**

**Department of Mathematics and Statistics**

**Course Structure and Syllabi**

**B.Sc. Mathematics (Major) course**

**Session 2018-21**

**Details of various subjects and their credits with contact hours are given below:**

**Semester I**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Subject Code** | **Subject** | **Lecture (Hr.)** | **Tutorials (Hrs.)** | **Practical****(Hrs.)** | **Credits** | **Total Credits** | **Paper****Type** |
|  |  |  |  |  |  | **L** | **T** | **P** |  |  |
| **1.** | **BMA001B** | **Discrete and Combinatorial** **Mathematics** | **4** | **1** | **-** | **4** | **1** |  | **5** |  **ID** |
| **2.** | **BMA002B** | **Differential Calculus** | **4** | **1** | **-** | **4** | **1** |  | **5** |  **F** |
| **3.** |  | **Core 2 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **4.** |  | **Core 3 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **5.** |  | **Computer Applications** | **2** | **-** | **2** | **2** |  | **1** | **3** | **G** |
| **6.** |  | **Environment Studies** | **3** | **-** | **1\*** | **3** |  | **1** | **4** | **C** |
|  |  |  |  |  |  |  |  |  | **27** |  |

 **\*Field/Project Work and Report**

**Semester II**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Subject Code** | **Subject** | **Lecture (Hr.)** | **Tutorials (Hrs.)** | **Practical****(Hrs.)** | **Credits** | **Total Credits** | **Paper****Type** |
|  |  |  |  |  |  | **L** | **T** | **P** |  |  |
| **1.** | **BMA003B** | **Integral Calculus**  | **3** | **1** | **-** | **3** | **1** |  | **4** |  **F** |
| **2.** | **BMA004B** | **Mechanics** | **4** | **1** | **-** | **4** | **1** |  | **5** |  **ID** |
|  **3.** | **BMA005B** | **MATLAB I** | **-** | **-** | **2** |  |  | **1** | **1** |  |
| **4.** |  | **Core 2 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **5.** |  | **Core 3 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **6.** |  | **Computer Applications** | **-** | **-** | **2** |  |  | **1** | **1** | **G** |
| **7.** |  | **Communication Skills** | **3** | **-** | **-** | **3** |  |  | **3** | **F** |
|  |  |  |  |  |  |  |  |  | **24** |  |

 **Semester III**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **Lecture (Hr.)** | **Tutorial (Hrs.)** | **Practical****(Hrs.)** | **Credits** | **Total****Credits** | **Paper****Type** |
|  |  |  |  |  |  | **L** | **T** | **P** |  |  |
| **1.** | **BMA006B** | **Real Analysis**  | **4** | **1** | **-** | **4** | **1** |  | **5** |  **C** |
| **2.** | **BMA007B** | **Vector Calculus and 3D Geometry** | **3** | **1** | **-** | **4** |  |  | **4** |  **F** |
| **3.** | **BMA008B** | **MATLAB II** | **-** | **-** | **2** |  |  | **1** | **1** |  |
| **4.** |  | **Core 2 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **5.** |  | **Core 3 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **6.** |  | **Computer Applications** | **-** | **-** | **2** |  |  | **1** | **1** | **G** |
| **7.** |  | **Communication Skills** | **3** | **-** | **-** | **3** |  |  | **3** | **F** |
|  |  |  |  |  |  |  |  |  | **24** |  |

**Semester IV**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **Lecture (Hr.)** | **Tutorial (Hrs.)** | **Practical****(Hrs.)** | **Credits** | **Total Credits** | **Paper****Type** |
|  |  |  |  |  |  | **L** | **T** | **P** |  |  |
| **1.** | **BMA009B** | **Numerical Analysis** | **4** | **1** | **-** | **4** | **1** |  | **5** |  **S** |
| **2.** | **BMA010B** | **Ordinary and Partial Differential Equations** | **4** | **1** | **-** | **4** | **1** |  | **5** |  **S** |
| **3.** |  | **Core 2 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **4.** |  | **Core 3 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **5.** |  | **Computer Applications** | **2** | **-** | **2** | **2** |  | **1** | **3** | **G** |
| **6.** |  | **Communication Skills** | **3** | **-** | **-** | **3** |  |  | **3** | **F** |
|  |  |  |  |  |  |  |  |  | **26** |  |

**Semester V**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **Lecture (Hr.)** | **Tutorial (Hrs.)** | **Practical****(Hrs.)** | **Credits** | **Total****Credits** | **Paper****Type** |
|  |  |  |  |  |  | **L** | **T** | **P** |  |  |
| **1.** | **BMA011B** | **Abstract Algebra**  | **4** | **1** | **-** | **4** | **1** |  | **5** |  **S** |
| **2.** | **BMA012B** | **Linear Programming** | **3** | **1** | **-** | **4** |  |  | **4** |  **S** |
| **3.** | **BMA013B** | **MATLAB III** | **-** | **-** | **2** |  |  | **1** | **1** |  |
| **4.** |  | **Core 2 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **5.** |  | **Core 3 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **6.** |  | **Communication Skills** | **3** | **-** | **-** | **3** |  |  | **3** | **F** |
| **7.** |  | **Value Education** | **3** | **-** | **-** | **3** |  |  | **3** | **G** |
|  |  |  |  |  |  |  |  |  | **26** |  |

 **Semester VI**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **Lecture (Hr.)** | **Tutorial****(Hrs.)** | **Practical****(Hrs.)** | **Credits** | **Total****Credits** | **Paper****Type** |
|  |  |  |  |  |  | **L** | **T** | **P** |  |  |
| **1.** | **BMA014B** | **Complex Analysis** | **4** | **1** | **-** | **4** | **1** |  | **5** |  **C** |
| **2.** | **BMA015B** | **Linear Algebra** | **4** | **1** | **-** | **4** | **1** |  | **5** |  **C** |
| **3.** |  | **Core 2 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **4.** |  | **Core 3 Minor** | **4** | **-** | **2** | **4** |  | **1** | **5** |  |
| **5.** | **BMA016B** | **Project** |  | **-** | **-** |  |  |  | **6** | **C** |
|  |  |  |  |  |  |  |  |  | **26** |  |
|  |  |  |  |  |  |  |  |  |  |  |

