 10 | CO 1 |
| II | **Linear Difference Equations:** First order equations - General Results for linear equations - Solving Linear equations **(Chapter - 3 Sections: 3.1 – 3.3)** | 10 | CO 2 |
| III | **Linear Difference Equations (Contd.):** Equations with variable Coefficients – The z – Transform **(Chapter – 3Sections: 3.5 and 3.7)** | 10 | CO 3 |
| IV | **Stability Theory:** Initial Value problems for linear systems – Stability of linear systems **(Chapter – 4 Sections: 4.1 and 4.2)** | 10 | CO 4 |
| V | **Asymptotic Methods:** Introduction – Asymptotic analysis of sums – linear equations **(Chapter - 5 Sections: 5.1 – 5.3)** | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Kelly, W.G.andPeterson, A.C.* 1991. **Difference Equations**, [Second Edition]. Academic Press, New York. |

**Reference Books**

| | |
|---|---|
| 1. | *Elaydi*, *S.N.* 1991. **An Introduction to Difference Equations**, Springer–Verlag, New York. |
| 2. | *Mickens*, R. 1990. **Difference Equations.** Van Nostrand Reinhold, New York. |
| 3. | *Agarwal*, *R.P.* 1992. **Difference Equations and Inequalities**, Marcel Dekker, New York. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Describe difference calculus with generating function |
| **CO 2** | Discuss general results for linear equations |
| **CO 3** | Analyze linear difference equations with variable coefficients |
| **CO 4** | Verify stability of linear system |
| **CO 5** | Explain asymptotic analysis of linear equations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | M | H | M |
| CO 2 | M | H | M | H | M |
| CO 3 | M | M | M | H | M |
| CO 4 | M | H | M | H | M |
| CO 5 | M | H | M | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PVE201 | VALUE EDUCATION: HUMAN RIGHTS | SEMESTER – II |
|---|---|---|

**Course Objective:**

The Course aims

- To make the students to understand the concepts of human rights.

**Credits: 2** **Total Hours: 25**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | Human Rights: Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights - Fundamental Rights - Directive Principles of the State Policy - Indian Constitution. | 05 | CO 1 |
| II | Civil and Political Rights: Right to Work - Right to Personal Freedom - Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality - Right to Religion - Right to Form Associations and Unions - Right to Movement - Right to Family - Right to Contract - Right to Constitutional Remedies - Right to Vote and Contest in Elections - Right to Hold Public Offices - Right to Petition - Right to Information - Right to Criticise the Government - Right to Democratic Governance. | 05 | CO 2 |
| III | Economic Rights: Right to Work - Right to Adequate Wages - Right to Reasonable Hours of Work - Right to Fair Working Conditions - Right to Self Government in Industry - Customer Rights - Social and Cultural Rights - Right to Life - Right to Clean Environment. | 05 | CO 3 |
| IV | Women's Rights: Right to Inheritance - Right to Marriage - Divorce and Remarry - Right to Adoption - Right to Education - Right to Employment and Career Advancement - Rights Relating to Dowry - Right for Equality - Right for Safe Working Conditions - Children's Rights - Right to Protection and Care - Right to Education - Issues Related with Infanticide - Street Children - Child Labour - Bonded Labour - Refugees Rights - Minority Rights - Dalit Rights - Tribal Rights - Nomads Rights. | 05 | CO 4 |
| V | Human Rights Violation: International, National, Regional Level Organizations to Protect Human Rights - UNO - National Commission for Human Rights - State Commissions - Non Governmental Organizations and Human Rights - Amnesty Terrorism and Human Rights - Emergency and Human Rights - Judiciary and Human Rights - Media and Human Rights - Police and Human Rights. | 05 | CO 5 |

| **Reference Book** | |
|---|---|
| **1.** | *Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Understand the core principles of human rights philosophy |
| **CO 2** | Know the importance and functions of human rights commission |
| **CO 3** | Apply their rights for democracy, human rights and gender equality |
| **CO 4** | Know the rights from Governance, economic and social development through various Acts |
| **CO 5** | Understand the right to information, rights for women, children, Nomads, refugees and various sector of people in our country |

| 18PLS201 | CAREER COMPETENCY SKILLS – II | SEMESTER – II |
|---|---|---|

**Course Objective:**

The Course aims

- To enhance employability skills and to develop career competency

**Total Hours: 15**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Interview Skills – Types of Interview – Groundwork before Interview – Abide by the dress code – Importance of Body language in Interviews – Tell Us about yourself – Do's and Don'ts of an interview – Concluding an Interview – A Mock Interview. | **03** | **CO 1** |
| **II** | Resume Preparation – Difference between a Resume and CV – The main body of Resume – The Career objective in Resume – A Fresher's Resume – Antiquity of Soft Skills – Classification of Soft Skills – Personality Analysis – Interpersonal Skills. | **03** | **CO 1** |
| **III** | Body Language – Emotion displayed by Body Language – Group Discussion – Group Discussion types – Guidelines Do's and Don'ts during a Group Discussion – Concluding the Discussion – The technique of Summing Up. | **03** | **CO 1** |
| **IV** | Speaking Skills – Effective Speaking Guidelines – Reading Skills – Types of Reading Skills – Barriers to Speed Reading – Listening Skills – Stages of Listening – Types of Listening – Barriers to Listening – Beware of Pitfalls – Avoid Errors : Indianisms in English – Most common errors in the world – Similar but not Quite the same – Words that are Singular or Couple. | **03** | **CO 2** |
| **V** | Avoid Pitfalls: of Beware Self-improvement - Facilitating Laboratory: Language Techniques and Concepts E-learning | **03** | **CO 3** |

**Text Book**

| | |
|---|---|
| **1.** | *Barun K. Mitra.* 2011.**Personality Development and Soft skills**. [Second Edition]. Oxford University Press, New Delhi. |

**Reference Book**

| | |
|---|---|
| **1.** | *S.P.Dhanavel. 2015,* **English and Soft Skills**. [Second Edition]. Orient Black Swan Publishers, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Understand the types of Interviews, Dress Code and Styles |
| **CO 2** | Develop Resume content and structures. |
| **CO 3** | Improve body language skills. |
| **CO 4** | Know how to represent self through communication. |
| **CO 5** | Attain the different level of Learning Skills. |

| 18PMAM301 | CORE X: COMPLEX ANALYSIS | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To study the concepts of complex functions.
- To learn the development of concept of complex integration.
- To gain the knowledge about singularities and Residues.
- To acquire a knowledge about power series expansions and infinite products.

**Credits: 5** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Analytic Functions as Mappings**<br>**Conformality:** Arcs and closed curves – Analytic functions in Regions – Conformal mapping – Length and Area.<br>**Linear Transformations**: The linear group – The Cross ratio – Symmetry.<br>**(Chapter – 3 Sections: 2.1 – 2.4, 3.1 – 3.3)** | **12** | **CO 1** |
| II | **Complex Integration**<br>**Fundamental theorems:** Line integrals – Rectifiable Arcs – Line integrals as functions of Arcs – Cauchy's theorem for Rectangle – Cauchy's theorem in a Disk.<br>**Cauchy's integral formula**: The index of a point with respect to a closed curve – The integral formula – Higher Derivatives.<br>**(Chapter – 4 Sections: 1.1 - 1.5, 2.1 - 2.3)** | **12** | **CO 2** |
| III | **Local Properties of Analytical Functions**: Removable Singularities – Zero's and Poles - Taylor's Theorem – The Maximum Principle.<br>**The Calculus of Residues**: The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals.<br>**(Chapter – 4 Sections: 3.1, 3.2, 3.4, 5.1 - 5.3)** | **12** | **CO 3** |
| IV | **Harmonic Functions:** Definition and Basic Properties – The Mean- Value property – Poisson's Formula – Schwarz's Theorem – The Reflection Principle.<br>**(Chapter - 4 Sections: 6.1 - 6.5)** | **12** | **CO 4** |
| V | **Series and Product Developments**<br>**Power Series Expansions:** Weierstrass's Theorem – The Taylor's Series – The Laurent Series.<br>**Partial Fractions and Factorization:** Partial fractions – Infinite Products.<br>**(Chapter – 5 Sections: 1.1 - 1.3, 2.1 – 2.2)** | **12** | **CO 5** |

| **Text Book** | |
|---|---|
| **1.** | *Lars V.Ahlfors, 1979.* **Complex Analysis.** [Third Edition]. McGraw Hill Book Company, New Delhi. |
| **Reference Books** | |
| **1.** | *Ponnusamy, S.* 1980. **Functions of Complex Variables.** Narosa Publishing House, New Delhi. |
| **2.** | *Conway, J.B.* 1991. **Functions of One Complex Variable**. [Second Edition]. Narosa Publishing House, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Know about analytic functions and bilinear transformations |
| **CO 2** | Understand Cauchy's fundamental theorems and Cauchy's integral formula |
| **CO 3** | Calculate poles and residues |
| **CO 4** | Gain knowledge on harmonic functions and theorems based on harmonic functions |
| **CO 5** | Expand a function in Taylor's series and Laurent's series |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | L | L | H |
| CO 2 | H | H | L | L | H |
| CO 3 | H | H | M | L | H |
| CO 4 | H | L | L | L | H |
| CO 5 | H | H | M | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM302 | CORE XI: FLUID DYNAMICS | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To introduce the Equations of motion of a fluid.
- To provide knowledge about two-dimensional flows, three dimensional flows and viscous flows.

**Credits: 5** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introduction:** General Description of Fluid Mechanics - Continuum Mechanics - Fluid Properties. **Kinematics of Fluids:** Methods of Describing Fluid Motion - Translation, Rotation and Rate of Deformation - Streamlines Path Lines and Streak Lines - The Material Derivative and Acceleration - Vorticity. **(Chapter – 1 Sections: 1.1 - 1.3) (Chapter – 3 Sections: 3.1 - 3.5)** | 12 | CO 1 |
| II | **Fundamental Equations of the Flow of Viscous Compressible Fluids:** The Equation of Continuity - Conservation of Mass - Equations of Motion (Navier-Stokes Equation) – Conservation of Momentum – The Energy Equation – Conservation of energy. **One – Dimensional Inviscid Incompressible flow:** Equation of continuity – Stream Tube Flow – Equation of Motion – Euler's Equation – The Bernoulli Equation. **(Chapter – 5 Sections: 5.1 - 5.3)(Chapter – 6 Sections: 6.1 - 6.3)** | 12 | CO 2 |
| III | **Two and Three Dimensional, Inviscid Incompressible Flow Basic Equations and Concepts of Flows:** Equation of Continuity - Eulerian Equations of Motion - Circulation Theorems - Velocity Potential - Irrotational Flow - Integration of the Equations of Motion - Bernoulli's Equation. Two-Dimensional Flow Examples. **(Chapter – 7 Sections: 7.1 - 7.5, 7.12)** | 12 | CO 3 |
| IV | **Laminar Flow of Viscous Incompressible Fluids:** Similarity of Flows -The Reynolds Number - Flow between Parallel Flat Plates – Couette Flow – Plane Poiseuille Flow Steady Flow in Pipes: Flow between Two Coaxial Cylinders - Flow between Two Concentric Rotating Cylinders. **(Chapter – 8 Sections: 8.1, 8.3 – 8.5)** | 12 | CO 4 |

| | | | |
|---|---|---|---|
| **V** | **The Laminar Boundary Layer:** Properties of the Navier-Stokes Equations - Boundary Layer Concept - The Boundary Layer Equations in Two-Dimensional Flow - The Boundary Layer along a Flat Plate – The Blasius Solution – Shearing Stress and Boundary layer Thickness - Momentum Integral Theorems for the Boundary Layer.<br>**(Chapter – 9 Sections: 9.1 – 9.3, 9.5)** | **12** | **CO 5** |
| **Text Book** | | | |
| **1.** | *Yuan, S.W.* 1969. **Foundation of Fluid Mechanics**. Prentice-Hall of India Private Limited, New Delhi. | | |
| **Reference Books** | | | |
| **1.** | *Curle. N and Davies. H.J.*1968**Modern Fluid Dynamics Vol-I"**D Van Nostrand Company Ltd., London. Princeton, N.J.Toronto. | | |
| **2.** | *Yuan. S.W.*1988**Foundations of Fluid Mechanics,** Prentice- Hall of India, New Delhi. | | |
| **3.** | *Chorlton, F.* 1985. **Text Book of Fluid Dynamics**. Publishers & Distributors, New Delhi. | | |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn fluid properties and motion of fluids |
| **CO 2** | Derive equations of motion for one dimensional flows |
| **CO 3** | Gain knowledge of Eulerian equation and circulation theorems |
| **CO 4** | Understand the velocity potential and stream function of laminar flow |
| **CO 5** | Know about boundary layer equations and Blasius solution |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | H | H | H |
| CO 2 | M | H | H | H | H |
| CO 3 | M | H | H | H | H |
| CO 4 | M | H | H | H | H |
| CO 5 | M | H | H | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM303 | CORE XII: OPTIMIZATION TECHNIQUES | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide the Mathematical techniques to model and analyze decision problems.
- To provide the effective application of optimization techniques in real life.

**Credits: 4** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Advanced Linear Programming**<br>**Revised Simplex Method:** Development of the Optimality and Feasibility Conditions – Revised Simplex Algorithm – Bounded-Variables Algorithm.<br>**(Chapter - 7 Sections: 7.2.1, 7.2.2 and 7.3)** | **12** | **CO 1** |
| II | **Integer Linear Programming**<br>**Integer Programming Algorithms:**Branch-and-Bound Algorithm - Cutting Plane Algorithm.<br>**(Chapter - 9 Sections: 9.2.1, 9.2.2)** | **12** | **CO 2** |
| III | **Deterministic Dynamic Programming:** Recursive Nature of Computation in DP – Forward and Backward Recursion.<br>**Selected DP Applications**:Work-Force Size Model – Equipment Replacement Model<br>**(Chapter - 10 Sections: 10.1, 10.2, 10.3.2, 10.3.3)** | **12** | **CO 3** |
| IV | **Classical Optimization Theory**<br>**Unconstrained Problems**: Necessary and Sufficient Conditions – The Newton-Raphson Method.<br>**Constrained Problems:** Equality Constraints – Inequality Constraints – Karush-Kuhn-Tucker Conditions.<br>**(Chapter - 18 Sections: 18.1.1, 18.1.2, 18.2.1, 18.2.2)** | **12** | **CO 4** |
| V | **Non Linear Programming Algorithms**<br>**Unconstrained Algorithms:**Direct Search Method – Gradient method.<br>**Constrained Algorithms:** Separable Programming – Quadratic Programming.<br>**(Chapter - 19 Sections: 19.1.1, 19.1.2, 19.2.1, 19.2.2)** | **12** | **CO 5** |

**Text Book**


| | |
|---|---|
| **1.** | *Hamdy A Taha.* 2007. **Operations Research: An Introduction.** [Eighth Edition]. Prentice Hall of India Private Limited, New Delhi. |

| **Reference Books** | |
|---|---|
| **1.** | *Frederick, S. Hillier and Gerald J Lieberman.*2007. **Introduction to Operations Research.** [Eighth Edition]. Tata McGraw Hill Publishing Company Limited, New Delhi. |
| **2.** | *Sharma, J.K.* 2007. **Introduction to Operations Research Theory and Applications.** [Third Edition]. MacMillan India Ltd., New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Solve advanced linear programming problem |
| **CO 2** | Find the integer solution of linear programming problem |
| **CO 3** | Determine the optimum work force size and optimum replacement period |
| **CO 4** | Solve non linear programming problem by using Newton-Raphson, Jacobi and Lagrangian methods |
| **CO 5** | Gain knowledge on separable and quadratic programming problem |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | H | H | M |
| CO 2 | M | H | H | H | M |
| CO 3 | M | H | H | H | M |
| CO 4 | M | H | H | H | M |
| CO 5 | M | H | H | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAEL301 | ELECTIVE II: CONTROL THEORY | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To impart analytical skills, in the areas of Initial and Boundary value problem of Control techniques.
- To serves as a prerequisite for specialized studies and research.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introduction:**Basic Results of Differential Equations – Fixed Point Methods.**Observability:** Linear Systems – Nonlinear Systems. **(Chapter - 1 Sections: 1.2, 1.3) (Chapter - 2 Sections: 2.1, 2.2)** | **10** | **CO 1** |
| II | **Controllability:** Linear Systems – Nonlinear systems. **(Chapter - 3 Sections: 3.1, 3.2)** | **10** | **CO 2** |
| III | **Stability:** Linear Systems– Perturbed linear systems – Nonlinear systems. **(Chapter - 4 Sections: 4.1 – 4.3)** | **10** | **CO 3** |
| IV | **Stabilizability:** Stabilization via Linear Feedback Control –The Controllable Subspace. **(Chapter - 5 Sections: 5.1, 5.2)** | **10** | **CO 4** |
| V | **Optimal Control:** Linear Time Varying Systems– Linear Time Invariant Systems. **(Chapter - 6 Sections: 6.1, 6.2)** | **10** | **CO 5** |

**Text Book**


| | |
|---|---|
| **1.** | *Balachandran. KandDauer. J.P. 2012.***Elements of Control Theory.**[Second Edition]. NarosaPublishing House, New Delhi. |