**Semester-wise Distribution of Courses and Credits**

**Semester –I**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Code** | **Title** | **Paper****Type** | **Credits**  |  **L** |  **T** | **P** |
| 1. | BMA001B | Discrete and Combinatorial Mathematics |  **ID** |  5 |  4 |  1 |  0 |
| 2. | BMA002B | Differential Calculus |  **F** |  5 |  4 |  1 |  0 |

 **Total-10**

**Semester –II**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Code** | **Title** | **Paper****Type** | **Credits**  |  **L** |  **T** | **P** |
| 1. | BMA003B | Integral Calculus  |  **F** |  4 |  3 |  1 | 0 |
| 2. | BMA004B | Mechanics |  **ID** |  5 |  4 |  1 | 0 |
| 3. | BMA005B | MATLAB I |  |  1 |  0 |  0 | 1 |

 **Total-10**

**Semester –III**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Code** | **Title** | **Paper****Type** | **Credits**  |  **L** |  **T** | **P** |
| 1. | BMA006B | Real Analysis  |  **C** |  5 |  4 |  1 | 0 |
| 2. | BMA007B | Vector Calculus and 3D Geometry  |  **F** |  4 |  3 | 1 | 0 |
| 3. | BMA008B | MATLAB II |  |  1 |  0 |  0 | 1 |

 **Total-10**

**Semester –IV**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Code** | **Title** | **Paper****Type** | **Credits**  |  **L** |  **T** | **P** |
| 1. | BMA009B | Numerical Analysis |  **S** |  5 |  4 |  1 |  0 |
| 2. | BMA010B | Ordinary and Partial Differential Equations |  **S** |  5 |  4 |  1 |  0 |

 **Total-10**

**Semester –V**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Code** | **Title** | **Paper****Type** | **Credits**  |  **L** |  **T** | **P** |
| 1. | BMA011B | Abstract Algebra  |  **S** |  5 |  4 |  1 | 0 |
| 2. | BMA012B | Linear Programming |  **S** |  4 |  3 |  1 | 0 |
| 3. | BMA013B | MATLAB III |  |  1 |  0 |  0 | 1 |

 **Total-10**

**Semester –VI**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Code** | **Title** | **Paper****Type** | **Credits**  |  **L** |  **T** | **P** |
| 1. | BMA014B | Complex Analysis |  **C** |  5 |  4 |  1 |  0 |
| 2. | BMA015B | Linear Algebra |  **C** |  5 |  4 |  1 |  0 |
| 4. | BMA016B | Project |  C |  6 |   |  |  |

 **Total-16**

 **Grand Total 56**

**C- Core**

**F- Foundation**

**S-Specialization**

**ID- Interdisciplinary**

**Program Outcome (PO’s)**

Upon completion of B.Sc.( **Major**) Mathematics programme, students will be able to:

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship:** Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

**Program Specific Outcome: B.Sc. (Major)** Mathematics programme

PSO1: The graduates will become successful professionals by demonstrating logical and analytical thinking abilities.( Professional Skills)

PSO2: The graduates will work and communicate effectively in inter-disciplinary environment, either independently or in a team, and demonstrate leadership qualities.(Problem-Solving Skills)

PSO3: The graduates will engage in life-long learning and professional development through self-study, continuing education or professional and doctoral level studies.(Successful Career and Entrepreneurship)

**Semester –I**

|  |  |  |
| --- | --- | --- |
| **BMA001B** | **Discrete and Combinatorial Mathematics** | **Credits: 5:4+1** |
| **OBJECTIVE:** * To introduce students to Basic concept of Discrete Mathematics.
* To focus on basic mathematical concepts in combinatorics.
* To focus on mathematical concepts in graph theory and trees.
 |
| **UNIT 1** | Proposition, Compound Proposition, Conjunction, Disjunction, Implication, Converse, Inverse & Contrpositive, Biconditional Statements, tautology, Contradiction & Contingency, Logical Equivalences, Quantifiers, Arguments, Boolean Algebra, Application of Boolean algebra to switching circuits( using AND, OR and NOT gates). |
| **UNIT 2** | Permutations, Combination, Pigeon-hole Principle, inclusion-exclusion principle, derangements, Fundamental theorem of arithmetic.  |
| **UNIT 3** | Graphs and Planar Graphs: Graph, Multigraph, Weighted Graphs, Directed graphs. Paths and circuits.  |
| **UNIT 4** | Matrix representation of graphs. Eulerian Paths and Circuits. Planar graphs. |
| **UNIT 5** | Trees and their properties-Trees as graphs-spanning trees-Directed trees-Binary trees-Their traversals-Arithmetic and Boolean expressions as trees- height balanced trees. |
|  |

***Text Books:***

1. Kenneth H Rosen, Discrete Mathematics and its applications with combinatorics and graph theory by (7th Edition), Tata McGraw-Hill Education private Limited, 2011.

***Reference Books:***

1. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill,

International Edition, 1986.

2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 199

3. S. Wiitala, Discrete Mathematics: A Unified Approach, McGraw-Hill Book Co.

4. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India

5. B. Bollobas: Graph Theory (Chapters I - III).

6. P. J. Cameron and J.H. Van Lint: Graphs, codes and designs.

7. Edgar G. Goodaire, Michael M. Parameter, Discrete Mathematics with Graph Theory (3rd Edition), Pearson, 2005

**Course Outcomes**

CO1:- Understand the notion of mathematical logics and mathematical proofs to apply them in problem solving.

CO2:- Understand the fundamentals of combinatorics and counting principles.

CO3:- Understand basic properties of graphs and related discrete structures, and relate these to practical examples.

CO4:- Determine if a graph has an Euler or a Hamilton path or circuit. To understand various problems related with planar graphs.

CO5:- Demonstrate different traversal methods for trees and to find shortest paths on google maps etc.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | H | L | L | L | M | L | M | H | M | H |
| CO2 | L |  | M | L | L | L | H | L | L | H |
| CO3 | H | M | M | H |  |  | M | H | H | M |
| CO4 | H | M |  | L | M | L |  | H | M | H |
| CO5 | H | M | M |  | L |  | H | H | H | L |

H = Highly Related; M = Medium L = Low

|  |  |  |
| --- | --- | --- |
| **BMA002B** | **Differential Calculus** | **Credits: 5:4+1** |
| **OBJECTIVE:** * To find successive differentiation and Leibnitz theorem
* Use Calculus to compute quantities like Asymptotes, Chain rule of differentiation, Mean value theorems, Taylor’s and Maclaurin theorems,.
* To find curvature, radius of curvature for Cartesian curves, parametric curves and polar curves.
* To trace curves in Cartesian, parametric and polar co-ordinates.
* To evaluate maxima and minima of two variables.
 |
| **UNIT 1** | Differential Calculus: Successive differentiation and Leibnitz theorem. Limit (ε-δ definition), Continuity, Discontinuity, properties of continuous functions.  |
| **UNIT 2** | Differentiability, Chain rule of differentiation, Mean value theorems, Taylor’s and Maclaurin theorems, Asymptotes in cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates. |
| **UNIT 3** | Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves, Newton’s method, Radius of curvature for pedal curves, Tangential polar equations, Centre of curvature, Circle of curvature, Chord of curvature, evolutes. Tests for concavity and convexity, Points of inflexion. |
| **UNIT 4** | Multiple points. Cusps and their types, nodes & conjugate points, Tracing of curves in Cartesian, parametric and polar co-ordinates. |
| **UNIT 5** | ***Functions of one variable***: limit, continuity, differentiation, Change of variables, Rolle’s Theorem, Mean value theorem. Taylor's theorem. Maxima and minima.***Functions of two real variable***: limit, continuity, partial derivatives, differentiability, Partial differentiation, maxima and minima. Method of Lagrange multipliers, Homogeneous functions including Euler’s theorem. |

***Recommended Books:***

1. BANSAL , J L; AGARWAL, S M; BHARGAV, S L., Differential Calculus-

Jaipur publishing house, 1988.

2. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.

3. Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.

4. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar Inc. New York 1975.

5. Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi.

6. H. S. Dhami, Differential Calculus – (New Age International)

7. Courant & John, Differential & Integral Calculus (Vols. I & II).

8. N. Piskunov ,Differential & Integral Calculus (Vol. I) – (CBS Publishers & Distributors)

9. Shanti Naryaan, Differential Calculus – (S. Chand & Co. Ltd.)

10. J. Edwards ,An elementary treatise on the Differential Calculus –

 (Radha Publishing House)

11. David V. Widder, Advanced Calculus – (Prentice Hall)

**Course Outcomes**

CO1. To find successive differentiation and Leibnitz theorem

CO2. Use Calculus to compute quantities like Asymptotes, Chain rule of differentiation, Mean value theorems, Taylor’s and Maclaurin theorems.

CO3.To find curvature, radius of curvature for Cartesian curves, parametric curves and polar curves

CO4. To trace curves in Cartesian, parametric and polar co-ordinates

CO5. To evaluate maxima and minima of two variables

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 |  | M | H |  | M |  |  | L | M | H |
| CO2 |  |  | L | M | H |  |  | M | M | H |
| CO3 |  | L | L | M | H |  |  | L | L | M |
| CO4 |  | M | M | L | H | L |  |  | M | M |
| CO5 | H | H | M | M | L |  | L | M | L | H |

H = Highly Related; M = Medium L = Low

**Semester –II**

|  |  |  |
| --- | --- | --- |
| **BMA003B** | **Integral Calculus** | **Credits: 4:3+1** |

**OBJECTIVE:**

* To understand the Integral Problem formulation and solution method.
* To describe methods for solving Beta and Gamma Function
* To develop an understanding of Triple Integral.

|  |  |
| --- | --- |
| **UNIT 1** | Integration as the inverse process of differentiation, definite integrals and their properties, Fundamental theorem of integral calculus |
| **UNIT 2** | Reduction Formulae: Sinnx,Cosnx ,tannx ,SinmxCosnx  where m, n are positive integers,Double integrals, Change of Variables Cartesian to Polar, change of order of integration. |
| **UNIT 3** | Definition and properties of Gamma and Beta functions, Relation between Gamma and Beta functions |
| **UNIT 4** | Rectification: length of Cartesian and polar curves, Calculating surface areas and volumes using double integrals and applications.  |
| **UNIT 5** | Triple integrals, Calculating volumes using triple integrals and applications, Drichlet’s Integral. |

***Recommended Books:***

1. Gorakh Prasad, A text book on Integral Calculus, Pothishala Pvt .Ltd , Allahabad.
2. Sharma & Jain, Integral Calculus, Galgotia Publication, Dariyaganj, NewDelhi.
3. Shanti Narayan, Integral Calculus, S.Chand and Co., New Delhi.
4. Shanti Narayan, A text book of Vector Calculus, S.Chand and Co. New Delhi
5. Ray and Sharma, Vector algebra &Calculus, Students and Friends Co. Agra
6.  Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and sons.

7. Muray R. Spiegel ,Vector Analysis,  Schaum Publishing Company , New York.
8. Saran and Nigam , Introduction to Vector Analysis, Pothisala Pvt. Ltd, Allahabad

9. Shanti Narayan & P. K. Mittal, Integral Calculus – (S. Chand & Co. Ltd.)

10. H. S. Dhami, Integral Calculus – (New Age International)

11. B. C. Das & B. N. Mukherjee ,Integral Calculus – (U. N. Dhur)

12. BANSAL, J L; AGARWAL, S M; BHARGAV, S L., Integral Calculus II

Jaipur, JAIPUR PUBLISHING HOUSE 1991.

**Course Outcomes**

CO1:-Understanding the difference between Beta and Gamma Function.

CO2:-Understanding the basics concepts of Integral calculus.

CO3:- Understanding the basics concepts of Rectification.

CO4:-Understanding the various techniques to solve integral problems.

CO5:-Developing the ability to understand the triple integral.