**Reference Books**


| | |
|---|---|
| **1.** | *Conti, R.* 1976.**Linear Differential Equations and Control.** Academic Press,London. |
| **2.** | *Klamka*, J. 1991.**Controllability of Dynamical Systems.** Kluwer Academic Publisher, Dordrecht. |
| **3.** | *Russell, D.L.*1979.**Mathematics of Finite Dimensional Control Systems.**Marcel Dekker, New York. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn about observability of linear and non-linear systems |
| **CO 2** | Discuss about controllability Grammian |
| **CO 3** | Understand the stability of linear time varying system and perturbed linear systems |
| **CO 4** | Stabilize a system via linear feedback control |
| **CO 5** | Find optimum control of Riccati equation and linear time invariant systems |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | M | H | M |
| CO 2 | H | M | M | H | M |
| CO 3 | H | M | M | H | M |
| CO 4 | H | M | M | H | M |
| CO 5 | H | M | M | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAEL302 | ELECTIVE II: NEURAL NETWORKS | SEMESTER – III |
|---|---|---|

**Course Objective:**

The Course aims

- To develop the skills to gain a basic understanding of neural network

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Neuron Model and Network Architectures:** Neuron Model – Network Architectures. **An Illustrative Example:** Perceptron – Hamming Network – Hopfield Network. **(Chapter –2 and 3)** | 10 | CO 1 |
| II | **Perceptron Learning Rule:** Learning Rules – Perceptron Architecture – Perceptron Learning Rule – Proof of Convergence. **Supervised Hebbian Learning:** Linear Associator – The Hebb Rule – Performance Analysis - Pseudoinverse Rule – Application – Variations of Hebbian Learning. **(Chapter –4 and 7).** | 10 | CO 2 |
| III | **Performances Surfaces and Optimum Points:** Taylor Series – Vector Case - Directional Derivatives – Minima – Necessary Conditions for Optimality – First-Order Conditions – Second-Order Conditions - Quadratic Functions. **(Chapter –8).** | 10 | CO 3 |
| IV | **Performance Optimization:** Steepest Descent – Stable Learning Rates – Minimizing Along a Line - Newton's Method – Conjugate Gradient. **BackPropagation:** Multilayer Perceptrons – Pattern Classification – Function Approximation – Using BackPropagation – Convergence - Generalization. **(Chapter – 9and 11).** | 10 | CO 4 |
| V | **Associative Learning:** Simple Associative Network – Unsupervised Hebb rule – Hebb Rule with Decay - Simple Recognition Network – Instar Rule – Kohonen Rule - Simple Recall Network – Outstar Rule. **(Chapter –13)** | 10 | CO 5 |

**Text Book**

**1.** *Martin T. Hagan, Howard B. Demuth and Mark Beale,* 2010. **Neural Network Design,** Cengage Learning India Private Ltd., New Delhi.

| **Reference Books** | |
|---|---|
| **1.** | James A. *Freeman and David M. Skapura,* 2003. **Neural Networks Algorithms, applications and Programming Techniques**, Pearson Education. |
| **2.** | *Robert J. Schalkoff*,1997. **Artificial Neural Network**,Mcgraw-Hill International Edition. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn basic neural network architecture |
| **CO 2** | Gain knowledge on Perceptron learning rule and Hebb rule |
| **CO 3** | Know about the optimality conditions for various functions |
| **CO 4** | Understand the concepts of performance optimization and Backpropagation |
| **CO 5** | Learn the concepts of associative learning |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | L | M | L | H |
| CO 2 | H | L | L | L | H |
| CO 3 | H | L | M | M | H |
| CO 4 | H | L | M | M | H |
| CO 5 | H | L | L | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAEL303 | ELECTIVE II: NUMBER THEORY | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To enrich the knowledge of students in logical reasoning.
- To give a grip on elementary concepts of number theory
- To provide a sound knowledge about congruence's, Mobius function and Diophantine equations

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Divisibility:** Introduction -Divisibility – Primes. **Congruences:** Congruences – Solutions of Congruences. **(Chapter - 1 Sections: 1.1 - 1.3) (Chapter - 2 Sections: 2.1, 2.2)** | 10 | CO 1 |
| II | **Congruences:** Prime Power Moduli – Prime Modulus –Primitive Roots and Power Residues - Congruences of Degree Two, Prime Modulus. **(Chapter - 2 Sections: 2.6 – 2.9)** | 10 | CO 2 |
| III | **Quadratic Reciprocity:** Quadratic Residues – Quadratic Reciprocity – The Jacobi Symbol – Binary Quadratic Forms. **(Chapter - 3 Sections: 3.1 – 3.4)** | 10 | CO 3 |
| IV | **Some Functions of Number Theory:** Greatest Integer Function - Arithmetic Functions – The Mobius Inversion Formula – Recurrence Functions. **(Chapter 4: Sections 4.1 – 4.4)** | 10 | CO 4 |
| V | **Some Diophantine Equations:** The Equation ax + by = c – Simultaneous Linear Equations – Pythagorean Triangles – Assorted Examples. **(Chapter 5: Sections 5.1 – 5.4)** | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Ivan Niven, Zuckerman, H.S. and Hugh L. Montgomery, 2014.* **An Introduction to the Theory of Numbers.** [Fifth Edition]. Wiley India Private Ltd., New Delhi. |


**Reference Books**


| | |
|---|---|
| 1. | *Burton, D.M.* 2001. **Elementary Number Theory.** Universal Book Stall, New Delhi. |
| 2. | *Ireland, K.and Rosen, M.* 1972**. A Classical Introduction to Modern Number Theory.** Springer Verlag, New York. |
| 3. | *Apostal, T.*M. 1980. **Introduction to Analytic Number Theory.** Narosa Publication House, Chennai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn about divisibility and solution of Congruences |
| **CO 2** | Discuss Prime modulus, Primitive roots and Power Residuals |
| **CO 3** | Understand the concepts of Quadratic residues and Quadratic Reciprocity |
| **CO 4** | Gain knowledge on mobius inverse formula and recurrence functions |
| **CO 5** | KnowDiaphantine equations and Pythagorean triangles |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | M | H | M |
| CO 2 | M | H | M | H | M |
| CO 3 | M | H | M | H | M |
| CO 4 | M | H | M | H | M |
| CO 5 | M | H | M | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PCSMAI301 | INTER DISCIPLINARY COURSE : PROGRAMMING IN C++ | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To write robust, maintainable, elegant and efficient C++ code.
- To deploy good C++ programming practices.
- To implement advanced Object-Oriented techniques in C++ to realize efficient and flexible applications

**Credits: 2** **Total Hours: 45**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Principles of Object Oriented Programming:** Object Oriented Paradigm – Basic concepts of OOP – Benefits of OOP – Applications of OOP – Beginning with C++: Structure of C++ program – Simple C++ program – Compiling and Linking. | 08 | CO 1 |
| II | **Tokens, Expressions and Control Structures:** Keywords – Identifiers and Constants – Variables – Data Types – Operators – Control Structures – Functions in C++. | 09 | CO 2 |
| III | **Classes and Objects:** Introduction – Defining Member Function – Arrays within a class – Arrays of Objects – Friendly Functions - Constructors and Destructors: Introduction – Parameterized Constructors – Copy Constructors – Destructors. | 09 | CO 3 |
| IV | **Operator Overloading:** Introduction - Rules – Overloading Unary and Binary Operators – Inheritance: Single – Multilevel – Multiple – Hybrid – Virtual Base Class – s – Virtual Functions. | 10 | CO 4 |
| V | **Working with Files:** Introduction – Opening and Closing a File – File Modes – Sequential Input and Output Operations – Random Access File. | 09 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Balagurusamy, E*. 2007. **Object Oriented Programming with C++**. [Third Edition]. Tata McGraw Hill Publishing Company Limited, New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *Ravichandran, D.* 2002. **Programming with C++**. [Second Edition].Tata McGraw Hill publishing company limited, New Delhi. |
| 2. | *Ira Pohl*. 2003. **Object oriented Programming using C++**. [Second Edition]. Pearson Education Asia, New Delhi. |
| 3. | *BjarneStroustrup*. 2000. **The C++ Programming Language**. [Third Edition]. Addison Wesley, Boston. |
| 4. | *John R. Hubbard*. 2003. **Programming with C++**. Schaums outline series,TMH, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Define the concepts of object oriented programming and its benefits. |
| **CO 2** | Apply the class and objects concepts in real time environments. |
| **CO 3** | Analyze the complexity of the real world problems and suitable methods to solve it. |
| **CO 4** | Apply the effective oops methodology in reducing runtime and coding lines. |
| **CO 5** | Manage file operations in different modes according to the requirement. |

**MAPPING**

| PSO / CO | PSO 1 | PSO 1 | PSO 1 | PSO 1 | PSO 1 |
|---|---|---|---|---|---|
| CO 1 | M | M | M | L | L |
| CO 2 | M | M | M | L | L |
| CO 3 | M | M | M | L | L |
| CO 4 | M | M | M | L | L |
| CO 5 | M | M | M | L | L |
| H-High; M-Medium; L-Low | | | | | |

| 18PCSMAIP301 | INTER DISCIPLINARY COURSE PRACTICAL: PROGRAMMING IN C++ | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To understand all the object oriented concepts practically.
- To develop the programmatical skill in C++ in real time Applications.

**Credits: 2** **Total Hours: 30**

| PROGRAM | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **1** | Program for Classes and Objects. | **03** | **CO 1** |
| **2** | Program for Classes and Objects using Scope Resolution Operator. | **03** | **CO 1** |
| **3** | Program for Inline functions. | **03** | **CO 2** |
| **4** | Program for Friend functions. | **03** | **CO 2** |
| **5** | Program for Function Overloading. | **03** | **CO 3** |
| **6** | Program using Constructor and Destructor. | **03** | **CO4** |
| **7** | Program using Operator Overloading. | **03** | **CO4** |
| **8** | Program using Pure Virtual Function. | **03** | **CO4** |
| **9** | Program for Single and Multiple Inheritances. | **03** | **CO5** |
| **10** | Program for Hierarchical and Hybrid Inheritances. | **03** | **CO5** |

**Web Reference**

https://www.programiz.com/cpp-programming/examples

https://www.javatpoint.com/cpp-program

https://www.geeksforgeeks.org/cc-programs

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Expertisein the Concepts of Class and Object. |
| **CO 2** | Work with Inline and Friend functions. |
| **CO 3** | Apply the Overloading conceptsin real time applications. |
| **CO 4** | Handle Memory management using Constructor and Destructor. |
| **CO 5** | Pertain different Types of Inheritance in Applications |

| 18PMAM401 | CORE XIII: FUNCTIONAL ANALYSIS | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- To study the details of Banach and Hilbert Spaces.
- To acquire knowledge of Orthonormal sets and convergence of sequences.
- To have an introduction of Banach algebras.

**Credits: 5** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Banach Spaces:** Definition and Some Examples – Continuous Linear Transformations –The Hahn-Banach Theorem. **(Chapter – 9 Sections: 46 – 48)** | 12 | CO 1 |
| II | **Banach Spaces:**The Open Mapping Theorem - The Conjugate of an Operator.**Hilbert spaces:** Definition and Some Simple Properties. **(Chapter – 9 Sections: 50 - 51) (Chapter – 10 Section: 52)** | 12 | CO 2 |
| III | **Hilbert spaces:**Orthogonal Complements - Orthonormal Sets - The Conjugate Space H* - The Adjoint of an Operator. **(Chapter – 10 Sections: 53 –56)** | 12 | CO 3 |
| IV | **Hilbert spaces:** Self-adjoint Operators - Normal and Unitary Operators –Projections. **(Chapter – 10 Sections: 57 – 59)** | 12 | CO 4 |
| V | **General Preliminaries on Banach Algebras:** Definition and Some Examples– Regular and Singular Elements – Topological Divisors of Zero – The Spectrum - The Formula for the Spectral Radius. **(Chapter – 12 Sections: 64 – 68)** | 12 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Simmons, G.F.*2010.**Introduction to Topology and Modern Analysis.** McGraw – Hill Book Company, London. |

**Reference Books**

| | |
|---|---|
| 1. | *Goffman, G.andPedrick*, G. 1987. **A First Course in Functional Analysis**. Prentice Hall of India, New Delhi. |
| 2. | *Bachman, G. and Narici*, *L.* 1966. **Functional Analysis.** Academic Press, New York. |
| 3. | *Lusternik, L.A. and Sobolev*, V.J. 1971. **Elements of Functional Analysis.** Hindustan Publishing Corporation, New Delhi. |
| 4. | *Taylor,A.E.* 1958. **Introduction to Functional Analysis.** John Wiley and Sons,New York. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Extend a functional from a subspace to whole space |
| **CO 2** | Discuss open mapping theorem and closed graph theorem |
| **CO 3** | Gain knowledge on Schwarz inequality and Bessel's inequality |
| **CO 4** | Know about normal and unitary operators |
| **CO 5** | Understand Banach algebra and spectral radius |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | L | M | H | H |
| CO 2 | H | L | M | L | H |
| CO 3 | H | M | M | M | H |
| CO 4 | H | M | M | L | H |
| CO 5 | H | L | M | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM402 | CORE XIV: INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn about the concepts of Fredholm and Volterra integral equations.
- To learn the applications of integral equations to Partial differential equations.

**Credits: 4** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introduction:**Definition – Regularity Conditions-Special Kinds of Kernels– Eigen Values and Eigen Functions- Convolution Integral. **Integral Equations with Separable Kernels**: Reduction to System of Algebraic Equations – Examples –Fredhlom Alternative –Examples –An Approximate Method. **(Chapter - 1 Sections: 1.1 - 1.5) (Chapter – 2 Sections: 2.1 - 2.5)** | **12** | **CO 1** |
| II | **Methods of Successive Approximations:** Iterative Scheme – Examples - Volterra Integral Equation – Examples – Some Results About the Resolvent Kernel. **Classical Fredholm Theory:** The Method of Solution of Fredholm – Fredholm's First Theorem – Examples. **(Chapter - 3 Sections: 3.1 - 3.5) (Chapter - 4 Sections: 4.1 –4.3)** | **12** | **CO 2** |
| III | **Variational Problems with Fixed Boundaries:** The Concept of Variation and Its Properties – Euler's Equation – Variational Problems for Functionals of the Form – Functionals Dependent on Higher-Order Derivatives - Functionals Dependent on Functions of Several Independent Variables. **(Chapter – 1 Sections: 1.1 - 1.5)** | **12** | **CO 3** |
| IV | **Variational Problems with Moving Boundaries:**Functional of the Form $I[y(x)]=\int_{x_1}^{x_2} F(x,y,y')dx$ – Variational Problem with a Movable Boundary for a Functional Dependent on Two Functions – One-Sided Variations – Reflection and Refraction of Extremals. **(Chapter - 2 Sections: 2.1 –2.4)** | **12** | **CO 4** |
| V | **Sufficient Conditions for an Extremum:** Field of Extremals – Jacobi Condition – Weirstrass Function – Legendre Condition. **(Chapter – 3 Sections: 3.1 – 3.4)** | **12** | **CO 5** |

| **Text Book** | |
|---|---|
| **1.** | *Ram P. Kanwal*. 1971. **Linear Integral Equations.** Academic Press, New York. (For Units I and II) |
| **2.** | *Gupta,A.S.* 2009. **Calculus of Variations with Applications,** PHI Learning Private Limited, New Delhi. (For Units III, IV and V) |
| **Reference Books** | |
| **1.** | *Raisinghania, M.D.* 2009. **Integral Equations and Boundary Value Problems.** S.Chand& Company Ltd., New Delhi. |
| **2.** | *Sneddon, I.N.* 1996. **Mixed Boundary Value Problems in Potential Theory.**Academic Press,North Holland. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Find Eigen values and Eigen functions of the integral equations |
| **CO 2** | Determine the solution of Volterra integral equations using method of successive approximation |
| **CO 3** | Solve variational problems with fixed boundaries |
| **CO 4** | Discuss reflection and refraction of Extremals |
| **CO 5** | Know the sufficient conditions for Extremals |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | H | H | H |
| CO 2 | M | H | H | H | H |
| CO 3 | M | H | H | H | H |
| CO 4 | M | H | H | H | H |
| CO 5 | M | H | H | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM403 | CORE XV: NUMERICAL ANALYSIS | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- To Introduce the concepts of Picard Method.
- To study the methods of solving ODE, PDE and Runge-Kutta methods

**Credits: 4** **Total Hours: 60**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Numerical Solution to Ordinary Differential Equations :** Introduction – Power Series Solution – Pointwise Methods – Solution by Taylor's Series – Taylor's Series Method for Simultaneous First Order Differential Equations. **(Chapter – 11 Sections: 11.1 - 11.5)** | 12 | CO 1 |
| II | Taylor'sSeries Method for Higher Order Differential Equations- Picard's Method of Successive Approximations - Picard's Method for Simultaneous First Order Differential Equations – Picard's Method for Second Order Differential Equations. **(Chapter – 11 Sections: 11.6 – 11.9)** | 12 | CO 2 |
| III | Runge-Kutta Methods for Simultaneous First Order Equations – Runge-KuttaMethod for Second Order Differential Equation – Predictor-Corrector Methods – Milne's Method – Adams-Bashforth Method.**(Chapter – 11 Sections: 11.16 – 11.20)** | 12 | CO 3 |
| IV | **Numerical Solution to Partial Differential Equations:** Introduction – Difference Quotients – Geometrical Representation of Partial Difference Quotients – Classification of Partial Differential Equations – Elliptic Equations – Solution to Laplace's Equation by Liebmann's Iteration Process . **(Chapter – 12 Sections: 12.1 – 12.6)** | 12 | CO 4 |
| V | Poisson's Equation - It's Solution – Parabolic Equations – Hyperbolic Equations – Solution to Partial Differential Equations by Relaxation Method.**(Chapter – 12 Sections: 12.7 – 12.10)** | 12 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Vedamurthy V.N. , IyengarN.Ch.S.N*. 2011. **Numerical Methods.** Vikas Publishing House PvtLtd, New Delhi. |