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 |  | L |  |  | M |  | M | L | M | H |
| CO2 |  |  |  | M | H | L | L | M | M | H |
| CO3 |  | L |  | M | H | M | L | L | L | M |
| CO4 |  | H |  | L | H | L | M |  | M | M |
| CO5 | H | M |  | M | M | H | M | M | L | H |

H = Highly Related; M = Medium L = Low

|  |  |  |
| --- | --- | --- |
| **BMA004B** | **Mechanics** | **Credits: 5:4+1** |

**OBJECTIVE:**

* Introduce rigorous kinematical analysis of particles and rigid bodies .
* Discuss creation of equations of motion for particles and rigid bodies in planar motion.
* Discuss orbital mechanics and general momentum conservation problems
* Introduce energy-based approaches to determining system motion
* Students will demonstrate that they can calculate the principal coordinates and the principal moments of inertia for arbitrary rigid bodies.

|  |  |
| --- | --- |
| **UNIT 1** | Velocity and acceleration along radial and transverse directions, along tangential and normal directions. S.H.M., Hooke's law, motion along horizontal and vertical elastic strings.  |
| **UNIT 2** | Motion in resisting medium—Resistance varies as velocity and square of velocity. Work and Energy. Motion on a smooth curve in a vertical plane. Motion on the inside and outside of a smooth vertical circle.  |
| **UNIT 3** | Central orbits-p-r equations, Apses, Time in an orbit, Kepler's laws of planetary motion.  |
| **UNIT 4** | Moment of inertia of rods, Circular rings, Circular disks, Solid and Hollow spheres, Rectangular lamina, Ellipse and Triangle. Theorem of parallel axis. Product of inertia.  |
| **UNIT 5** | Virtual work, Lagrange’s Equation of holonomic system, Hamiltonian equation. |

***Suggested Books***

1. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid

 Bodies, Kalyani Publishers, New Delhi, 2004.

2. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.

3. Ray,M., Dynamics of Rigid Bodies, Students Friends and Co. 1998.

4. Bansal, J.L., Dynamics of a Rigid Body, Jaipur Publishing Co., 2004.

|  |
| --- |
| **COURSE OUTCOMES:** At the end of the course, the student should be able to:CO1: Determine the component of velocity and acceleration in different coordinate systems. Also able to explain Simple Harmonic Motion and motion along horizontal and vertical elastic strings.CO2: Understand motion in resisting medium and motion on a smooth curve in vertical plane. Work and Energy.CO3: Explain orbital motion and Kepler's laws of planetary motion. |

CO4: Demonstrate that they can calculate the principal coordinates and the principal moments

 of inertia for arbitrary rigid bodies, theorem of parallel axis and product of inertia.

CO5: Understand the Virtual Work and Lagrange’s Equation of holonomic system,

 Hamiltonian equation.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 |  | M | H |  | M |  |  | L | M | H |
| CO2 |  |  | L | M | H |  |  | M | M | H |
| CO3 |  | L | L | M | H |  |  | L | L | M |
| CO4 |  | M | M | L | H | L |  |  | M | M |
| CO5 | H | H | M | M | L |  | L | M | L | H |

H = Highly Related; M = Medium L = L

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| **BMA005B** | **MATLAB I** | **Credit(s) : 1** |

**Course objective:**

* The aim of this lab is to introduce you to the software MATLAB for numerical computations and in particular familiarizing yourself with the Matlab Desktop, basic commands through the Command window and output through the Graph window.

Exercises Based on MatLab and Mathematica.

Following topics given below will be taken up using Matlab and Mathematical

Softwares.

1. Centre of gravity by integration: C.G of plane area, arc, surface and solid of revolution.

2. Solving Differential Equations obtained in planetary motions and Simple Harmonic

 Motions.

***Suggested Books***

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.

2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.

3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education

 Private Limited.

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| **COURSE OUTCOMES:** At the end of the lab, the student should be able to:CO1: Determine the centre gravity of plane area.CO2: Determine the centre gravity of plane surface area.CO3: Determine the centre gravity of solids. |

CO4: Solution of differential equations in case of planetary motion.

CO5: Solution of differential equations in case of simple Harmonic motion.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 |  | M | H |  | M |  |  | L | M | H |
| CO2 |  |  | L |  | H |  |  | M | M | L |
| CO3 |  | L | L | M |  |  |  | L | L | M |
| CO4 |  | M | M | L |  | L | M | M | M | M |
| CO5 | H | H | M | M | L |  | L | M | L | H |

H = Highly Related; M = Medium L = Low

**Semester –III**

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|  **BMA006B** | **Real Analysis** | **Credits:5: 4+1** |
| **OBJECTIVE:** * To understand the basic theory of Metric space.
* To understand Riemann integrals and improper integrals.
* To develop an understanding of sequence and infinite series.
 |
| **UNIT 1** | Metric spaces: Introduction. Neighborhood, limit points, interior points, open and closed set, closure and interior, boundary points. |
| **UNIT 2** | Subspace of a metric space, Completeness. Cantor’s intersection theorem. Dense subsets. Separable metric spaces. Continuous functions. Uniform continuity. |
| **UNIT 3** | Riemann Integral, Integrability of continuous and monotonic functions, Fundamental theorems of integral calculus, Mean Value theorems of integral calculus. Improper integrals and their convergence.  |
| **UNIT 4** | Comparison test, Abel’s and Dirichlet’s test, Integral as a function of a parameter and its applications, Sequences, Theorems on limits of sequences, Monotone convergence theorem, Cauchy’s convergence criterion. |
| **UNIT 5** | Infinite series, Comparison test, Ratio test,Rabbe’s, logarithmic, De Morgan and Bertrand’s tests. Alternating series, Leibnitz’s test. |
|  |

***Recommended Books:***

1. Shanti Narayan, A Course of Mathematical Analysis. S. Chand & Co. New Delhi, 2004.

2. T. M. Apostol, Mathematical Anslysis, Narosa Publishing House, New Delhi,1985.

3. R.R. Goldberg, Real Analysis, Oxford & IBH Publishing Co., New Delhi, 1970.

4. S. Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.

5. P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis, S. Chand & Co.,New Delhi, 2000.

**Course Outcomes**

CO1:- To understand the basic theory of Metric space.

CO2:-To understand Subspace of a Metric space and seperable metric space.

CO3:- To understand Riemann integrals and improper integrals.

CO4:- To develop an understanding of sequences and its related theorems.

CO5:- To develop an understanding of convergence and divergence of infinite series.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | M |  | L | L |  | L | M | M | M | L |
| CO2 | M |  | L | L |  | L | M | L | M | M |
| CO3 | M |  | L | L |  | L | M | M | M | M |
| CO4 | M |  | L | L |  | L | M | H | M | M |
| CO5 | M |  | L | L |  | L | M | M | M | M |

H = Highly Related; M = Medium L = Low

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|  **BMA007B** | **Vector Calculus and 3D Geometry** | **Credits: 4:3+1** |
| **OBJECTIVE:** * To educate on directional derivatives, total differential, gradient, divergence, curl and Laplacian operator and their application to Green's, Stokes and Gauss theorems.
* To describe methods for solving of three dimensional plane.
* To describe methods for solving straight line.
* To describe methods for solving sphere.
* To develop an understanding of cone.
 |
| **UNIT 1** | Operations with vectors. Scalar and dot product, Vector differentiation. Directional derivatives, the tangent plane, total differential, gradient, divergence, curl. Line integrals, surface and volume integrals. Green's, Stokes and Gauss theorems and their applications. |
| **UNIT 2** | **Plane:** Definition, Equation of a plane, Angle between two planes, planes through two planes, Distance of a point from a plane, Area of a triangle, Volume of Tetrahedron. |
| **UNIT 3** | **Straight lines:** Introduction, Equations of coordinate axes, Symmetrical form & Non Symmetrical form, Angle between a line and a plane, Perpendicular distance, Intersecting lines, Skew lines, Shortest distance and equation of line of shortest distance, Intersection of three planes. |
| **UNIT 4** | **Sphere:** Definition, Equation of a sphere, General equation of a sphere, Centre and radius of a sphere, Great circle, Equation of circle, Diameter form of the equation of a sphere, Tangent line and tangent plane of a sphere, Condition of tangency for a line and equation of tangent plane, Angle of intersection of two spheres, Condition of  orthogonality of two spheres. |
| **UNIT 5** | **Cone:** Cone, Quadratic Cone, Equation of a cone, Enveloping cone, Condition for general equation of second degree to represent a cone, Intersection with a line, Tangent plane, Reciprocal Cone, Right Circular Cone. **Cylinder:** Definition, Equation of a cylinder, Enveloping cylinder, Equation of enveloping cylinder, Right circular cylinder, Equation of right circular cylinder. |
|  |

***Recommended Books:***

1. N.Saran and R.S.Gupta , Analytical Geometry of Three Dimensions , PothisalaPvt.Ltd , Allahabad, 2001.

2. Gorakh Prasad and H.C.Gupta ,Text book on Coordinate Geometry , Pothisala Pvt. Ltd., Allahabad, 2004.

3. Sharma & Jain, Co-ordinate Geometry, Galgotia Publication, Dariyaganj , New Delhi, 1998.

4. P.K.Jain and Khalil Ahmad  , A text book of Analytical Geometry of  Three Dimensions , Wiley Eastern Ltd, 2008.

5. S.L.Loney, The Elements of Coordinate Geometry , Macmillan and Co., London, 2001.

6. R.J.T.Bell, Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan India Ltd, 1998.

7. Bansal J.L., Bhargva S.L., Agarwal S.M., 3-D Coordinate Geometry II, Jaipur Publishing House 2004.

8. Susan J. Colley, Vector Calculus (4th Edition) (Featured Titles for Vector Calculus) Pearson; 4 edition (October 8, 2011) (Oct 8, 2011).

9. Susan J. Colley, Vector Calculus (3rd Edition) Pearson; 3 edition (March 26, 2005) (Mar 26, 2005)

10. J N Sharma, Vector Calculus, Krishna Prakashan Media.

**Course Outcomes**

CO1:- To understand the basics of Directional derivatives, total differential, gradient, divergence, curl, Line integrals, surface and volume integrals. Their application to Green's, Stokes and Gauss theorems

CO2:-To understand about three dimensional plane.

CO3:-To understand the basics concepts of straight line.

CO4:-To understand the methods of solving problems of sphere.

CO5:-To understand the techniques for solving problems of cone.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | M |  | L | L |  | L | M | M | M | L |
| CO2 | M |  | L | L |  | L | M | L | M | M |
| CO3 | M |  | L | L |  | L | M | M | M | M |
| CO4 | M |  | L | L |  | L | M | H | M | M |
| CO5 | M |  | L | L |  | L | M | M | M | M |

H = Highly Related; M = Medium L = Low

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| **BMA008B** | **MATLAB-II** | **Credit(s) : 01** |

**OBJECTIVE:**

* To understand the basic concept of Matlab.
* To understand Numerical integration.
* To develop programs for Differentiation and Integration of Vector point functions.
* To develop programs for 2-D and 3-D graphicsfor Spheres,Cone,Cylinder

Following topics given below will be taken up using Matlab and Mathematica Softwares.

1. Numerical integration

2. Finding Area and Volume using Integration

3. Differentiation and Integration of Vector point functions.

4. 2-D and 3-D graphics.( Spheres,Cone,Cylinder)

(MATLAB- High performance numeric computation and visualization software. MATHEMATICA- Stephen Wolfram.)

***Suggested Books***

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.

2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.

3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education

Private Limited.

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| **COURSE OUTCOMES:**CO1: Understanding the basic concepts of Matlab.CO2: Understanding the Area using integration.CO3: Understanding to find volume using integration. |

CO4: 2-D graph formation.