**Reference Books**


| | |
|---|---|
| 1. | *Jain, M.K., Iyengar, S.R.K.* and *Jain, R.K.* 1993. **Numerical Methods for Scientific and Engineering Computation.** [Third Edition]. New Age International (P) Ltd., New Delhi. |
| 2. | *Jain, M.*K. 1983. **Numerical Solution of Differential Equations**. [Second Edition]. McGraw Hill International Edition. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Solve first order ordinary differential equations using Taylor's method |
| **CO 2** | Find the solutions of second order ordinary differential equations using Picard's method. |
| **CO 3** | Find solutions of simultaneous first and second order differential equations |
| **CO 4** | Classify the Partial differential equations and solve it |
| **CO 5** | Derive the solutions of the Poisson's equation. |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | H | H | M |
| CO 2 | M | H | H | H | M |
| CO 3 | M | H | H | H | M |
| CO 4 | M | H | H | H | M |
| CO 5 | M | H | H | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM404 | CORE XVI: FUZZY SETS AND FUZZY LOGIC | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn about basic concepts of fuzzy sets.
- To learn about fuzzy relations and measures.
- To learn about general applications of fuzzy logic.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Crisp Sets And Fuzzy Sets:** The Notion of Fuzzy Sets - Basic Concepts of Fuzzy Sets. **Operations on Fuzzy Sets:** Fuzzy Complement – Fuzzy Union – Fuzzy Intersection – Combinations of Operations – General Aggregation Operations. **(Chapter - 1 Sections: 1.3, 1.4) (Chapter - 2 Sections: 2.2 – 2.6)** | 10 | CO 1 |
| II | **Fuzzy Relations:** Crisp and Fuzzy Relations – Binary Relations – Binary Relations on a Single Set – Equivalence and Similarity Relations – Compatibility or Tolerance Relations – Orderings – Morphisms – Fuzzy Relation Equations. **(Chapter - 3 Sections: 3.1 – 3.8)** | 10 | CO 2 |
| III | **Fuzzy Measures:**Belief and Plausibility Measures – Probability Measures – Possibility and Necessity Measures – Relationship Among Classes of Fuzzy Measures. **(Chapter - 4 Sections: 4.2 – 4.5)** | 10 | CO 3 |
| IV | **Uncertainty and Information:**Types of Uncertainty – Measures of Fuzziness – Classical Measures of Uncertainty – Measure of Dissonance – Measures of non-specificity. **(Chapter - 5 Sections: 5.1 – 5.4, 5.6)** | 10 | CO 4 |
| V | **Applications:** Natural, Life and Social Sciences – Engineering - Medicine – Management and Decision Making. (**Chapter - 6 Sections: 6.2 – 6.5)** | 10 | CO 5 |

**Text Book**

| | |
|---|---|
| 1. | *George J. KlirandTina A. Folger*, 2007. **Fuzzy Sets, Uncertainty and Information.** Prentice-Hall of India Private Limited. |

**Reference Books**

| | |
|---|---|
| 1. | *H.J.Zimmermann*, **Fuzzy Set Theoryand its applications** [FourthEdition].Springer International Edition. |
| 2. | *George J. Klir*and*Boyuan*, **Fuzzy Sets and Fuzzy Logic-Theory and Applications.** Prentice-Hall of India Private Limited. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Define fuzzy sets and fuzzy complements |
| **CO 2** | Illustrate fuzzy relations, binary fuzzy relations and fuzzy equivalence relations |
| **CO 3** | Characterize the various of fuzzy measures |
| **CO 4** | Classify the uncertainty and information of fuzziness |
| **CO 5** | State some applications of fuzzy sets |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | M | M |
| CO 2 | M | M | H | M | M |
| CO 3 | M | M | H | M | M |
| CO 4 | M | M | H | M | M |
| CO 5 | H | H | L | L | L |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAM405 | CORE XV: MATLAB | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- To familiarize the student in introducing and exploring MATLAB software
- To provide a foundation in use of this software for real time applications.

**Credits: 2** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introduction:**Basics of MATLAB: MATLAB Windows – Online help – Input-Output File Types – Platform Dependence – General Commands. **(Chapter - 1 Sections: 1.6.1 - 1.6.6)** | 08 | CO 1 |
| II | **Interactive Computation:** Matrices and Vectors – Matrix and Array Operations – Command-Line Functions – Using Built-in Functions and On-line Help – Saving and Loading Data – Plotting Simple Graphs. **(Chapter - 3 Sections: 3.1, 3.2, 3.5 – 3.8)** | 08 | CO 2 |
| III | **Programming in MATLAB (Scripts and Functions):**Script Files – Functions Files – Language- Specific Features – Advanced Data Objects. **(Chapter - 4 Sections: 4.1 – 4.4)** | 08 | CO 3 |
| IV | **Applications:**Linear Algebra: Solving a Linear System – Finding Eigen Values and Eigen Vectors – Matrix Factorizations. **(Chapter - 5 Sections: 5.1.1, 5.1.3, 5.1.4)** | 08 | CO 4 |
| V | **Applications:** Data Analysis and Statistics – Numerical Integration – Ordinary Differential Equations – Nonlinear Algebraic Equations. (**Chapter - 5 Sections: 5.3 – 5.6)** | 08 | CO 5 |

**Text Book**

| | |
|---|---|
| 1. | *RudraPratap*, 2010. **Getting Started with MATLAB,**Oxford University Press, New York. |

**Reference Books**

| | |
|---|---|
| 1. | *William John Palm*, [2005], **Introduction to Matlab 7 for Engineers,**Mcgraw-Hill Professional. |
| 2. | *Dolores M. Etter, David C. Kuncicky, and Holly Moore,* [2004], **Introduction to MATLAB 7,** Pearson India, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Gain knowledge on MATLAB |
| **CO 2** | Learn various types of functions in MATLAB |
| **CO 3** | Know the properties of script and function files |
| **CO 4** | Find solutions of the mathematical equations and Eigen values and Eigen vectors of given matrices. |
| **CO 5** | Solve ordinary differential equations and non-linear algebraic equations. |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | M | M | L | M |
| CO 2 | L | M | M | L | M |
| CO 3 | L | L | M | L | M |
| CO 4 | M | H | M | H | M |
| CO 5 | M | H | M | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAMP401 | CORE PRACTICAL II:MATLAB | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- Gain knowledge to solve the differential equations and solve the system of linear equations.
- Learning about to plot for a function.

**Credits: 2** **Total Hours: 21**

| PROGRAM | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **1** | Addition of two matrices, finding the determinant of a matrix and finding Eigen values and Eigen vectors of a matrix. | **03** | **CO 1** |
| **2** | Straight line fit and exponential curve fitting. | **03** | **CO 2** |
| **3** | Solving linear ODE using Euler and Runge-Kutta method. | **03** | **CO 2** |
| **4** | Solving non-linear ODE using Newton and RegulaFalsi method. | **03** | **CO 2** |
| | Solving integral equations using Trapezoidal and Simpson's rule. | **03** | **CO 2** |
| **5** | Solving system of equation using matrix method and Gauss Elimination method. | **03** | **CO 3** |
| **6** | Calculate mean, median, standard deviation, variance, maximum value, minimum value, range, skewness and kurtosis from the given data. | **03** | **CO 4** |
| **7** | Plotting a function (2D & 3D) | **03** | **CO 5** |

**Reference Book**


| | |
|---|---|
| **1.** | *RudraPratap*, 2010. **Getting Started with MATLAB,**Oxford University Press, New York. |


**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Find Eigen Value and Eigen Vector for a given matrix |
| **CO 2** | Gain knowledge on solving differential equations and integral equations |
| **CO 3** | Know about the concept of solving the system of equations |
| **CO 4** | Find the value of averages and standard deviation of the given data |
| **CO 5** | Plot a diagram for the given function |

## GUIDELINES

### 1. SUBMISSION OF RECORD NOTE BOOKS:

Candidates appearing for Practical Examinations shall submit Bonafide Record Note Books prescribed for Practical, otherwise the candidates will not be permitted to appear for the Practical Examinations.

1. **PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical)**

**(i) THEORY**

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Theory paper with a passing minimum of 38 marks in External out of 75.

***Internal Marks Distribution** [CA- Total Marks: 25]*

| | |
|---|---|
| Attendance | : 5 Marks |
| Assignment | : 5 Marks |
| Seminar | : 5 Marks |
| Internal Examinations | : 10 Marks |
| **Total** | **: 25 Marks** |

**(ii) PRACTICAL**

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

***Internal Marks Distribution** [CA- Total Marks: 40]*

| | |
|---|---|
| Experiment/ Documents | : 10 Marks (10-12 Experiments/Documents) |
| Attendance | : 5 Marks |
| Record | : 5 Marks |
| Internal Examinations | : 20 Marks |
| **Total** | **: 40 Marks** |

**CAREER COMPETENCY SKILLS**
**METHODOLOGY OF ASSESSMENT**

- **On Line Objective Examination (Multiple Choice questions) – Semester I**

  - 100 questions-100 minutes
  - Twenty questions from each UNIT.
  - On line examination will be conducted at the end of I Semester.

- **Viva Voce – Semester II**
  - The student has to come in proper dress code and he/she should bring 2 copies of resume for the Viva Voce
  - The student may be asked to
    - Give Self introduction
    - Submit the resume to the examiner(s) and answer the questions based on it.
    - Speak on any given topic for at least two minutes.
    - Give a presentation for 10 minutes on a topic of their choice.
    - Sit with other students in a group for a discussion.

**QUESTION PAPER PATTERN AND MARK DISTRIBUTION (*THEORY )***

***Question Paper Pattern and Mark Distribution*** **(For 75 marks)**

1. **PART – A (5 x 5 = 25 Marks)**
   Answer ALL questions
   One question from each UNIT with Internal Choice

2. **PART – B (5 x 10 = 50 Marks)**
   Answer ALL questions
   One question from each UNIT with Internal Choice

**INTER DISCIPLINARY COURSES OFFERED BY THE DEPARTMENT**

**(FOR STUDENTS ADMITTED FROM 2018-2019 ONWARDS)**

| **Second Semester** | | | |
|---|---|---|---|
| **S. No.** | **Subject Code** | **Subject** | **Offered for the students of** |
| 1 | 18PMACSI201 | Advanced Business Statistics | M.Com. (CA) |
| 2 | 18PMACSI201 | Discrete Mathematics | M.Sc. Computer Science |
| **Third Semester** | | | |
| 3 | 18PMACCI301/ 18PMACSI301 | Resource Management Techniques | M.Com. (CA)/ M.Sc. Computer Science |
| 4 | 18PMAENI301 | Aptitude and Reasoning | M.A. English |
| 5 | 18PMBM303/ 18PBCM303/ 18PBTM303 | Biostatistics and Research Methodology | M.Sc. Applied Microbiology M.Sc. Biochemistry/ M.Sc. Biotechnology |
| 6 | 18PMBMP301/ 18PBCMP301/ 18PBTMP301 | Practical: Statistical Software | M.Sc. Applied Microbiology M.Sc. Biochemistry/ M.Sc. Biotechnology |

| 18PMACCI201 | IDC I: ADVANCED BUSINESS STATISTICS | SEMESTER – II |
|---|---|---|

**Course Objective:**

The Course aims

- To create knowledge of analyzing the data based on sample information and making interpretation about the population.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Statistics:** Definition - Limitations and Uses –Collection of Data – Classification and Tabulation of Data - Diagrammatic and Graphical Presentation of Data - Measures of Central Value: Mean - Median and Mode. | 10 | CO 1 |
| II | **Correlation Analysis:** Types of Correlation - Methods of studying Correlation - Karl Pearson's Correlation Co-efficient- Rank Correlation Co-efficient. **Regression Analysis**:Regression Lines - Regression Equations. | 10 | CO 2 |
| III | **Test of Hypothesis:** Procedure of testing hypothesis – Standard error and sampling distribution – Test of Significance for attributes Large samples –Test of significance for small samples. | 10 | CO 3 |
| IV | Testing of Significance - Parametric Tests - Chi-Square Test - Uses of Chi-Square Test - F Test – ANOVA - One Way Classification - Two Way Classification. | 10 | CO 4 |
| V | Multivariate Analysis - Partial Correlation, Multiple Correlation and Multiple Regression - Discriminant Analysis - Introduction - Factor Analysis - Terminologies - Centroid Method, Cluster Analysis (Concept only). | 10 | CO 5 |

**Text Books**

| | |
|---|---|
| 1. | *Gupta, S.P.* **Statistical Methods.**Sultan Chand and Sons, New Delhi. |
| 2. | *Panneerselvam, R.* 2010,**Research Methodology.**PHILearning Private Limited, New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *Sancheti, D.C and Kapoor V.K. 2005.* **Statistics.***[Seventh Edition].* Sultan Chand and Sons, New Delhi. |
| 2. | *Kapoor, V.K and Gupta, S.C.* **Fundamentals of Mathematical Statistics.** [Eleventh Edition]. Sultan Chand and Sons, New Delhi. |
| 3. | *Kapoor, V.K and Gupta, S.P.* **Elements of Mathematical Statistics.**Sultan Chand and Sons, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics and understand the concepts of measures of central tendency |
| **CO 2** | Find the correlation between the set of values |
| **CO 3** | Know about the concepts of sampling theory |
| **CO 4** | Test the research statements through ANOVA. |
| **CO 5** | Gain knowledge on multivariate analysis |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | L | L |
| CO 2 | H | M | L | M | L |
| CO 3 | H | H | M | L | M |
| CO 4 | L | H | M | H | H |
| CO 5 | M | M | L | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMACSI201 | IDC I:DISCRETE MATHEMATICS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To introduce mathematical logics and theory of automata
- To introduce basic concepts of graph theory

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Logic – Introduction – TF-statements – Connectives – Atomic and Compound statements – Well formed formulae – Truth table of a formula – Tautology. **(Chapter – 9 Sections: 1 – 7)** | **10** | **CO 1** |
| **II** | Tautological implications and equivalence of formulae – Replacement process – Functionally complete sets of connectives and duality law – Normal forms – Principal normal forms. **(Chapter – 9 Sections: 8 - 12)** | **10** | **CO 2** |
| **III** | Theory of inference – Open statements – Quantifiers. **(Chapter – 9 Sections: 13 – 15)** | **10** | **CO 3** |
| **IV** | Boolean algebra – Boolean polynomials – Karnaugh map (K-map for 5 variables and 6 variables are not included) – Switching circuits (Simple circuits). **(Chapter: 10 Sections: 5 – 8)** | **10** | **CO 4** |
| **V** | Graph Theory – Basic concepts – Matrix representation of graphs – Trees – Spanning trees. **(Chapter: 11 Sections: 1 – 4)** | **10** | **CO 5** |

**Text Books**


| | |
|---|---|
| **1.** | *Venkataraman, M.K. Sridharan, N. and Chandrasekaran, N.,* 2000. **Discrete Mathematics.** The National Publish Company, New Delhi. |
| **2.** | *Mishra, K.L.P., and Chandrasekaran, N.,* 2001. **Theory of Computer Sciences.** [Second Edition]. Prentice Hall of India Private Limited, New Delhi. |


**Reference Book**


| | |
|---|---|
| **1.** | *Trembley, J.P. and Manohar, R.,* 1975. **Discrete Mathematical Structures with applications to computer Science.** International Edition, McGraw Hill Publication. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the concepts of logic |
| **CO 2** | Discuss various normal forms |
| **CO 3** | Understand the concepts of inference theory |
| **CO 4** | Construct Karnaugh map and switch circuits |
| **CO 5** | Know the concepts of graphs and trees |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | H | M | L |
| CO 2 | H | M | H | M | L |
| CO 3 | M | H | M | L | M |
| CO 4 | M | H | H | L | M |
| CO 5 | M | H | H | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMACSI301 | IDC II: RESOURCE MANAGEMENT TECHNIQUES | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To know the concepts of mathematical formulation and solving.
- To find solution of Transportation and Assignment models.
- To introduce inventory model, Replacement model.
- To learn the concepts in CPM and PERT.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Linear Programming Problem:** Introduction –Linear Programming Problem – Mathematical Formulation of the problem - Illustration on Mathematical Formulation of LPPs - Graphical Solution method – Some Exceptional cases – General Linear Programming Problem – Canonical and Standard forms of LPP - The Simplex method: The Simplex Algorithm and Problems – The Big-M method.<br>**(Chapter – 2)(Chapter 3 Sections: 3.2 – 3.5)**<br>**(Chapter – 4 Sections: 4.3 – 4.4)** | **10** | **CO 1** |
| II | **Transportation Model:** Introduction - Formulation of the Transportation Problem –Finding an initial basic feasible solution – Degeneracy in Transportation Problem - Transportation algorithm (MODI method) –Unbalanced Transportation Problems – Maximization case in Transportation problems.<br>**Assignment Problems:** Introduction – Mathematical formulation of the Problem - Assignment algorithm (Hungarian method) – Unbalanced Assignment Models – Maximization case in Assignment Problems.<br>**(Chapter – 10 Sections: 10.1, 10.2, 10.9, 10.12, 10.13, 10.15)**<br>**(Chapter – 11 Sections: 11.1 - 11.4)** | **10** | **CO 2** |
| III | **Replacement Problem and System Reliability:** Introduction – Replacement of Equipment that Deteriorates Gradually – Replacement of Equipment that fails suddenly –Reliability and system Failure Rates<br>**(Chapter – 18 Sections: 18.1 – 18.3,18.6)** | **10** | **CO 3** |
| IV | **Inventory Control -I**: Introduction – Types of Inventories – Reasons for Carrying Inventories –The Inventory Decisions – Costs Associated with Inventories–FactorsAffecting Inventory Control – The Concept of EOQ - Deterministic Inventory | **10** | **CO 4** |

| | | | |
|---|---|---|---|
| | Problems With No Shortages - Deterministic Inventory Problems With Shortages.<br>**(Chapter – 19 Sections: 19.1 – 19. 4, 19.6-19.7, 19.9-19.11)** | | |
| **V** | **Network Scheduling by PERT /CPM:** Introduction – Basic Components – Logical Sequencing - Rules of NetworkConstruction– Concurrent Activities – Critical Path Analysis –Probability Considerations in PERT – Distinction between PERT and CPM.<br>**(Chapter – 25 Sections: 25.1 – 25.8)** | **10** | **CO 5** |
| **Text Book** | | | |
| **1.** | *KantiSwarup, Gupta, P.K.and Man Mohan*. 2014. **Operations Research**. Sultan Chand & Sons, New Delhi. | | |
| **Reference Books** | | | |
| **1.** | *Sundaresan,V., Ganapathy Subramanian, K.S. and Ganesan, K.* 2014. **Resource Management Techniques**. [Eighth Edition]. AR Publication, Chennai. | | |
| **2.** | *Sharma, J.K*. 2007. **Introduction to Operations Research Theory and Applications.** [Third Edition]. MacMillan India Ltd., New Delhi. | | |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Formulate and solve real life problems through LPP |
| **CO 2** | Find the optimum transportation schedule and assignment model |
| **CO 3** | Know the concepts of replacement policies |
| **CO 4** | Gain knowledge of keeping optimum stockhold |
| **CO 5** | Use the techniques for planning and scheduling of projects |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | M | M | L |
| CO 2 | M | H | M | M | M |
| CO 3 | M | H | H | M | L |
| CO 4 | M | H | H | H | M |
| CO 5 | L | H | M | M | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMACCI301 | IDC II: RESOURCE MANAGEMENT TECHNIQUES | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To know the concepts of mathematical formulation and solving.
- To find solution of Transportation and Assignment models.
- To introduce inventory model, Replacement model.
- To learn the concepts in CPM and PERT.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Linear Programming Problem:** Introduction –Linear Programming Problem – Mathematical Formulation of the problem - Illustration on Mathematical Formulation of LPPs - Graphical Solution method – Some Exceptional cases – General Linear Programming Problem – Canonical and Standard forms of LPP - The Simplex method: The Simplex Algorithm and Problems – The Big-M method.<br>**(Chapter – 2)(Chapter 3 Sections: 3.2 – 3.5)**<br>**(Chapter – 4 Sections: 4.3 – 4.4)** | **10** | **CO 1** |
| II | **Transportation Model:** Introduction - Formulation of the Transportation Problem –Finding an initial basic feasible solution – Degeneracy in Transportation Problem - Transportation algorithm (MODI method) –Unbalanced Transportation Problems – Maximization case in Transportation problems.<br>**Assignment Problems:** Introduction – Mathematical formulation of the Problem - Assignment algorithm (Hungarian method) – Unbalanced Assignment Models – Maximization case in Assignment Problems.<br>**(Chapter – 10 Sections: 10.1, 10.2, 10.9, 10.12, 10.13, 10.15)**<br>**(Chapter – 11 Sections: 11.1 - 11.4)** | **10** | **CO 2** |
| III | **Replacement Problem and System Reliability:** Introduction – Replacement of Equipment that Deteriorates Gradually – Replacement of Equipment that fails suddenly – Reliability and system Failure Rates<br>**(Chapter – 18 Sections: 18.1 – 18.3,18.6)** | **10** | **CO 3** |
| IV | **Inventory Control -I**: Introduction – Types of Inventories – Reasons for Carrying Inventories –The Inventory Decisions – Costs Associated with Inventories–FactorsAffecting Inventory Control – The Concept of EOQ - Deterministic Inventory | **10** | **CO 4** |

| | | | |
|---|---|---|---|
| | Problems With No Shortages - Deterministic Inventory Problems With Shortages.<br>**(Chapter – 19 Sections: 19.1 – 19. 4, 19.6-19.7, 19.9-19.11)** | | |
| **V** | **Network Scheduling by PERT /CPM:** Introduction – Basic Components – Logical Sequencing - Rules of NetworkConstruction– Concurrent Activities – Critical Path Analysis –Probability Considerations in PERT – Distinction between PERT and CPM.<br>**(Chapter – 25 Sections: 25.1 – 25.8)** | **10** | **CO 5** |
| **Text Book** | | | |
| **1.** | *KantiSwarup, Gupta, P.K.and Man Mohan*. 2014. **Operations Research**. Sultan Chand & Sons, New Delhi. | | |
| **Reference Books** | | | |
| **1.** | *Sundaresan,V., Ganapathy Subramanian, K.S. and Ganesan, K.* 2014. **Resource Management Techniques**. [Eighth Edition]. AR Publication, Chennai. | | |
| **2.** | *Sharma, J.K*. 2007. **Introduction to Operations Research Theory and Applications.** [Third Edition]. MacMillan India Ltd., New Delhi. | | |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Formulate and solve real life problems through LPP |
| **CO 2** | Find the optimum transportation schedule and assignment model |
| **CO 3** | Know the concepts of replacement policies |
| **CO 4** | Gain knowledge of keeping optimum stockhold |
| **CO 5** | Use the techniques for planning and scheduling of projects |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | L | L |
| CO 2 | H | M | L | M | L |
| CO 3 | H | H | M | L | M |
| CO 4 | L | H | M | H | H |
| CO 5 | M | M | L | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18PMAENI301 | IDC I:APTITUDE AND REASONING | SEMESTER – III |
|---|---|---|

**Course Objective:**

The Course aims

- To equip the students for writing competitive examinations

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | Series completion – Coding-Decoding – Blood relations. **(Chapter 1, Chapter 4 and Chapter 5)** | 08 | CO 1 |
| II | Puzzle Test – Direction sense test – Logical Venn Diagram. **(Chapter 6, Chapter 8 and Chapter 9)** | 08 | CO 2 |
| III | Number Ranking and Time Sequence Test – Mathematical operation. **(Chapter 12 and Chapter 13)** | 08 | CO 3 |
| IV | Logical sequence of words – Arithmetical Reasoning – Inserting the missing character **(Chapter 14, Chapter 15 and Chapter 16)** | 08 | CO 4 |
| V | Data Sufficiency – Situation Reaction Test. **(Chapter 17 and Chapter 20)** | 08 | CO 5 |

**Reference Book**

**1.** *Agarwal, R.S., 2011*. **A Modern Approach to Verbal and Non-Verbal Reasoning,** S.Chand& Company Ltd., New Delhi.

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Gain knowledge on coding and decoding |
| **CO 2** | Perform mathematical operations and finding solutions to puzzles |
| **CO 3** | Find the pattern of given numerical series |
| **CO 4** | Predict the logical sequence of given words and missing characters |
| **CO 5** | Answer with his presence of mind. |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | L | L | L | L |
| CO 2 | H | H | H | H | H |
| CO 3 | H | H | H | H | H |
| CO 4 | M | M | M | M | M |
| CO 5 | M | M | L | M | L |
| H-High; M-Medium; L-Low | | | | | |

| 18PMBM302 | CORE: BIOSTATISTICS AND RESEARCH METHODOLOGY | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Statistics:** Introduction – Definition of Statistics – Functions of Statistics – Applications and Limitations of Statistics.<br>**Collection of data**: Primary and Secondary Data – Methods of Collecting Primary Data – Sources of Secondary Data.<br>**Classification and Tabulation of data**: Types of Classification – Tabulation of Data – Parts of a Table - Types of Tables.<br>**Diagrammatic and Graphical Representation:** Types of Diagrams – Graphs – Graphs of Frequency Distributions.<br>**Measures of Central Tendency:** Arithmetic Mean (except weighted mean and corrected values) – Median – Mode – Merits and demerits.<br>**(Volume 1: Chapters 1, 3, 5, 6 and 7)** | **10** | **CO 1** |
| II | **Measures of Dispersion:** Mean Deviation – Standard Deviation – Coefficient of Variation.<br><br>**Correlation Analysis:** Types of Correlation – Methods of Correlation - Karl Pearson's Coefficient – Rank Correlation Coefficient.<br><br>**Regression Analysis:** Regression Lines – Regression Equations.<br>**(Volume 1: Chapters 8, 10 and 11)** | **10** | **CO 2** |
| III | **Test of Hypothesis:** Population – Sample – Procedure of Testing Hypothesis – Types of errors – Standard Error - t test – F test - Chi-square Test of Independence of Attributes.<br>**Analysis of Variance:** One way Classification – Two way Classification.<br>**(Volume 2: Chapter 3, 4 and 5)** | **10** | **CO 3** |
| IV | **Research–** Planning and Classification, Components of research report, Essential steps in research. Problem Identification& Formulation, Research Question, **Hypothesis**- Qualities of a good Hypothesis, Null Hypothesis& Alternative Hypothesis. Experimental design. Literature collection – and its importance. | **10** | **CO 4** |

| | | | |
|---|---|---|---|
| **V** | Preparing proposal for a research project. Scientific Research report writing– writing Introduction, Review of literature, Materials and methods, Results, Table, Figures, Discussion, Citing and listing references. Format of a Thesis. Preparation of manuscript for publication. Scientific information-Introduction, Writing proposals, scientific papers and figures. Plagiarism. | **10** | **CO 5** |

**Text Books**

| | |
|---|---|
| **1.** | *Gupta, S.P.* 2008. **Statistical Methods.** Sultan Chand and Sons Publishers, New Delhi. **(UNITS I – III)** |
| **2.** | *Gurumani, N.*2006. **ResearchMethodology**.MJPPublishers. (**UNIT IV**). |
| **3.** | *Gurumani*, N. 2016. Scientific thesis writing and paper presentation. MJP Publishers. (**UNIT V**) |

**Reference Books**

| | |
|---|---|
| **1.** | *Gurumani, N.* 2008. **An Introduction to Biostatistics.** [Second edition], MJP Publishers, Chennai. |
| **2.** | *Antonisamy, B., SolomonChristopher andPrasannaSamuel.* 2010. **Biostatistics: Principles andPractice**.Tata McGrawHill EducationPrivateLtd, New Delhi. |
| **3.** | *Padmini E.*2007.**Biochemical Calculations&Biostatistics**. [FirstEdition]. Books andAllied (P)Ltd., Kolkata. |
| **4.** | *Kothari,C.R.*1990.**ResearchMethodology–MethodsandTechniques**.NewAge Publications. New Delhi |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics and Understand the concepts of measures of central tendency and measures of dispersion |
| **CO 2** | Gain knowledge on correlation and regression analyses |
| **CO 3** | Test the research statements through ANOVA. |
| **CO 4** | Select the appropriate procedure for carrying out their research work |
| **CO 5** | Understand the concepts in writing thesis, proposal and result interpretation |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | H | M | M |
| CO 2 | H | M | H | M | M |
| CO 3 | M | H | H | M | M |
| CO 4 | H | H | H | H | H |
| CO 5 | M | M | H | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PBCM302 | CORE: BIOSTATISTICS AND RESEARCH METHODOLOGY | SEMESTER – III |
|---|---|---|

**Course Objective:**

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

**Credits: 4Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Statistics:** Introduction – Definition of Statistics – Functions of Statistics – Applications and Limitations of Statistics.<br>**Collection of data**: Primary and Secondary Data – Methods of Collecting Primary Data – Sources of Secondary Data.<br>**Classification and Tabulation of data**: Types of Classification – Tabulation of Data – Parts of a Table - Types of Tables.<br>**Diagrammatic and Graphical Representation:** Types of Diagrams – Graphs – Graphs of Frequency Distributions.<br>**Measures of Central Tendency:** Arithmetic Mean (except weighted mean and corrected values) – Median – Mode – Merits and demerits.<br>**(Volume 1: Chapters 1, 3, 5, 6 and 7)** | **10** | **CO 1** |
| II | **Measures of Dispersion:** Mean Deviation – Standard Deviation – Coefficient of Variation.<br><br>**Correlation Analysis:** Types of Correlation – Methods of Correlation - Karl Pearson's Coefficient – Rank Correlation Coefficient.<br><br>**Regression Analysis:** Regression Lines – Regression Equations.<br>**(Volume 1: Chapters 8, 10 and 11)** | **10** | **CO 2** |
| III | **Test of Hypothesis:** Population – Sample – Procedure of Testing Hypothesis – Types of errors – Standard Error - t test – F test - Chi-square Test of Independence of Attributes.<br>**Analysis of Variance:** One way Classification – Two way Classification.<br>**(Volume 2: Chapter 3, 4 and 5)** | **10** | **CO 3** |
| IV | **Research–** Planning and Classification, Components of research report, Essential steps in research. Problem Identification& Formulation, Research Question, **Hypothesis**- Qualities of a good Hypothesis, Null Hypothesis& Alternative Hypothesis. Experimental design. Literature collection – and its importance. | **10** | **CO 4** |

| | | | |
|---|---|---|---|
| **V** | Preparing proposal for a research project. Scientific Research report writing– writing Introduction, Review of literature, Materials and methods, Results, Table, Figures, Discussion, Citing and listing references. Format of a Thesis. Preparation of manuscript for publication. Scientific information-Introduction, Writing proposals, scientific papers and figures. Plagiarism. | **10** | **CO 5** |

**Text Books**

| | |
|---|---|
| **1.** | *Gupta, S.P.* 2008. **Statistical Methods.** Sultan Chand and Sons Publishers, New Delhi. **(UNITS I – III)** |
| **2.** | *Gurumani, N.*2006. **ResearchMethodology**.MJPPublishers. (**UNIT IV**). |
| **3.** | *Gurumani*, N. 2016. Scientific thesis writing and paper presentation. MJP Publishers. (**UNIT V**) |

**Reference Books**

| | |
|---|---|
| **1.** | *Gurumani, N.* 2008. **An introduction to Biostatistics.** [Second edition], MJP Publishers, Chennai. |
| **2.** | *Antonisamy, B., SolomonChristopher andPrasannaSamuel.* 2010. **Biostatistics: Principles andPractice**.Tata McGrawHill EducationPrivateLimited, New Delhi. |
| **3.** | *Padmini E.*2007.**Biochemical Calculations&Biostatistics**. [FirstEdition]. Books andAllied (P)Ltd., Kolkata. |
| **4.** | *Kothari,C.R.*1990.**ResearchMethodology–MethodsandTechniques**.NewAge Publications. New Delhi |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics and Understand the concepts of measures of central tendency and measures of dispersion |
| **CO 2** | Gain knowledge on correlation and regression analyses |
| **CO 3** | Test the research statements through ANOVA. |
| **CO 4** | Select the appropriate procedure for carrying out their research work |
| **CO 5** | Understand the concepts in writing thesis, proposal and result interpretation |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | M | M | H | H |
| CO 2 | L | M | M | H | H |
| CO 3 | L | M | H | H | H |
| CO 4 | L | H | H | H | H |
| CO 5 | L | H | H | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PBTM303 | CORE: BIOSTATISTICS AND RESEARCH METHODOLOGY | SEMESTER – III |
|---|---|---|