CO5: 3-D graph formation.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 |  | M | H |  | M |  |  | L | M | H |
| CO2 |  |  | L |  | H |  |  | M | M | L |
| CO3 |  | L | L | M |  |  |  | L | L | M |
| CO4 |  | M | M | L |  | L | M | M | M | M |
| CO5 | H | H | M | M | L |  | L | M | L | H |

H = Highly Related; M = Medium L = Low

**Semester III**

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| --- | --- | --- |
| **BMA009B**  | **Numerical Analysis** | **Credits: 5:4+1** |
| **OBJECTIVE:**  * Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science.
* Such methods include techniques for simple optimisation, interpolation from the known to the unknown, linear algebra underlying systems of equations, Integrals, ordinary differential equations to simulate systems, and stochastic simulation under random influences.
 |
| **UNIT 1** | Differences, Relation between differences and derivatives of polynomials, Factorial notation, Newton’s forward and backward interpolation formula (including proof), Inverse Interpolation. |
| **UNIT 2** | Divided differences: Newton’s and Lagrange’s divided differences formulae. Central differences: Gauss’s, Stirling’s and Bessel’s interpolation formulae, Numerical differentiation.   |
| **UNIT 3** | Numerical integration: Quadrature formula, Trapezoidal rule , Simpson’s 1/3 rd and 3/8 th formulae, Gaussian Integration , Newton cotes formula.  |
| **UNIT 4** | Numerical solution of algebraic and transcendental equations- Bisection method, Regula-falsi method, Method of iteration and Newton Raphson’s Method, Newton’s iterative formula for obtaining square and inverse square root.  |
| **UNIT 5** | Solution of system of linear equations: Gauss elimination method, Jacobi and Gauss Seidal method . Solutions of ordinary differential equations with initial boundary conditions: Picard’s method, Euler’s and modified Euler’s method, Runge’s Kutta Method. |

***References Books:***

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, 1999.

2. C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.

3. S. D. Conte, C de Boor, Elementary Numerical Analysis, McGraw-Hill, 1980.

4. C.E. Froberg, Introduction to Numerical Analysis, (Second Edition), Addition-Wesley,1979.

5. Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan Publishing Co. Inc. New York, 1982.

***Text Book:***

* 1. Gupta and Malik, Calculus of Finite Differences and Numerical Analysis, Krishna Prakashan Mandir.

**Course Outcomes:**

CO1. To be familiar with the finite differences for interpolation, differentiation, etc.

CO2: Find the Lagrange Interpolation Polynomial for any given set of points. Use Unequal Interpolation

*CO3:* Apply several methods of numerical integration, including Romberg integration.

CO4: Find numerical approximations to the roots of an equation by Newton method, Bisection Method, Secant Method, etc.

CO5: Find numerical solution of a differential equation by Euler's, Modified Euler's, Predictor Corrector and Runge Kutta fourth order Methods.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | H | L | L | L | M | L | H | H | M | H |
| CO2 | H | M | M | L | L | L | H | H | M | H |
| CO3 | H | M | M | L | M | L | H | H | H | M |
| CO4 | H | M | M | L | M | L | H | H | M | H |
| CO5 | H | M | M | L | L | L | H | H | H | M |

H = Highly Related; M = Medium L = Low

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| **BMA010B** | **Ordinary and Partial Differential Equations** | **Credits: 5:4+1** |
| **OBJECTIVE:** * To understand the concepts relating to the order and linearity of ODEs and PDEs, analytic and computational solution methods for ODEs and PDEs, and the real-world applications of ODEs.
* To teach students the formation of partial differential equations and types of solutions. PDEs of the first order.
* To expose students to the Classification of linear partial differential equation of second order.
 |
| **UNIT 1** | Ordinary differential equations of the first order of the form y'=f(x,y):initial and boundary conditions, Bernoulli’s equation, exact differential equations, integrating factor, Orthogonal trajectories, Homogeneous differential equations-separable solutions. |
| **UNIT 2** | Linear differential equations of second and higher order with constant coefficients, First order higher degree equations solvable for x, y, p. Singular solution and envelopes. |
| **UNIT 3** | Second order linear differential equations with variable coefficients, homogeneous linear differential equations, method of variation of parameters. Cauchy- Euler equation. |
| **UNIT 4** | Formation of partial differential equations. Types of solutions. PDEs of the first order. Lagrange's solution, Non-linear PDE of first order: Charpit’s method. |
| **UNIT 5** | Classification of linear partial differential equation of second order, Canonical forms, Cauchy’s problem of first and second order partial differential equation. Partial differential equations of first order, Lagrange’s solution. Charpit’smethod. |
|   |

**Recommended Books:**

1. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.

2. S. Balachandra Rao & H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad, 1996.

3. R.S. Senger, Ordinary Differential Equations with Integration, Prayal Publ. 2000.

4. D.A. Murray, Introductory Course in Differential Equations, Orient Longman (India),1967.

5. E.A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall ofIndia, 1961.

6. B.Rai, D.P.Choudhary,Ordinary Differential Equations, Narosa Publ. 2004.

7. J.L. Bansal & H.S. Dhami : Differential Equations Vol. I & II, Jaipur House,Jaipur.

8. S. Balachandra Rao & H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad, 1996.

9. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.

**Course Outcomes**

CO1:- Determine solutions to first order differential equations

CO2:- Determine solutions to second order linear homogeneous and non-homogeneous differential equations with constant coefficients.

CO3:- Determine solutions to second order linear homogeneous and non-homogeneous differential equations with variable coefficients.

CO4:- To understand the fundamentals of the Formation of partial differential equations. Types of solutions. PDEs of the first order.

CO5:- To understand the classification and solution of linear partial differential equation of second order. Solution of partial differential equations of first order by Lagrange’s solution and Charpit’s method

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 |  | L | H |  | M |  |  | L | M | H |
| CO2 |  |  | L | M | H |  |  | M | M |  |
| CO3 |  | L | L | M | H |  |  | L | L | M |
| CO4 |  | M | M | L | H | L |  |  | M |  |
| CO5 | H | H | M | M | L |  | L | M | L | H |

H = Highly Related; M = Medium L = Low

**Semester –V**

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| **BMA011B** | **Abstract Algebra** | **Credits: 5:4+1** |

 **Objectives**: This course has the following objectives:

* To teach students about elementary operations of matrices. Knowledge about the types of matrices.
* To expose students concept of group and their properties.
* To expose students Normal subgroups, Quotient group, Fundamental theorem of Homomorphism. Isomorphism theorems for groups.
* To teach students Normalizer and centre, Finite groups, Commutator subgroups. Rings, Integral Domains and Fields.
* Ideal and quotient Rings. Ring Homomorphism and basic isomorphism theorems. Prime and maximal ideals.