**COURSE OBJECTIVES:**

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Statistics:** Introduction – Definition of Statistics – Functions of Statistics – Applications and Limitations of Statistics.<br>**Collection of data**: Primary and Secondary Data – Methods of Collecting Primary Data – Sources of Secondary Data.<br>**Classification and Tabulation of data**: Types of Classification – Tabulation of Data – Parts of a Table - Types of Tables.<br>**Diagrammatic and Graphical Representation:** Types of Diagrams – Graphs – Graphs of Frequency Distributions.<br>**Measures of Central Tendency:** Arithmetic Mean (except weighted mean and corrected values) – Median – Mode – Merits and demerits.<br>**(Volume 1: Chapters 1, 3, 5, 6 and 7)** | **10** | **CO 1** |
| II | **Measures of Dispersion:** Mean Deviation – Standard Deviation – Coefficient of Variation.<br><br>**Correlation Analysis:** Types of Correlation – Methods of Correlation - Karl Pearson's Coefficient – Rank Correlation Coefficient.<br>**Regression Analysis:** Regression Lines – Regression Equations.<br>**(Volume 1: Chapters 8, 10 and 11)** | **10** | **CO 2** |
| III | **Test of Hypothesis:** Population – Sample – Procedure of Testing Hypothesis – Types of errors – Standard Error - t test – F test - Chi-square Test of Independence of Attributes.<br>**Analysis of Variance:** One way Classification – Two way Classification.<br>**(Volume 2: Chapter 3, 4 and 5)** | **10** | **CO 3** |
| IV | **Research**– Planning and Classification, Components of research report, Essential steps in research. Problem Identification& Formulation, Research Question, **Hypothesis**- Qualities of a good Hypothesis, Null Hypothesis& Alternative Hypothesis. Experimental design. Literature collection – and its importance. | **10** | **CO 4** |
| V | Preparing proposal for a research project. Scientific Research | **10** | **CO 5** |

| | | | |
|---|---|---|---|
| | report writing– writing Introduction, Review of literature, Materials and methods, Results, Table, Figures, Discussion, Citing and listing references. Format of a Thesis. Preparation of manuscript for publication. Scientific information-Introduction, Writing proposals, scientific papers and figures. Plagiarism. | | |

| | |
|---|---|
| **Text Books** | |
| **1.** | *Gupta, S.P.* 2008. **Statistical Methods.** Sultan Chand and Sons Publishers, New Delhi. **(UNITS I – III)** |
| **2.** | *Gurumani, N.*2006. **ResearchMethodology**.MJPPublishers. (**UNIT IV**). |
| **3.** | *Gurumani*, N. 2016. Scientific thesis writing and paper presentation. MJP Publishers. (**UNIT V**) |
| **Reference Books** | |
| **1.** | *Gurumani, N.* 2008. **An introduction to Biostatistics.** [Second edition], MJP Publishers, Chennai. |
| **2.** | *Antonisamy, B., SolomonChristopher andPrasannaSamuel.* 2010. **Biostatistics: Principles andPractice**.Tata McGrawHill EducationPrivateLtd, New Delhi. |
| **3.** | *Padmini E.*2007.**Biochemical Calculations&Biostatistics**. [FirstEdition]. Books andAllied (P)Ltd., Kolkata. |
| **4.** | *Kothari,C.R.*1990.**ResearchMethodology–MethodsandTechniques**.NewAge Publications. New Delhi |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics and Understand the concepts of measures of central tendency and measures of dispersion |
| **CO 2** | Gain knowledge on correlation and regression analyses |
| **CO 3** | Test the research statements through ANOVA. |
| **CO 4** | Select the appropriate procedure for carrying out their research work |
| **CO 5** | Understand the concepts in writing thesis, proposal and result interpretation |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | H | M | H | H |
| CO 2 | L | M | L | H | H |
| CO 3 | L | H | M | H | H |
| CO 4 | H | M | H | H | H |
| CO 5 | H | M | M | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18PMBMP302/ 18PBCMP302/ 18PBTMP302 | CORE PRACTICAL IV: STATISTICAL SOFTWARE | SEMESTER – III |
|---|---|---|

**Course Objective:**

The Course aims

- To give a good grip on concepts in analyzing the data using statistical software

**Credit: 2Total Hours: 24**

| PROGRAM | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **1** | Diagrams and graphs | **03** | **CO 1** |
| **2** | Measures of Central Tendency | **03** | **CO 2** |
| **3** | Measures of Dispersion | **03** | **CO 2** |
| **4** | Correlation Coefficient (Karl Pearson and Spearman Rank Method) | **03** | **CO 3** |
| **5** | Regression lines | **03** | **CO 3** |
| **6** | Small Sample Test (t and F) | **03** | **CO 4** |
| **7** | Chi-square Test for Independence of Attributes. | **03** | **CO 4** |
| **8** | ANOVA (one way and two way classification) | **03** | **CO 4** |

**Reference Books**


| | |
|---|---|
| **1.** | *Shentan J. Coakes, Lyndall Steed and PetaDzidic.***SPSS 13.0 version for Windows analysis without Anguish.** John Wiley & Sons, Australia. |
| **2.** | *Andy Field.* 2006. **Discovering Statistics using SPSS.** [Second Edition]. SAGE Publications. |


**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Demonstrate the data in diagrammatic and graphical representation |
| **CO 2** | Find the averages and measures dispersion |
| **CO 3** | Calculate correlation and regression for huge amount data |
| **CO 4** | Gain knowledge about test of significance |

## ALLIED COURSES OFFERED BY THE DEPARTMENT
## (FOR STUDENTS ADMITTED FROM 2018-2019 ONWARDS)

| **First Semester** | | | |
|---|---|---|---|
| **S. No.** | **Subject Code** | **Subject** | **Offered for the students of** |
| 1 | 18UMACSA101/ 18UMAECA101 | Algebra and Calculus | B.Sc. Computer Science & B.Sc. Electronics and Communications |
| 2 | 18UMACAA101 | Mathematics for Computer Applications | BCA |
| 3 | 18UMAPHA101/ 18UMACHA101 | Algebra and Differential Calculus | B.Sc. Physics<br>B.Sc. Chemistry |
| 4 | 18UMABAA101 | Business Mathematics and Statistics | BBA |
| **Second Semester** | | | |
| **S. No.** | **Subject Code** | **Subject** | **Offered for the students of** |
| 5 | 18UMACSA201/ 18UMAECA201 | Numerical Methods | B.Sc. Computer Science & B.Sc. Electronics and Communications |
| 6 | 18UMACAA201 | Scientific Computing Methods | BCA |
| 7 | 18UMAPHA201/ 18UMACHA201 | Integral Calculus and Vector Calculus | B.Sc. Physics<br>B.Sc. Chemistry |
| **Third Semester** | | | |
| 8 | 18UMACS301 | Statistical Methods | B.Sc. Computer Science |
| 9 | 18UMABAA301 | Operations Research | BBA |
| 10 | 18UMACOA301/ 18UMACCA301 | Business Mathematics and Operations Research | B.Com & B.Com CA |
| 11 | 18UMANM301 | NMEC: Quantitative Aptitude | All UG Courses |
| **Fourth Semester** | | | |
| 12 | 18UMACSA301 | Operations Research | B.Sc. Computer Science |
| 13 | 18UMACOA401/ 18UMACCA401 | Business Statistics | B.Com. & B.Com CA |
| 14 | 18UMAMBA401/ 18UMABCA401/ 18UMABTA401 | Biostatistics | B.Sc. Microbiology<br>B.Sc. Biochemistry<br>B.Sc. Biotechnology |
| 15 | 18UMAMBAP401/ 18UMABCAP401/ 18UMABTAP401 | Practical: Statistical Software (Using MS-Excel) | B.Sc. Microbiology<br>B.Sc. Biochemistry<br>B.Sc. Biotechnology |
| 16 | 18UMANM401 | NMEC: Basic Statistics | All UG Courses |

| 18UMACSA101 | ALLIED I: ALGEBRA AND CALCULUS | SEMESTER – I |
|---|---|---|

Note: Proof of the theorem and proof of examples are excluded.

**Course Objectives:**

The Course aims

- To get knowledge about matrices and various method of solving algebraic equations
- To learn basic concepts of differentiation and integration.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Matrices:** Matrix operations – Characteristics equation of a matrix – Eigen values and Eigen vectors – Cayley-Hamilton Theorem (Statement only) and its problems – Rank of a matrix – Problems. | 10 | CO 1 |
| II | **Theory of Equation:** Relation between roots and coefficients (Problems based on A.P., G.P. and H.P.) – Imaginary and Irrational roots. | 10 | CO 2 |
| III | **Differentiation:** Differential coefficient of a sum or difference – Product rule – Quotient rule – Function of function rule. **Successive Differentiation:** The nth derivative - Leibnitz formula for nth derivative – problems. | 10 | CO 3 |
| IV | **Partial differentiation:** Partial derivative - Partial derivatives of higher orders – Homogeneous functions (Euler theorem on homogeneous functions) – Problems. | 10 | CO 4 |
| V | **Methods of integration:** Integral of functions involving $\sqrt{a^2+x^2}$ - Integration by parts – Bernoulli's formula. | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Vittal, P.R.* 2002. **Allied Mathematics.** [Third Edition].Margham Publications, Chennai. |

**Reference Books**

| | |
|---|---|
| 1. | *ManicavachagamPillay, T.K. and Narayanan, S.* 2004. **Algebra – vol II.** Vijay Nicole Imprints Private Limited, Chennai. |
| 2. | *Singaravelu. A.*2002. **Allied Mathematics.** Meenakshi Publishers, Chennai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Calculate Eigen values and Rank of a matrix |
| **CO 2** | Solve algebraic equations |
| **CO 3** | Understand the variations in variables. |
| **CO 4** | Understand the difference between partial and total differentiation |
| **CO 5** | Evaluate simple integrations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | M | M |
| CO 2 | M | M | H | M | M |
| CO 3 | M | M | H | M | M |
| CO 4 | M | M | H | M | M |
| CO 5 | M | M | H | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMAECA101 | ALLIED I: ALGEBRA AND CALCULUS | SEMESTER – I |
|---|---|---|

Note: Proof of the theorem and proof of examples are excluded.

**Course Objectives:**

The Course aims

- To get knowledge about matrices and various method of solving algebraic equations
- To learn basic concepts of differentiation and integration.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Matrices:** Matrix operations – Characteristics equation of a matrix – Eigen values and Eigen vectors – Cayley-Hamilton Theorem (Statement only) and its problems – Rank of a matrix – Problems. | 10 | CO 1 |
| II | **Theory of Equation:** Relation between roots and coefficients (Problems based on A.P., G.P. and H.P.) – Imaginary and Irrational roots. | 10 | CO 2 |
| III | **Differentiation:** Differential coefficient of a sum or difference – Product rule – Quotient rule – Function of function rule. **Successive Differentiation:** The nth derivative - Leibnitz formula for nth derivative – problems. | 10 | CO 3 |
| IV | **Partial differentiation:** Partial derivative - Partial derivatives of higher orders – Homogeneous functions (Euler theorem on homogeneous functions) – Problems. | 10 | CO 4 |
| V | **Methods of integration:** Integral of functions involving $\sqrt{a^2+x^2}$ - Integration by parts – Bernoulli's formula. | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Vittal, P.R.* 2002. **Allied Mathematics.** [Third Edition].Margham Publications, Chennai. |

**Reference Books**

| | |
|---|---|
| 1. | *ManicavachagamPillay, T.K. and Narayanan, S.* 2004. **Algebra – vol II.** Vijay Nicole Imprints Private Limited, Chennai. |
| 2. | *Singaravelu. A.*2002. **Allied Mathematics.** Meenakshi Publishers, Chennai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Calculate Eigen values and Rank of a matrix |
| **CO 2** | Solve algebraic equations |
| **CO 3** | Understand the variations in variables. |
| **CO 4** | Understand the difference between partial and total differentiation |
| **CO 5** | Evaluate simple integrations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | L | L | L | L |
| CO 2 | H | M | L | L | L |
| CO 3 | H | M | M | L | M |
| CO 4 | H | H | L | M | M |
| CO 5 | H | H | M | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACAA101 | ALLIED I: MATHEMATICS FOR COMPUTER APPLICATIONS | SEMESTER – I |
|---|---|---|

Note: Proof of the theorem and proof of examples are excluded.

**Course Objectives:**

The Course aims

- To get knowledge about matrices and various method of solving algebraic equations
- To learn basic concepts of logic and Probability.

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Matrices:**Definition of a matrix – Importance – Notation – Order of a matrix – Types of matrices – Matrix operations-I – A System of Linear Equations - Determinants –Cramer's Rule. **(Part I: Chapter 4 Sections: 1-8)** | 08 | CO 1 |
| II | **Set Theory:**Definition – Notations – Methods of description of sets – Types of sets – Venn diagram – Set operations – Laws and Properties of sets – Number of elements – Cartesian product. **(Part I: Chapter 3 Sections: 1-9)** | 08 | CO 2 |
| III | **Logic:** Logic – Normal forms – Logical inferences – Predicate logic – Rules of Inferences. **(Chapter 1 Sections: 1.6 – 1.10)** | 08 | CO 3 |
| IV | **Combinatorics and Recurrence relations:** Permutations – Combinations – Partitions – Binomial Coefficients – Recurrence relations. **(Chapter 3 Sections: 3.2 – 3.5, 3.7)** | 08 | CO 4 |
| V | **Probability:**Mathematical probability – Relative frequency approach – Axiomatic approach – Addition theorem (Method II) – Multiplication theorem (Method III) – Both addition and multiplication theorem (Method IV) – Baye's theorem (Method VI). | 08 | CO 5 |

**Text Books**


| | |
|---|---|
| 1. | *Navnitham, P.A.* 2011. **Business Mathematics and Statistics.** Jai Publishers, Trichy. (for Units I, II and V) |
| 2. | *Somasundaram, R.M.* 2009. **Discrete Mathematical Structures.** [Sixth Edition]. PHI Learning Private Limited, New Delhi. (for Units III and IV) |


**Reference Books**


| | |
|---|---|
| 1. | *Singaravelu. A.*2002. **Allied Mathematics.** Meenakshi Publishers, Chennai. |
| 2. | *Venkataraman, M.K. Sridharan, N. and Chandrasekaran, N.,* 2000. **Discrete Mathematics,** The National Publish Company, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Calculate determinants and Inverse of a matrix |
| **CO 2** | Gain Knowledge on Sets and operations on sets |
| **CO 3** | Learn the concepts of logic and normal forms |
| **CO 4** | Understand the concept of Combinatorics |
| **CO 5** | Gain Knowledge on Probability theory |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | L | M | M |
| CO 2 | L | M | H | M | M |
| CO 3 | M | H | M | M | M |
| CO 4 | H | H | M | M | M |
| CO 5 | H | H | L | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMAPHA101 | ALLIED I: ALGEBRA AND DIFFERENTIAL CALCULUS | SEMESTER – I |
|---|---|---|

Note: Proof of the theorem and proof of examples are excluded.

**Course Objectives:**

The Course aims

- To get knowledge about matrices and various method of solving algebraic equations
- To learn basic concepts of differentiation which is instrumental in constructing many of mathematical concepts and also applied in all sciences and social sciences.

**Credits: 4Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Characteristics equation of a matrix – Eigen values and Eigen vectors – Cayley-Hamilton Theorem (Statement only) and its problems – Rank of a matrix – Problems. | **10** | **CO 1** |
| **II** | Polynomial Equations - Imaginary and Irrational roots - Relation between roots and coefficients – Transformation of equations – Descarte's rule of signs – Problems. | **10** | **CO 2** |
| **III** | Successive Differentiation – nth derivative – Leibnitz formula for nth derivative – problems. | **10** | **CO 3** |
| **IV** | Partial differentiation – Partial derivatives of higher orders – Homogeneous functions – Problems. | **10** | **CO 4** |
| **V** | Radius of Curvature in Cartesian and polar coordinates – Pedal equation of a curve – Radius of curvature in p-r coordinates. | **10** | **CO 5** |

**Text Book**

| | |
|---|---|
| **1.** | *Vittal, P.R.* 2002. **Allied Mathematics.** [Third Edition]. Margham Publications, Chennai. |

**Reference Books**

| | |
|---|---|
| **1.** | *ManicavachagamPillay, T.K. and Narayanan, S.* 2004. **Algebra – vol II.** Vijay Nicole Imprints Private Limited, Chennai. |
| **2.** | *Singaravelu. A.*2002. **Allied Mathematics.** Meenakshi Publishers, Chennai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Calculate Eigen values and Rank of a matrix |
| **CO 2** | Solve algebraic equations |
| **CO 3** | Understand the variations in variables. |
| **CO 4** | Understand the difference between partial and total differentiation |
| **CO 5** | Find the curvature and radius of curvature of a curve |

**MAPPING**

| CO \ PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | H | M | H |
| CO 2 | H | H | M | M | L |
| CO 3 | L | L | H | H | M |
| CO 4 | H | H | M | L | H |
| CO 5 | H | M | H | M | L |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACHA101 | ALLIED I: ALGEBRA AND DIFFERENTIAL CALCULUS | SEMESTER – I |
|---|---|---|

Note: Proof of the theorem and proof of examples are excluded.