|  |  |
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| **UNIT 1** | Matrix: Introduction, Elementary operations of matrices. Inverse of a matrix, Rank of a matrix, Symmetric, Skew symmetric, Hermitian, Skew-Hermitian and unitary matrices. Determinants: Definition and properties, application of matrices to the system of linear equations, Consistency of the system of linear equations. |
| **UNIT 2** | Algebra: Definition of a group with examples and simple properties, Subgroups, Generator of groups, Cyclic groups, Coset. Lagrange’s theorem and its consequences.Homomorphism and Isomorphism. Permutation groups and Cayley’s theorem.  |
| **UNIT 3** | Normal subgroups, Quotient group, Fundamental theorem of Homomorphism. Isomorphism theorems for groups. Automorphism and inner automorphism, Automorphism groups and their computations. |
| **UNIT 4** | Normalizer and centre, Finite groups, Commutator subgroups. Rings, Integral Domains and Fields.  |
| **UNIT 5** | Ideal and quotient Rings. Ring Homomorphism and basic isomorphism theorems. Prime and maximal ideals.  |

***Recommended Books:***

1. I. N. Herstein , Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975.

2. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers,New Delhi, 1986.

3. K.B. Datta, Matrix and Linear Algebra, PHI Pvt. Ltd. New Delhi, 2000.

4. P.B. Bhattacharya, S.K.Jain , S.R. Nagpal, First Course in Linear Algebra, WileyEastern Ltd. New Delhi, 1983.

5. S. D. Dummit and M. R. Foote: Abstract Algebra.

6. P.B. Bhatacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2nd Edition)Cambridge University Press, Indian Edition, 1977.

7. Sharma, Gokhroo, saini,Elements of Abstract Algebra, Jaipur Publishing House, S.M.S. Highway, Jaipur.

9. N. P. Chaudhuri, Abstract Algebra –(Tata Mc.Graw Hill).

10. A. R. Vasishtha, A. K. Vasishtha, Modern Algebra (Abstract Algebra), Krishna Prakashan Media (p) Ltd. 2011.

**Course Outcomes**

CO1:- Understanding the concept of matrices and determinants.

CO2:- Understanding the basic Subgroups, Generator of groups, Cyclic groups, Coset. Lagrange’s theorem and its consequence, Homomorphism and Isomorphism, Permutation groups and Cayley’s theorem

CO3:- Quotient group, Fundamental theorem of Homomorphism. Isomorphism theorems for groups, Automorphism and inner automorphism, Automorphism groups and their computations

CO4:- Understanding concept of Normalizer and centre, Finite groups, Commutator subgroups. Rings, Integral Domains and Fields

CO5:- Understanding the Ideal and quotient Rings. Ring Homomorphism

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 |  | L | H |  | M |  |  | L | M | H |
| CO2 |  |  | L | M | H |  |  | M | M | H |
| CO3 |  | L | L | M | H |  |  | L | L | M |
| CO4 |  | M | M | L | H | L |  |  | M | M |
| CO5 | H | H | M | M | L |  | L | M | L | H |

H = Highly Related; M = Medium L = Low

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| **BMA012B** | **Linear programming Problem and Operation Research** | **Credits: 4:3+1** |

**Objectives**: This course has the following objectives:

* To understand the basic concept of LPP.
* To understand Simplex and Revised Simplex algorithm.
* To understand ing Duality theory, Dual simplex method.
* To understand Transportation, Assignment and Traveling Salesman problems.
* To understand the Portfolio Theory, Principle of Optimality and its applications

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| **UNIT 1** | Linear Programming problem, formulation, concave and convex sets, Graphical method. |
| **UNIT 2** | Simplex and Revised Simplex algorithm. |
| **UNIT 3** | Duality theory, Dual simplex method. |
| **UNIT 4** | Transportation, Assignment and Traveling Salesman problems. |
| **UNIT 5** | Portfolio Theory, Principle of Optimality and its applications. |

***Recommended Books:***

1. G. Hadley, Linear Programming, Narosa Publishing House, 1995.

2. S.I. Gass, Linear Programming: Methods and Applications (4th edition) McGraw-Hill,New York, 1975.

3. Kanti Swaroop, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi, 1998.

4. Hamdy A. Taha, Operations Research, Prentice-Hall of India, 1997.

5. Sharma S. D., Operations Research : Theory, Methods & Applications, KEDAR NATH RAM NATH-MEERUT, 2011.

**Course Outcome**

CO1:- Understanding the basic concept of LPP.

CO2:- Understanding Simplex and Revised Simplex algorithm.

CO3:- Understanding Duality theory, Dual simplex method.

CO4:- Understanding Transportation, Assignment and Traveling Salesman problems.

CO5:- Understanding the Portfolio Theory, Principle of Optimality and its applications

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | M |  | L | L |  | L | M | M | M | L |
| CO2 | M | L | L | M |  | L | M | L | L | M |
| CO3 | M |  | M | L |  | L | M | M | M | L |
| CO4 | M | L | L | M | L | L | L | L | M | L |
| CO5 | M |  | L | L |  | L | M | M | M | M |

H = Highly Related; M = Medium L = Low

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| **BMA013B** | **MATLAB-III** | **Credits: 1** |

**OBJECTIVE:**

* To understand the basic theory of stereographic projection.
* To understand linear transformation, contours, line integrals, Cauchy-Goursattheorem (without proof), Cauchy integral formula.
* To develop an understanding of Convergence of sequences and series, Residues, the residue theorem, the principle part of a function, poles, evaluation of improper real integrals, improper integrals.

Following topics given below will be taken up using Matlab and Mathematica Softwares.

1. Numerical differentiation

2 Numerical Integration

3. Solving simultaneous equations of more than three variables

***Suggested Books***

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.

2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.

3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill

Education Private Limited.

**Course Outcome**

CO1:- Understanding the basic concept of matlab.

CO2:- Understanding the basic commands of matlab.

CO3:- Understanding Numerical differentiation.

CO4:- Understanding Numerical integration.

CO5:- Understanding the programme for solution of simultaneous linear differential equations.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | M |  | L | L |  | L | H | M | M | L |
| CO2 | M | L | L | M |  | L | M | L | L | M |
| CO3 | M |  | M | L |  | L | M | M |  |  |
| CO4 | M | L | L | M | L | L | L | L | M | L |
| CO5 | M |  | L | L |  | L | M | M | H | M |

H = Highly Related; M = Medium L = Low

**Semester –VI**

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| **BMA014B** | **Complex Analysis** | **Credits: 5:4+1** |

**OBJECTIVE:**

* To understand the basic theory of stereographic projection.
* To understand linear transformation, contours, line integrals, Cauchy-Goursattheorem (without proof), Cauchy integral formula.
* To develop an understanding of Convergence of sequences and series, Residues, the residue theorem, the principle part of a function, poles, evaluation of improper real integrals, improper integrals.

|  |  |
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| **UNIT 1** | Complex Numbers**:**Stereographic projection.Functions of a complex variable, mappings, limits,theorems of limits without proof, continuity, derivatives, differentiation formula,Cauchy-Riemann equations, sufficient conditions, Cauchy-Riemann equations in Polar form, analytic functions, and harmonic functions. |
| **UNIT 2** | Linear functions,the function 1/Z, linear fractional transformations, the functions w = zn,w =exp(Z), special linear fractional transformations. |
| **UNIT 3** | Definite integrals, contours, line integrals, Cauchy-Goursattheorem (without proof), Cauchy integral formula, derivatives of analytic functions, maximum moduli of functions. |
| **UNIT 4** | Convergence of sequences and series (theorems without proofs), Taylor's series, Laurent's series, zero's of analytic functions. |
| **UNIT 5** | Residues,the residue theorem, the principle part of a function, poles, evaluation of improper real integrals, improper integrals. integrals involving trigonometric functionc, definite integrals of trigonometric functions. |

***Recommended Books:***

1. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand &Co.NewDelhi.

2. R.V. Churchil& J.W. Brown, Complex Variables and Applications, 5th Edition,McGraw-Hill, New York, 1990.

3. Mark J., Ablowitz& A.S. Fokas, Complex Variables: Introduction and

Applications,Cambridge University Press. South Asian Edition, 1998.

4. Murray.R.Spiegel,Theory and Problems of Complex Variables-,Schaum outline series, 2004.

**Course Outcomes**

CO1:-Understanding the basic concepts of Understanding the basic theory of stereographic projection.

CO2:- Understanding linear transformation, contours, line integrals, Cauchy-Goursattheorem, Cauchy integral formula.

CO3:- Understanding the various fundamental aspects of Convergence of sequences and series (theorems without proofs), Taylor's series, Laurent's series, zero's of analytic functions

CO4:- Understanding the concept of Convergence of sequences and series, Residues, the residue theorem, the principle part of a function, poles, improper real integrals, and improper integrals.

CO5:-Developing the ability to understand Residues, the residue theorem, the principle part of a function, poles, evaluation of improper real integrals, improper integrals, definite integrals of trigonometric functions

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | L |  | H | L | M | M | M | L |
| CO2 | M | L | L | M |  |  | H | L | L | M |
| CO3 | L |  | M | L | M | M | M | M | M |  |
| CO4 | M |  | L | H |  | L |  | H |  | M |
| CO5 |  | H | L |  | L | L | M | M | M | H |

H = Highly Related; M = Medium L = Low

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| **BMA015B** | **Linear Algebra** | **Credits: 5:4+1** |

**OBJECTIVE:**

* To understand the basic theory of linear algebra.
* To understand the basic theory of vector space.
* To understand linear transformation and dual space.
* To develop an understanding of Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel’s inequality.

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| **UNIT 1** | Vector spaces, subspaces and linear spans, linear dependence and independence. |
| **UNIT 2** | Finite dimensional vector spaces. Linear transformations and their matrix representations |
| **UNIT 3** | Algebra oflinear transformations, the rank and nullity theorem. Change of basis.  |
| **UNIT 4** | Dual spaces, bi dualspace and natural isomorphism. Eigen values and Eigen vectors of LT. Diagonalization, CayleyHamilton theorem.. |
| **UNIT 5** | Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel’s inequality, Gram-Schmidt orthogonalization process. |

***Recommended Books:***

1. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Prentice-Hall of India,

NewDelhi, 1971.

2. K.B. Dutta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New

Delhi,2000.

3. David C. Lay, Linear Algebra and Its Applications, 4th Edition (Jan 20, 2011).

4. Georgi E. Shilov, Linear Algebra (Dover Books on Mathematics) (Jun 1, 1977).

5. Rajul Dutt, A. R. Vasishtha, J.N. Sharma, A. K. Vasishtha, Linear Algebra, Krishna Prakashan Media (p) Ltd., 2011.

**Course Outcomes**

CO1:-Understanding the basic concepts of Vector spaces, subspaces and linear spans, linear dependence and independence

CO2:-Understanding the basics concepts of Finite dimensional vector spaces, Linear transformations and their matrix representations.

CO3:- Understanding the basics concepts of Algebra of linear transformations, the rank and nullity theorem. Change of basis.

CO4:- Dual spaces, bi dual space and natural isomorphism, eigen values and eigen vectors of LT. Diagonalization, Cayley Hamilton theorem.

CO5:-Developing the ability to understand the Cauchy-Schwarz inequality, orthogonal vectors, Orthonormal basis, Bessel’s inequality, Gram-Schmidt orthogonalization process

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| ***Course Outcome*** | Program Outcome | Program Specific Outcome |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
| CO1 | M |  | L | L |  | L | M | L | M | L |
| CO2 | M | L | L | L | L | M | M | M | M | L |
| CO3 | L |  | M | L |  | L | M | L | H | M |
| CO4 | M |  | L | L | M | L | M |  | M | L |
| CO5 | M |  | L | L |  | L | M | M | M | H |

H = Highly Related; M = Medium L = Low

**BMA016B: Project Credits: 6**