**Course Objectives:**

The Course aims

- To get knowledge about matrices and various method of solving algebraic equations
- To learn basic concepts of differentiation which is instrumental in constructing many of mathematical concepts and also applied in all sciences and social sciences.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Characteristics equation of a matrix – Eigen values and Eigen vectors – Cayley-Hamilton Theorem (Statement only) and its problems – Rank of a matrix – Problems. | **10** | **CO 1** |
| **II** | Polynomial Equations - Imaginary and Irrational roots - Relation between roots and coefficients – Transformation of equations – Descarte's rule of signs – Problems. | **10** | **CO 2** |
| **III** | Successive Differentiation – nth derivative – Leibnitz formula for nth derivative – problems. | **10** | **CO 3** |
| **IV** | Partial differentiation – Partial derivatives of higher orders – Homogeneous functions – Problems. | **10** | **CO 4** |
| **V** | Radius of Curvature in Cartesian and polar coordinates – Pedal equation of a curve – Radius of curvature in p-r coordinates. | **10** | **CO 5** |

**Text Book**

| | |
|---|---|
| **1.** | *Vittal, P.R.* 2002. **Allied Mathematics.** [Third Edition]. Margham Publications, Chennai. |

**Reference Books**

| | |
|---|---|
| **1.** | *ManicavachagamPillay, T.K. and Narayanan, S.* 2004. **Algebra – vol II.** Vijay Nicole Imprints Private Limited, Chennai. |
| **2.** | *Singaravelu. A.*2002. **Allied Mathematics.** Meenakshi Publishers, Chennai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Calculate Eigen values and Rank of a matrix |
| **CO 2** | Solve algebraic equations |
| **CO 3** | Understand the variations in variables. |
| **CO 4** | Understand the difference between partial and total differentiation |
| **CO 5** | Find the curvature and radius of curvature of a curve |

**MAPPING**

| CO \ PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | H | L | M | M |
| CO 2 | H | M | H | L | H |
| CO 3 | L | H | M | L | M |
| CO 4 | M | H | L | M | M |
| CO 5 | M | L | M | H | L |
| H-High; M-Medium; L-Low | | | | | |

| 18UMABAA101 | ALLIED I: BUSINESS MATHEMATICS AND STATISTICS | SEMESTER – I |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn the basic concepts of mathematics and statistics which are instrumental in constructing mathematical models in Business
- To know the concepts of measures of central tendency and dispersions.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Set Theory:** Definition – Notations – Methods of description of sets – Kind or Types of sets – Venn diagram – Set operations – Laws and properties of sets – Number of elements. **(Part – I Chapter 3 Sections: 1 – 8)** | 10 | CO 1 |
| II | **Matrices and Determinants:** Definition of a matrix – Importance – Notation – Order of a matrix – Types of matrices – Matrix operations – I – A system of linear equations – Determinants – Matrix operations – II. **(Part – I Chapter 4 Sections: 1 – 9)** | 10 | CO 2 |
| III | **Measure of Central Tendency:** Arithmetic mean – Weighted arithmetic mean – Median – Mode – Geometric mean – Harmonic mean. **(Part – II Chapter 7)** | 10 | CO 3 |
| IV | **Measures of Dispersion:** Range – Quartile deviation – Standard deviation – Coefficient of variation. **(Part – II Chapter 8)** | 10 | CO 4 |
| V | **Simple Linear Correlation:** Karl Pearson's coefficient of correlation – Spearman's rank correlation coefficient. **Simple Linear Regression:** Methods of forming the regression equations – Properties of regression lines and coefficients. **(Part – II Chapter 12,13)** | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Navnitham, P.A.* 2011. **Business Mathematics and Statistics.** Jai Publishers, Trichy. |

**Reference Books**

| | |
|---|---|
| 1. | *Gupta, S.P.* 2011. **Statistical Methods.** [Thirty Seventh Edition]. Sultan Chand and Sons, New Delhi. |
| 2. | Pillai, R.*S.N and Bagavathi, V.* 2012. **Statistics.** [Seventh Edition]. S.Chand and Company Ltd., New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the concepts of sets and set operations |
| **CO 2** | Gain knowledge on matrices and their operations |
| **CO 3** | Find averages and positional averages |
| **CO 4** | Compare the consistency of the group of data |
| **CO 5** | Measure the degree of relationship between variables |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | H | L | H | H |
| CO 2 | H | H | L | H | H |
| CO 3 | H | H | H | L | H |
| CO 4 | H | H | H | H | L |
| CO 5 | H | H | H | H | L |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACSA201 | ALLIED II: NUMERICAL METHODS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide a basic knowledge in Numerical Solution for Algebraic and Transcendental Equations.
- Introducing the methods for Interpolation.
- To solve integration using Numerical methods.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **The solution of Numerical Algebraic and Transcendental Equations**: Bisection Method –Iteration Method – Regula-Falsi Method – Newton-Raphson Method. **(Chapter – 3 Sections: 3.1 – 3.4)** | 10 | CO 1 |
| II | **Solution of Simultaneous Linear Algebraic Equations**: Introduction - Gauss Elimination Methods - Gauss Jordan method – Inversion of a matrix using Gauss Elimination method – Iterative method – Gauss-Jacobi - Gauss Seidal method of iteration. **(Chapter – 4 Sections: 4.1 – 4.3, 4.7 - 4.9)** | 10 | CO 2 |
| III | **Finite Differences**: Forward Difference – Backward Diffference. **Interpolation (for Equal Intervals):** Newton forward interpolation formula and backward interpolation. **(Chapter – 5 Sections: 5.1 – 5.2) (Chapter – 6 Sections: 6.1 – 6.6)** | 10 | CO 3 |
| IV | **Central Difference Interpolation Formulae (for Equal Intervals):** Central Differences and Central Differences Table – Central Difference Interpolation formula – Gauss forward interpolation formula – Gauss backward interpolation formula – Stirling's formula. **(Chapter – 7 Sections: 7.1 – 7.5)** | 10 | CO 4 |
| V | **Numerical Integration:** Trapezoidal rule – Simpson's one-third rule – Simpson's three-eighth rule. **Numerical Solution of Ordinary Differential Equations:** Euler's method – Improved Euler Method – Modified Euler method – Runge-Kutta method - Second order Runge-Kutta method (for first order ODE). **(Chapter – 9 Sections: 9.9, 9.13, 9.14, Chapter – 11 Sections: 11.9 – 11.13)** | 10 | CO 5 |

| **Text Book** | |
|---|---|
| **1.** | *Kandasamy, P., Thilagavathy, K., Gunavathi, K.* 2008. **Numerical Methods.** [First Edition]. S. Chand & Company Ltd, New Delhi. |
| **Reference Books** | |
| **1.** | *Dr. M.K. Venkataraman,* 2007. **Numerical Methods in Science and Engineering** [Fifth Edition]. The National Publishing Company, Chennai. |
| **2.** | *Dr. V.N. Vedamurthy, D.N. Ch. and S.N. Iyengar,* 2011. **Numerical Methods.** Vikas Publishing House Private Limited, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Find solution of algebraic and transcendental equations |
| **CO 2** | Solve system of linear equations |
| **CO 3** | Interpolate unknown values from known values |
| **CO 4** | Know numerical methods of solving differential equations |
| **CO 5** | Find the solution of the integral equations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | M | M |
| CO 2 | M | M | H | M | M |
| CO 3 | M | M | H | M | M |
| CO 4 | M | M | H | M | M |
| CO 5 | M | M | H | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMAECA201 | ALLIED II: NUMERICAL METHODS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide a basic knowledge in Numerical Solution for Algebraic and Transcendental Equations.
- To introduce the methods for Interpolation.
- To solve integration using Numerical methods.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **The solution of Numerical Algebraic and Transcendental Equations**: Bisection Method –Iteration Method – Regula-Falsi Method – Newton-Raphson Method. **(Chapter – 3 Sections: 3.1 – 3.4)** | **10** | **CO 1** |
| II | **Solution of Simultaneous Linear Algebraic Equations**: Introduction - Gauss Elimination Methods - Gauss Jordan method – Inversion of a matrix using Gauss Elimination method – Iterative method – Gauss-Jacobi - Gauss Seidal method of iteration. **(Chapter – 4 Sections: 4.1 – 4.3, 4.7 - 4.9)** | **10** | **CO 2** |
| III | **Finite Differences**: Forward Difference – Backward Diffference. **Interpolation (for Equal Intervals):** Newton forward interpolation formula and backward interpolation. **(Chapter – 5 Sections: 5.1 – 5.2) (Chapter – 6 Sections: 6.1 – 6.6)** | **10** | **CO 3** |
| IV | **Central Difference Interpolation Formulae (for Equal Intervals):** Central Differences and Central Differences Table – Central Difference Interpolation formula – Gauss forward interpolation formula – Gauss backward interpolation formula – Stirling's formula. **(Chapter – 7 Sections: 7.1 – 7.5)** | **10** | **CO 4** |
| V | **Numerical Integration:** Trapezoidal rule – Simpson's one-third rule – Simpson's three-eighth rule. **Numerical Solution of Ordinary Differential Equations:** Euler's method – Improved Euler Method – Modified Euler method – Runge-Kutta method - Second order Runge-Kutta method (for first order ODE). **(Chapter – 9 Sections: 9.9, 9.13, 9.14, Chapter – 11 Sections: 11.9 – 11.13)** | **10** | **CO 5** |

| **Text Book** | |
|---|---|
| **1.** | *Kandasamy, P., Thilagavathy, K., Gunavathi, K.* 2008. **Numerical Methods.** [First Edition]. S. Chand & Company Ltd, New Delhi. |
| **Reference Books** | |
| **1.** | *Dr. M.K. Venkataraman,* 2007. **Numerical Methods in Science and Engineering** [Fifth Edition]. The National Publishing Company, Chennai. |
| **2.** | *Dr. V.N. Vedamurthy, D.N. Ch. and S.N. Iyengar,* 2011. **Numerical Methods.** Vikas Publishing House Private Limited, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Find solution of algebraic and transcendental equations |
| **CO 2** | Solve system of linear equations |
| **CO 3** | Interpolate unknown values from known values |
| **CO 4** | Know numerical methods of solving differential equations |
| **CO 5** | Find the solution of the integral equations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | L | L | L |
| CO 2 | H | M | M | L | M |
| CO 3 | H | M | M | L | M |
| CO 4 | H | H | M | M | H |
| CO 5 | H | H | M | M | H |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACAA201 | ALLIED II: SCIENTIFIC COMPUTING METHODS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide a basic knowledge in Numerical Solution for Algebraic and Transcendental Equations.
- Introducing the methods for Interpolation.
- To solve integration using Numerical methods.

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **The solution of Numerical Algebraic and Transcendental Equations**: Bisection Method –Iteration Method – Regula-Falsi Method – Newton-RaphsonMethod. **(Chapter – 3 Sections: 3.1 – 3.4)** | 08 | CO 1 |
| II | **Solution of Simultaneous Linear Algebraic Equations**: Introduction - Gauss Elimination Methods - Gauss Jordan method –Iterative method – Gauss-Jacobi - Gauss Seidal method of iteration. **(Chapter – 4 Sections: 4.1 – 4.2, 4.7 - 4.9)** | 08 | CO 2 |
| III | **Finite Differences**: Forward Difference – Backward Difference. **Interpolation (for Equal Intervals):** Newton forward interpolation formula and backward interpolation. **(Chapter – 5 Sections: 5.1 – 5.2) (Chapter – 6 Sections: 6.1 – 6.6)** | 08 | CO 3 |
| IV | **Central Difference Interpolation Formulae (for Equal Intervals):** Central Differences and Central Differences Table – Central Difference Interpolation formula – Gauss forward interpolation formula – Gauss backward interpolation formula – Stirling's formula. **(Chapter – 7 Sections: 7.1 – 7.5)** | 08 | CO 4 |
| V | **Numerical Integration:** Trapezoidal rule – Simpson's one-third rule – Simpson's three-eighth rule. **Numerical Solution of Ordinary Differential Equations:** Euler's method – Improved Euler Method – Modified Euler method. **(Chapter – 9 Sections: 9.9, 9.13, 9.14, Chapter – 11 Sections: 11.9 – 11.11)** | 08 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Kandasamy, P., Thilagavathy, K., Gunavathi, K.* 2008. **Numerical Methods.** [First Edition]. S. Chand & Company Ltd, New Delhi. |

| **Reference Books** | |
|---|---|
| **1.** | *Dr. M.K. Venkataraman,* 2007. **Numerical Methods in Science and Engineering** [Fifth Edition]. The National Publishing Company, Chennai. |
| **2.** | *Dr. V.N. Vedamurthy, D.N. Ch. and S.N. Iyengar,* 2011. **Numerical Methods.** Vikas Publishing House Private Limited, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Find solution of algebraic and transcendental equations |
| **CO 2** | Solve system of linear equations |
| **CO 3** | Interpolate unknown values from known values |
| **CO 4** | Know numerical methods of solving differential equations |
| **CO 5** | Find the solution of the integral equations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | M | M |
| CO 2 | L | M | H | M | M |
| CO 3 | M | H | H | M | M |
| CO 4 | L | L | H | M | M |
| CO 5 | M | M | H | M | H |
| H-High; M-Medium; L-Low | | | | | |

| 18UMAPHA201 | ALLIED II: INTEGRAL CALCULUS AND VECTOR CALCULUS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn the concepts about integration.
- To introduce the concept of Fourier series.
- To study in detail about vector differentiation and vector integration.

**Credits: 4Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Integral Calculus – Integration by parts - $\int_0^{\pi/2} \sin^n x dx$; $\int_0^{\pi/2} \cos^n x dx$; $\int_0^{\pi/2} \tan^n x dx$ - Definite integrals – Properties – Reduction formula – Problems. | **10** | **CO 1** |
| **II** | Fourier series: Definition – To find Fourier coefficients of Periodic functions with period $2\pi$ - Even and odd functions – Half range series – Problems. | **10** | **CO 2** |
| **III** | Vector Differentiation: Definition of gradient of a scalar point function – Directional derivative of a vector point function – Unit normal vector.<br><br>Vector point function: Divergent and curl of a vector point function – Definitions – Solenoidal and irrorational vector – Problems. | **10** | **CO 3** |
| **IV** | Line integrals – Surface integrals and volume integrals - Problems. | **10** | **CO 4** |
| **V** | Gauss Divergence theorem – Stoke's theorem – Green's theorem (Statement only) - Problems. | **10** | **CO 5** |

**Text Book**


| | |
|---|---|
| **1.** | *Vittal, P.R.* 2002. **Allied Mathematics.** [Third Edition]. Margham Publications, Chennai. |

**Reference Books**

| | |
|---|---|
| **1.** | *ManicavachagamPillay, T.K. and Narayanan, S.* 2004. **Algebra – vol II.** Vijay Nicole Imprints Private Limited, Chennai. |
| **2.** | *Singaravelu. A.*2002. **Allied Mathematics.** Meenakshi Publishers, Chennai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Integrate trigonometric functions and integrations involving more than onefactor |
| **CO 2** | Expand a given function in terms of Fourier series |
| **CO 3** | Identify conservative field and Solenoidal vector |
| **CO 4** | Find work done by the force, area and volume of different regions |
| **CO 5** | Discuss the relations between line integral, surface integral and volume integral |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | H | M | M | M |
| CO 2 | H | H | M | M | L |
| CO 3 | M | L | H | H | M |
| CO 4 | H | H | M | L | H |
| CO 5 | H | M | H | M | L |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACHA201 | ALLIED II: INTEGRAL CALCULUS AND VECTOR CALCULUS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To learn the concepts about integration.
- To introduce the concept of Fourier series.
- To study in detail about vector differentiation and vector integration.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Integral Calculus – Integration by parts - $\int_0^{\pi/2} \sin^n x dx$; $\int_0^{\pi/2} \cos^n x dx$; $\int_0^{\pi/2} \tan^n x dx$ - Definite integrals – Properties – Reduction formula – Problems. | **10** | **CO 1** |
| **II** | Fourier series: Definition – To find Fourier coefficients of Periodic functions with period $2\pi$ - Even and odd functions – Half range series – Problems. | **10** | **CO 2** |
| **III** | Vector Differentiation: Definition of gradient of a scalar point function – Directional derivative of a vector point function – Unit normal vector.<br><br>Vector point function: Divergent and curl of a vector point function – Definitions – Solenoidal and irrorational vector – Problems. | **10** | **CO 3** |
| **IV** | Line integrals – Surface integrals and volume integrals - Problems. | **10** | **CO 4** |
| **V** | Gauss Divergence theorem – Stoke's theorem – Green's theorem (Statement only) - Problems. | **10** | **CO 5** |

**Text Book**


| | |
|---|---|
| **1.** | *Vittal, P.R.* 2002. **Allied Mathematics.** [Third Edition]. Margham Publications, Chennai. |

**Reference Books**

| | |
|---|---|
| **1.** | *ManicavachagamPillay, T.K. and Narayanan, S.* 2004. **Algebra – vol II.** Vijay Nicole Imprints Private Limited, Chennai. |
| **2.** | *Singaravelu. A.*2002. **Allied Mathematics.** Meenakshi Publishers, Chennai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Integrate trigonometric functions and integrations involving more than onefactor |
| **CO 2** | Expand a given function in terms of Fourier series |
| **CO 3** | Identify conservative field and Solenoidal vector |
| **CO 4** | Find work done by the force, area and volume of different regions |
| **CO 5** | Discuss the relations between line integral, surface integral and volume integral |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | H | H | L | M |
| CO 2 | H | L | M | H | H |
| CO 3 | L | H | M | L | M |
| CO 4 | M | H | L | M | M |
| CO 5 | M | L | M | H | L |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACSA301 | ALLIED III: STATISTICAL METHODS | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- Providing knowledge about statistical tools which enables them to develop their programming skills.

**Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Measures of Central Tendency (Averages):** Arithmetic Mean - Median - Mode. **Measures of Dispersion:** Range - Quartile deviation – Standard deviation - Coefficient of variation. **(Chapter 9 and Chapter 10)** | 08 | CO 1 |
| II | **Correlation:** Definition of Correlation – Karl Pearson's Coefficient of Correlation – Rank correlation coefficient. **Regression:** Correlation and Regression - Regression Equations (for ungrouped data). **(Chapter 12 and Chapter 13)** | 08 | CO 2 |
| III | **Analysis of Time Series:** Meaning – Definition – Uses of Time Series – Time series model - Components of Time Series. Measurement of Secular Trend: Graphic Method – Semi-average method - Moving average method – Method of Least Square. Measurement of Seasonal variations: Method of simple average – Ratio to Trend Method. **(Chapter 15)** | 08 | CO 3 |
| IV | **Probability:** Basic definitions – Problems – Addition theorem (statement only) Conditional probability – Multiplication Theorem (Statement only) – Baye's theorem (statement only) – Problems. **(Chapter 18)** | 08 | CO 4 |
| V | **Theoretical standard distributions:** Binomial distribution – Poisson distribution – Normal distribution – Properties and Problems. **(Chapter 19)** | 08 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | Pillai, R.*S.N and Bagavathi, V*. 2012. **Statistics.** [Seventh Edition]. S.Chand and Company Ltd., New Delhi. |

| **Reference Books** | |
|---|---|
| **1.** | *Gupta, S.P.* 2008. **Statistical Methods.** [Thirty Seventh Edition]. Sultan Chand and Sons, New Delhi. |
| **2.** | *Mariappan, P.* 2008. **Statistics for Scientific Solutions (Business Statistics).** [First Edition]. New Century Book House Private Ltd., Chennai. |

**Course Outcomes (CO)**

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

| | |
|---|---|
| **CO 1** | Find averages and positional averages |
| **CO 2** | Measure the degree of relationship between variables |
| **CO 3** | Measure the seasonal variations |
| **CO 4** | Gain knowledge on probability theory |
| **CO 5** | Know about discrete and continuous distributions |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | M | M |
| CO 2 | M | M | H | M | M |
| CO 3 | M | M | H | M | M |
| CO 4 | M | M | H | M | M |
| CO 5 | M | M | H | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMABAA301 | ALLIED: OPERATIONS RESEARCH | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To know the concepts of mathematical formulation and solving.
- To find the solutions of Transportation and Assignment models.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Linear Programming Formulation and Graphical Method:** Introduction - Requirements for employing LPP technique – Mathematical Formulation of L.P.P. - Basic assumptions - Graphical method of the Solution of a L.P.P. – Some more cases – Advantage of Linear Programming – Limitations of Linear Programming.<br><br>**General Linear Programming Problem – Simplex method:** General linear programming problem – Canonical and standard forms of LPP – The Simplex method –The Simplex Algorithm.<br>**(Chapter – 2 Sections: 2.1 – 2.8)**<br>**(Chapter – 3 Sections: 3.1.1 – 3.1.4)** | **10** | **CO 1** |
| II | **Transportation Model:** Introduction - Mathematical formulation of a transportation problem - Methods for finding initial basic feasible solution – Transportation algorithm or MODI method – Degeneracy in Transportation problems – Unbalanced Transportation Problems – Maximization case in Transportation problems.<br><br>**(Chapter – 7 Sections: 7.1 – 7.5)** | **10** | **CO 2** |
| III | **Assignment Problem:** Introduction – Mathematical formulation of an Assignment Problem –Difference between the Transportation Problem and Assignment Problem – Assignment Algorithm or Hungarian Method – Unbalanced Assignment Models – Maximization case in Assignment Problems.<br>**(Chapter – 8 Sections: 8.1 – 8.2, 8.4 - 8.7)** | **10** | **CO 3** |
| IV | **Scheduling by PERT and CPM:** Introduction – Basic Terminologies – Rules for constructing a project network – Network computations – Floats – Programme Evaluation Review Technique (PERT) – Basic differences between PERT and CPM.<br><br>**(Chapter – 15 Sections: 15.1 – 15.7)** | **10** | **CO 4** |

| | | | |
|---|---|---|---|
| **V** | **Game Theory:** Introduction – Two person zero-sum games – The Maximin-Minimax Principle – Games without Saddle points, Mixed strategies – Dominance property - Graphical method for 2 x n or m x 2 games. **(Chapter - 16 Sections: 16.1 – 16.4, 16.6 – 16.7)** | **10** | **CO 5** |
| **Text Book** | | | |
| **1.** | *Sundaresan,V., Ganapathy Subramanian, K.S. and Ganesan, K.* 2014. **Resource Management Techniques**. [Eighth Edition]. AR Publication, Chennai. | | |
| **Reference Books** | | | |
| **1.** | *KantiSwarup, Gupta, P.K. and Man Mohan.* 2014. **Operations Research.** [Seventeenth Edition]. Sultan Chand & Sons, New Delhi. | | |
| **2.** | *Gupta, P.K. and Hira. D.S.* 2004. **Operations Research.** [Eighth Edition]. S.Chand and Company, New Delhi. | | |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Formulate and solve real life problems through LPP |
| **CO 2** | Calculate the optimum transportation schedule |
| **CO 3** | Find the optimum assignment model |
| **CO 4** | Use the techniques for planning and scheduling of projects |
| **CO 5** | Identify the optimum strategies in business |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | H | H | H | H |
| CO 2 | H | H | H | L | H |
| CO 3 | H | H | H | H | L |
| CO 4 | H | H | H | L | H |
| CO 5 | H | L | H | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACOA301 | ALLIED III: BUSINESS MATHEMATICS AND OPERATIONS RESEARCH | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide skill of converting business problems into mathematical problems.
- To impart knowledge on mathematical tools to solve problems.

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Series:** Sequence and Series – Arithmetic Progression – Geometric Progression. **Mathematics of Finance:** Basic concepts – Symbols used - Simple interest – Formulae and Problems – Compound interest – Formulae and problems. **(Chapter 1 Sections: 1 - 3) (Chapter 2 Sections: 1 – 5)** | 08 | CO 1 |
| II | **Matrices and Determinants:** Definition of a matrix – Order of a Matrix - Types of matrices – Matrix operations I: Addition – Subtraction – Scalar multiplication - Multiplication – Transpose – A system of linear equations – Determinants –Cramer's Rule. **(Chapter 4 Sections: 1 - 8)** | 08 | CO 2 |
| III | **Linear Programming Formulation and Graphical Method:** Introduction - Requirements for employing LPP technique – Mathematical Formulation of L.P.P. - Basic assumptions - Graphical method of the Solution of a L.P.P. – Some more cases – Advantage of Linear Programming – Limitations of Linear Programming. **(Chapter – 2 Sections: 2.1 – 2.8)** | 08 | CO 3 |
| IV | **Transportation Model:** Introduction - Mathematical formulation of a transportation problem - Methods for finding initial basic feasible solution – Transportation algorithm or MODI method – Degeneracy in Transportation problems – Unbalanced Transportation Problems – Maximization case in Transportation problems. **(Chapter – 7 Sections: 7.1 – 7.5)** | 08 | CO 4 |
| V | **Assignment Problem:** Introduction – Mathematical formulation of an Assignment Problem –Difference between the Transportation Problem and Assignment Problem – Assignment Algorithm or Hungarian Method – Unbalanced Assignment Models – Maximization case in Assignment Problems. **(Chapter – 8 Sections: 8.1 – 8.2, 8.4 - 8.7)** | 08 | CO 5 |

| **Text Books** | |
|---|---|
| **1.** | *Navnitham, P.A.* 2011. **Business Mathematics and Statistics.** Jai Publishers, Trichy. (For Units I - II) |
| **2.** | *Sundaresan,V., Ganapathy Subramanian, K.S. and Ganesan, K.* 2014. **Resource Management Techniques**. [Eighth Edition]. AR Publication, Chennai. (For Units III - V) |
| **Reference Books** | |
| **1.** | *Vittal, P.R.,* 2008. **Business Mathematics and Statistics.** [Fifth Edition]. Margham Publications, Chennai. |
| **2.** | *KantiSwarup, Gupta, P.K.and Man Mohan*. 2014. **Operations Research**. Sultan Chand & Sons, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Solve problems involved in business environment |
| **CO 2** | Gain knowledge on matrices and their operations |
| **CO 3** | Formulate and solve real life problems through LPP |
| **CO 4** | Find the optimum transportation schedule |
| **CO 5** | Calculate the optimum assignment model |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | M | H | M | M |
| CO 2 | L | M | H | M | M |
| CO 3 | L | H | M | M | M |
| CO 4 | L | M | H | L | M |
| CO 5 | L | M | H | L | L |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACCA301 | ALLIED III: BUSINESS MATHEMATICS AND OPERATIONS RESEARCH | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide skill of converting business problems into mathematical problems.
- To impart knowledge on mathematical tools to solve problems.

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Series:** Sequence and Series – Arithmetic Progression – Geometric Progression. **Mathematics of Finance:** Basic concepts – Symbols used - Simple interest – Formulae and Problems – Compound interest – Formulae and problems. **(Chapter 1 Sections: 1 - 3) (Chapter 2 Sections: 1 – 5)** | 08 | CO 1 |
| II | **Matrices and Determinants:** Definition of a matrix – Order of a Matrix - Types of matrices – Matrix operations I: Addition – Subtraction – Scalar multiplication - Multiplication – Transpose – A system of linear equations – Determinants –Cramer's Rule. **(Chapter 4 Sections: 1 - 8)** | 08 | CO 2 |
| III | **Linear Programming Formulation and Graphical Method:** Introduction - Requirements for employing LPP technique – Mathematical Formulation of L.P.P. - Basic assumptions - Graphical method of the Solution of a L.P.P. – Some more cases – Advantage of Linear Programming – Limitations of Linear Programming. **(Chapter – 2 Sections: 2.1 – 2.8)** | 08 | CO 3 |
| IV | **Transportation Model:** Introduction - Mathematical formulation of a transportation problem - Methods for finding initial basic feasible solution – Transportation algorithm or MODI method – Degeneracy in Transportation problems – Unbalanced Transportation Problems – Maximization case in Transportation problems. **(Chapter – 7 Sections: 7.1 – 7.5)** | 08 | CO 4 |
| V | **Assignment Problem:** Introduction – Mathematical formulation of an Assignment Problem –Difference between the Transportation Problem and Assignment Problem – Assignment Algorithm or Hungarian Method – Unbalanced Assignment Models – Maximization case in Assignment Problems. **(Chapter – 8 Sections: 8.1 – 8.2, 8.4 - 8.7)** | 08 | CO 5 |

| **Text Books** | |
|---|---|
| **1.** | *Navnitham, P.A.* 2011. **Business Mathematics and Statistics.** Jai Publishers, Trichy. (For Units I - II) |
| **2.** | *Sundaresan,V., Ganapathy Subramanian, K.S. and Ganesan, K.* 2014. **Resource Management Techniques**. [Eighth Edition]. AR Publication, Chennai. (For Units III - V) |
| **Reference Books** | |
| **1.** | *Vittal, P.R.,* 2008. **Business Mathematics and Statistics.** [Fifth Edition]. Margham Publications, Chennai. |
| **2.** | *KantiSwarup, Gupta, P.K.and Man Mohan*. 2014. **Operations Research**. Sultan Chand & Sons, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Solve problems involved in business environment |
| **CO 2** | Gain knowledge on matrices and their operations |
| **CO 3** | Formulate and solve real life problems through LPP |
| **CO 4** | Find the optimum transportation schedule |
| **CO 5** | Calculate the optimum assignment model |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | H | H | L | H |
| CO 2 | L | M | H | L | H |
| CO 3 | L | L | H | M | M |
| CO 4 | M | L | H | L | H |
| CO 5 | L | L | H | L | H |
| H-High; M-Medium; L-Low | | | | | |

| 18UMANM301 | NMEC: QUANTITATIVE APTITUDE | SEMESTER – III |
|---|---|---|

**Course Objective:**

The Course aims

- To create and improve the problem solving skills

**Credits: 2** **Total Hours: 25**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Problems on Time and Work<br>**Chapter: 15** | **05** | **CO 1** |
| **II** | Problems on Trains<br>**Chapter: 18** | **05** | **CO 2** |
| **III** | Simplification – Logarithm based problems<br>**Chapters: 4 and 23** | **05** | **CO 3** |
| **IV** | Problems on Areas<br>**Chapter: 24** | **05** | **CO 4** |
| **V** | Problems on Volumes, Surface Areas<br>**Chapter: 25** | **05** | **CO 5** |

**Text Book**

**1.** *Aggarwal, R.S.* 2008. **Quantitative Aptitude.** S.Chand and Company Ltd., New Delhi.

**Course Outcomes (CO)**

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

| | |
|---|---|
| **CO 1** | Solve problems involved in Time and Work |
| **CO 2** | Gain knowledge on Problems on Trains |
| **CO 3** | Simplify the given problem and find solution for the Logarithms |
| **CO 4** | Find the area value for the different regions |
| **CO 5** | Calculate volumes and Surface areas |

| 18UMACSA401 | ALLIED IV: OPERATIONS RESEARCH | SEMESTER – IV |
|---|---|---|

**Course Objective:**

The Course aims

- To describe the industrial problems in terms of mathematical modeling and find the solution to the problem.

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Linear Programming Formulation and Graphical Method:** Introduction - Requirements for employing LPP technique – Mathematical Formulation of L.P.P. - Basic assumptions - Graphical method of the Solution of a L.P.P. – Some more cases – Advantage of Linear Programming – Limitations of Linear Programming. | 08 | CO 1 |
| II | **Transportation Model:** Introduction - Mathematical formulation of a transportation problem - Methods for finding initial basic feasible solution – Transportation algorithm or MODI method – Degeneracy in Transportation problems – Unbalanced Transportation Problems – Maximization case in Transportation problems. **(Chapter – 7 Sections: 7.1 – 7.5)** | 08 | CO 2 |
| III | **Assignment Problem:** Introduction – Mathematical formulation of an Assignment Problem –Difference between the Transportation Problem and Assignment Problem – Assignment Algorithm or Hungarian Method – Unbalanced Assignment Models – Maximization case in Assignment Problems. **(Chapter – 8 Sections: 8.1 – 8.2, 8.4 - 8.7)** | 08 | CO 3 |
| IV | **Scheduling by PERT and CPM:** Introduction – Basic Terminologies – Rules for constructing a project network – Network computations – Floats – Programme Evaluation Review Technique (PERT) – Basic differences between PERT and CPM. **(Chapter – 15 Sections: 15.1 – 15.7)** | 08 | CO 4 |
| V | **Game Theory:** Introduction – Two person zero-sum games – The Maximin-Minimax Principle – Games without Saddle points, Mixed strategies – Dominance property - Graphical method for 2 x n or m x 2 games. **(Chapter - 16 Sections: 16.1 – 16.4, 16.6 – 16.7)** | 08 | CO 5 |

| **Text Book** | |
|---|---|
| **1.** | *Sundaresan,V., Ganapathy Subramanian, K.S. and Ganesan, K.* 2014. **Resource Management Techniques**. [Eighth Edition]. AR Publication, Chennai. |
| **Reference Books** | |
| **1.** | *KantiSwarup, Gupta, P.K. and Man Mohan.* 2014. **Operations Research.** [Seventeenth Edition]. Sultan Chand & Sons, New Delhi. |
| **2.** | *Gupta, P.K. and Hira. D.S.* 2004. **Operations Research.** [Eighth Edition]. S.Chand and Company, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Formulate and solve real life problems through LPP |
| **CO 2** | Calculate the optimum transportation schedule |
| **CO 3** | Find the optimum assignment model |
| **CO 4** | Use the techniques for planning and scheduling of projects |
| **CO 5** | Identify the optimum strategies in business |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | M | M |
| CO 2 | M | M | H | M | M |
| CO 3 | M | M | H | M | M |
| CO 4 | M | M | H | M | M |
| CO 5 | M | M | H | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACOA401 | ALLIED IV: BUSINESS STATISTICS | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide knowledge on statistical techniques used for decision making in business.
- To impart knowledge on statistical tools to solve problems.

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Measures of Central Tendency (Averages):** Arithmetic Mean – Median – Mode - Geometric Mean - Harmonic Mean (Simple problems). **(Chapter 9)** | 08 | CO 1 |
| II | **Measures of Dispersion:** Range - Quartile deviation - Standard deviation - Coefficient of Variation. **(Chapter 10)** | 08 | CO 2 |
| III | **Correlation:** Definition – Types of Correlation – Method of studying Correlation: Karl Pearson's Coefficient of correlation – Properties of coefficient Correlation – Rank Correlation Coefficient. **(Chapter 12)** | 08 | CO 3 |
| IV | **Index Numbers:** Introduction – Meaning – Definition – Characteristics of Index Numbers – Uses – Types of Index Numbers – Unweighted– Quantity Index Numbers – Consumer Price Index – Limitations of Index Numbers. **(Chapter 14)** | 08 | CO 4 |
| V | **Analysis of Time Series:** Meaning – Definition – Uses of Time Series – Time series model - Components of Time Series. Measurement of Secular Trend: Graphic Method – Semi-average method - Moving average method – Method of Least Square. Measurement of Seasonal variations: Method of simple average – Ratio to Trend Method. **(Chapter 15)** | 08 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Pillai, R.S.N. and Bagavathi, V.* 2012. **Statistics.** [Seventh Edition]. S.Chand and Company Ltd., New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *Vittal, P.R., .* 2008. **Business Mathematics and Statistics.** [Fifth Edition]. Margham Publications, Chennai. |
| 2. | *Navnitham, P.A.* 2011. **Business Mathematics and Statistics.** Jai Publishers, Trichy. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn about measures of central tendency |
| **CO 2** | Understand the concepts of measures of dispersion |
| **CO 3** | Gain knowledge on correlation and regression analysis |
| **CO 4** | Calculate variations in prices of different commodities |
| **CO 5** | Measure the seasonal variations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | L | H | H | M |
| CO 2 | L | M | H | M | M |
| CO 3 | L | M | H | H | M |
| CO 4 | L | H | H | H | M |
| CO 5 | L | M | H | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMACCA401 | ALLIED IV: BUSINESS STATISTICS | SEMESTER – IV |
|---|---|---|

**Course Objectives:**

The Course aims

- To provide knowledge on statistical techniques used for decision making in business.
- To impart knowledge on statistical tools to solve problems.

**Credits: 4** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Measures of Central Tendency (Averages):** Arithmetic Mean – Median – Mode - Geometric Mean - Harmonic Mean (Simple problems). **(Chapter 9)** | 08 | CO 1 |
| II | **Measures of Dispersion:** Range - Quartile deviation - Standard deviation - Coefficient of Variation. **(Chapter 10)** | 08 | CO 2 |
| III | **Correlation:** Definition – Types of Correlation – Method of studying Correlation: Karl Pearson's Coefficient of correlation – Properties of coefficient Correlation – Rank Correlation Coefficient. **(Chapter 12)** | 08 | CO 3 |
| IV | **Index Numbers:** Introduction – Meaning – Definition – Characteristics of Index Numbers – Uses – Types of Index Numbers – Unweighted– Quantity Index Numbers – Consumer Price Index – Limitations of Index Numbers. **(Chapter 14)** | 08 | CO 4 |
| V | **Analysis of Time Series:** Meaning – Definition – Uses of Time Series – Time series model - Components of Time Series. Measurement of Secular Trend: Graphic Method – Semi-average method - Moving average method – Method of Least Square. Measurement of Seasonal variations: Method of simple average – Ratio to Trend Method. **(Chapter 15)** | 08 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Pillai, R.S.N. and Bagavathi, V.* 2012. **Statistics.** [Seventh Edition]. S.Chand and Company Ltd., New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *Vittal, P.R., .* 2008. **Business Mathematics and Statistics.** [Fifth Edition]. Margham Publications, Chennai. |
| 2. | *Navnitham, P.A.* 2011. **Business Mathematics and Statistics.** Jai Publishers, Trichy. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn about measures of central tendency |
| **CO 2** | Understand the concepts of measures of dispersion |
| **CO 3** | Gain knowledge on correlation and regression analysis |
| **CO 4** | Calculate variations in prices of different commodities |
| **CO 5** | Measure the seasonal variations |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | H | M | H | L | H |
| CO 2 | M | M | H | L | L |
| CO 3 | M | L | H | L | L |
| CO 4 | M | L | H | M | M |
| CO 5 | L | L | H | L | L |
| H-High; M-Medium; L-Low | | | | | |

| 18UMABCA401 | ALLIED: BIOSTATISTICS | SEMESTER – IV |
|---|---|---|

**Course Objective:**

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

**Credits: 2** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introduction:** Definition – Function of Statistics – Limitations of Statistics – Collection of data – Classification and Tabulation. **(Chapter 1 Sections: 1.3, 1.7, 1.8) (Chapter 2 Sections: 2.1, 2.3)** | 08 | CO 1 |
| II | **Measures of Central Tendency:** Arithmetic Mean – Median – Mode – Geometric mean – Harmonic mean. **(Chapter 3 Sections: 3.1.1, 3.2 - 3.5)** | 08 | CO 2 |
| III | **Measures of Dispersion and Variability:** Range – Inter Quartile Range and Quartile Deviation – Mean Deviation – Standard deviation – Coefficient of variation. **(Chapter 4 Sections: 4.1 – 4.4)** | 08 | CO 3 |
| IV | **Correlation Analysis:** Types of correlation – Methods of studying Correlation (Excluding Correlation of grouped data). **Regression Analysis:** Regression line – Regression equations (Excluding Method of Least Square). **(Chapter 6 Sections: 6.1 – 6.2) (Chapter 7 Sections: 7.1 – 7.2)** | 08 | CO 4 |
| V | **Sampling and Test of Significance:** Steps in test of hypothesis – Test of significance of small samples (t and F) – Chi-square test (Problems only). **(Chapter 10 Sections:10.1, 10.5) (Chapter 11)** | 08 | CO 5 |

**Text Book**

| | |
|---|---|
| 1. | *Palanichamy. S and Manoharan. M,* 2001. **Statistical methods for Biologists.** [Third Edition]. Palani Paramount Publications, Palani. |

**Reference Books**

| | |
|---|---|
| 1. | *Daniel W.W.* 1987. **Biostatistics.** John Wiley and Sons, Newyork. |
| 2. | *Arora, P.N. and Malhan, P.K.* 2006. **Biostatistics.** Himalaya Publishing House, Mumbai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics |
| **CO 2** | Understand the concepts of measures of central tendency |
| **CO 3** | Know the concepts of measures of dispersion |
| **CO 4** | Gain knowledge on correlation and regression analyses |
| **CO 5** | Test the samples using testing of hypothesis |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | L | H | L | H | H |
| CO 2 | L | H | L | H | H |
| CO 3 | L | H | L | H | H |
| CO 4 | L | H | L | H | H |
| CO 5 | L | H | L | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18UMAMBA401 | ALLIED: BIOSTATISTICS | SEMESTER – IV |
|---|---|---|

**Course Objective:**

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

**Credits: 2** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introduction:** Definition – Function of Statistics – Limitations of Statistics – Collection of data – Classification and Tabulation. **(Chapter 1 Sections: 1.3, 1.7, 1.8) (Chapter 2 Sections: 2.1, 2.3)** | 08 | CO 1 |
| II | **Measures of Central Tendency:** Arithmetic Mean – Median – Mode – Geometric mean – Harmonic mean. **(Chapter 3 Sections: 3.1.1, 3.2 - 3.5)** | 08 | CO 2 |
| III | **Measures of Dispersion and Variability:** Range – Inter Quartile Range and Quartile Deviation – Mean Deviation – Standard deviation – Coefficient of variation. **(Chapter 4 Sections: 4.1 – 4.4)** | 08 | CO 3 |
| IV | **Correlation Analysis:** Types of correlation – Methods of studying Correlation (Excluding Correlation of grouped data). **Regression Analysis:** Regression line – Regression equations (Excluding Method of Least Square). **(Chapter 6 Sections: 6.1 – 6.2) (Chapter 7 Sections: 7.1 – 7.2)** | 08 | CO 4 |
| V | **Sampling and Test of Significance:** Steps in test of hypothesis – Test of significance of small samples (t and F) – Chi-square test (Problems only). **(Chapter 10 Sections:10.1, 10.5) (Chapter 11)** | 08 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Palanichamy. S and Manoharan. M,* 2001. **Statistical methods for Biologists.** [Third Edition]. Palani Paramount Publications, Palani. |

**Reference Books**

| | |
|---|---|
| 1. | *Daniel W.W.* 1987. **Biostatistics.** John Wiley and Sons, Newyork. |
| 2. | *Arora, P.N. and Malhan, P.K.* 2006. **Biostatistics.** Himalaya Publishing House, Mumbai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics |
| **CO 2** | Understand the concepts of measures of central tendency |
| **CO 3** | Know the concepts of measures of dispersion |
| **CO 4** | Gain knowledge on correlation and regression analyses |
| **CO 5** | Test the samples using testing of hypothesis |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | H | H | M | M |
| CO 2 | M | M | M | M | M |
| CO 3 | M | L | M | L | L |
| CO 4 | M | M | M | M | M |
| CO 5 | M | M | M | H | M |
| H-High; M-Medium; L-Low | | | | | |

| 18UMABTA401 | ALLIED: BIOSTATISTICS | SEMESTER – IV |
|---|---|---|

**Course Objective:**

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

**Credits: 2** **Total Hours: 40**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | **Introduction:** Definition – Function of Statistics – Limitations of Statistics – Collection of data – Classification and Tabulation. **(Chapter 1 Sections: 1.3, 1.7, 1.8) (Chapter 2 Sections: 2.1, 2.3)** | 08 | CO 1 |
| II | **Measures of Central Tendency:** Arithmetic Mean – Median – Mode – Geometric mean – Harmonic mean. **(Chapter 3 Sections: 3.1.1, 3.2 - 3.5)** | 08 | CO 2 |
| III | **Measures of Dispersion and Variability:** Range – Inter Quartile Range and Quartile Deviation – Mean Deviation – Standard deviation – Coefficient of variation. **(Chapter 4 Sections: 4.1 – 4.4)** | 08 | CO 3 |
| IV | **Correlation Analysis:** Types of correlation – Methods of studying Correlation (Excluding Correlation of grouped data). **Regression Analysis:** Regression line – Regression equations (Excluding Method of Least Square). **(Chapter 6 Sections: 6.1 – 6.2) (Chapter 7 Sections: 7.1 – 7.2)** | 08 | CO 4 |
| V | **Sampling and Test of Significance:** Steps in test of hypothesis – Test of significance of small samples (t and F) – Chi-square test (Problems only). **(Chapter 10 Sections:10.1, 10.5) (Chapter 11)** | 08 | CO 5 |

**Text Book**

| | |
|---|---|
| 1. | *Palanichamy. S and Manoharan. M,* 2001. **Statistical methods for Biologists.** [Third Edition]. Palani Paramount Publications, Palani. |

**Reference Books**

| | |
|---|---|
| 1. | *Daniel W.W.* 1987. **Biostatistics.** John Wiley and Sons, Newyork. |
| 2. | *Arora, P.N. and Malhan, P.K.* 2006. **Biostatistics.** Himalaya Publishing House, Mumbai. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics |
| **CO 2** | Understand the concepts of measures of central tendency |
| **CO 3** | Know the concepts of measures of dispersion |
| **CO 4** | Gain knowledge on correlation and regression analyses |
| **CO 5** | Test the samples using testing of hypothesis |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | L | H | H |
| CO 2 | M | M | L | H | H |
| CO 3 | M | M | L | H | H |
| CO 4 | M | M | L | H | H |
| CO 5 | M | M | L | H | H |
| H-High; M-Medium; L-Low | | | | | |

| 18UMABCAP401/ 18UMAMBAP401/ 18UMABTAP401 | ALLIED PRACTICAL: STATISTICS (USING MS-EXCEL) | SEMESTER – IV |
|---|---|---|

**Course Objective:**

The Course aims

- To give a good grip on concepts in analyzing the data using statistical software

**Credits: 2** **Total Hours: 21**

| PROGRAM | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **1** | Diagrams and graphs | **03** | **CO 1** |
| **2** | Measures of Locations | **03** | **CO 2** |
| **3** | Measures of Dispersion | **03** | **CO 2** |
| **4** | Correlation coefficient (Karl Pearson and Rank method) | **03** | **CO 3** |
| **5** | Regression lines | **03** | **CO 3** |
| **6** | Small sample test (t and F) | **03** | **CO 4** |
| **7** | Chi-square test for independence of attributes. | **03** | **CO 4** |

**Reference Books**


| | |
|---|---|
| **1.** | *BhattacharjeeDibyojyoti.***Practical Statistics Using Microsoft Excel.** Asian Books Private Ltd. |
| **2.** | *Apte D.P.*2008. **Statistical Tools for Mangers using MS EXCEL.** Excel Books.. |


**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Demonstrate the data in diagrammatic and graphical representation |
| **CO 2** | Find the averages and measures of dispersion |
| **CO 3** | Calculate correlation and regression for huge amount of data |
| **CO 4** | Gain knowledge about test of significance |

| 18UMANM401 | NMEC: BASIC STATISTICS | SEMESTER – IV |
|---|---|---|

**Course Objective:**

The Course aims

- To create and improve the problem solving skills

**Credits: 2** **Total Hours: 25**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| **I** | Statistics – Definition – Classification and Tabulation – Formation of Frequency Distribution | **05** | **CO 1** |
| **II** | Measures of Central Tendency: Arithmetic Mean, Median and Mode. | **05** | **CO 2** |
| **III** | Measures of Dispersion: Range, Standard Deviation and Coefficient of Variation. | **05** | **CO 3** |
| **IV** | Correlation – Definition – Properties – Karl Pearson Coefficient of Correlation – Spearman's Rank Correlation | **05** | **CO 4** |
| **V** | Regression Lines- Properties of Regression Coefficients – Difference between Correlation and Regression | **05** | **CO 5** |

**Text Book**

| | |
|---|---|
| **1.** | *Agarwal, R.S.* 2008. **Quantitative Aptitude.** S.Chand and Company Ltd., New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics |
| **CO 2** | Understand the concepts of measures of central tendency |
| **CO 3** | Know the concepts of measures of dispersion |
| **CO 4** | Gain knowledge on correlation |
| **CO 5** | Discuss the regression analysis |

## INTER DISCIPLINARY COURSE OFFERED BY THE DEPARTMENT

## (FOR STUDENTS ADMITTED FROM 2019-2020 ONWARDS)

| **Second Semester** | | | |
|---|---|---|---|
| **S. No.** | **Subject Code** | **Subject** | **Offered for the students of** |
| 1 | 19PMACOI201 | Advanced Business Statistics | M.Com. |
| **Third Semester** | | | |
| 2 | 19PMACOI301 | Resource Management Techniques | M.Com. |

| 19PMACOI201 | IDCI: ADVANCED BUSINESS STATISTICS | SEMESTER – II |
|---|---|---|

**Course Objectives:**

The Course aims

- To create knowledge of analyzing the data based on sample information and making interpretation about the population.

**Credits : 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs. | CO |
|---|---|---|---|
| I | ComputationofBasicStatistics–MeasuresofCentralTendency–DispersionandRelations–ExcelworkandSPSS | 10 | CO 1 |
| II | Probabilitytheoremsdistributions-Binomial,Poissonandnormaldistributions-CharacteristicsandApplications. | 10 | CO 2 |
| III | TestingofHypothesis-StandardErrorandSamplingDistribution - Errorsin Testing Hypothesis – Large Samples Test-Tests of Significance - Z test-Small SamplesTest-'t'test. | 10 | CO 3 |
| IV | TestingofHypothesis-ParametricTests-F-Test-One-way-Two-way–Chi-Square Test andGoodnessoffit-YatesCorrection-UsesofChi-squareTest. | 10 | CO 4 |
| V | MultivariateAnalysis-PartialandMultipleCorrelationandRegression–Factor Analysis. | 10 | CO 5 |

**Text Book**


| | |
|---|---|
| 1. | *Gupta, S.P.* **Statistical Methods.**Sultan Chand and Sons, New Delhi. |

**Reference Books**

| | |
|---|---|
| 1. | *Panneerselvam, R.* 2010,**Research Methodology.**PHILearning Private Limited, New Delhi. |
| 2. | *Sancheti, D.C and Kapoor V.K. 2005.* **Statistics.***[Seventh Edition].* Sultan Chand and Sons, New Delhi. |
| 3. | *Kapoor, V.K and Gupta, S.C.* **Fundamentals of Mathematical Statistics.** [Eleventh Edition]. Sultan Chand and Sons, New Delhi. |
| 4. | *Kapoor, V.K and Gupta, S.P.* **Elements of Mathematical Statistics.**Sultan Chand and Sons, New Delhi. |

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of statistics and understand the concepts of measures of central tendency |
| **CO 2** | Understand the concepts of theoretical distributions. |
| **CO 3** | Know about the concepts of sampling theory |
| **CO 4** | Test the research statements through ANOVA. |
| **CO 5** | Gain knowledge on multivariate analysis |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | L | L |
| CO 2 | H | M | L | M | L |
| CO 3 | H | H | M | L | M |
| CO 4 | L | H | M | H | H |
| CO 5 | M | M | L | M | M |
| H-High; M-Medium; L-Low | | | | | |

| 19PMACOI301 | IDC II: RESOURCE MANAGEMENT TECHNIQUES | SEMESTER – III |
|---|---|---|

**Course Objectives:**

The course aims

- To know the concepts of mathematical formulation and solving.
- To find solution of Transportation and Assignment models.
- To learn the concepts in CPM and PERT.

**Credits: 4** **Total Hours: 50**

| UNIT | CONTENTS | Hrs | CO |
|---|---|---|---|
| I | Resource Management Techniques – Introduction Nature – Application of RMT in decision Making – Modeling – Classification of Models – Principles of Modeling. | 10 | CO1 |
| II | Linear Programming Problem – Assumptions – Formulation of Linear Programming – Problems and Solutions – Graphic Method – Simplex Method – Big M Method ( Not exceeding Z variables) | 10 | CO2 |
| III | Transportation Problem – IBFS North West Corner Rule – Least Cost Method – Vogel's Approximation Method – Optimum Solution – Modi Method – Assignment Problem – Minimisation – Balanced – Unbalanced. | 10 | CO3 |
| IV | Decision Theory – Decision Theory under Uncertainty – Maximin Criterion – Minimax Criterion – Minimax Regret Criterion – Decision Theory Under Risk – Expected Monetary Value – Expected Opportunity Loss – Expected Value Under Perfect Information – Decision Tree. | 10 | CO4 |
| V | Network Analysis – Basic Concepts – Construction of Network – Critical path Method (CPM) – Program Evaluation Review Technique (PERT) - Demand Forecasting – Time series – Secular Trend – Method of Moving Average – Method of Least Squares – Seasonal Indices – Method of Simple Average Method of Link Relatives. | 10 | CO5 |

**Text Book**


1 *KantiSwarup, Gupta, P.K.and Man Mohan*. 2014. **Operations Research**. Sultan Chand & Sons, New Delhi.


**Reference Books**


1 *Sundaresan,V., Ganapathy Subramanian, K.S. and Ganesan, K.* 2014. **Resource Management Techniques**. [Eighth Edition]. AR Publication, Chennai.

2 *Sharma, J.K.* 2007. **Introduction to Operations Research Theory and Applications.** [Third Edition]. MacMillan India Ltd., New Delhi.

**COURSE OUTCOMES (CO)**

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

| | |
|---|---|
| **CO 1** | Learn the importance of Resource management techniques and modeling |
| **CO 2** | Formulate and solve real life problems through LPP |
| **CO 3** | Find the optimum transportation schedule and assignment model |
| **CO 4** | Know the concepts of Decision theory |
| **CO 5** | Use the techniques for planning and scheduling of projects |

**MAPPING**

| PSO / CO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|
| CO 1 | M | M | H | L | L |
| CO 2 | H | M | L | M | L |
| CO 3 | H | H | M | L | M |
| CO 4 | L | H | M | H | H |
| CO 5 | M | M | L | M | M |
| H-High; M-Medium; L-Low | | | | | |