|  |  |  |  |
| --- | --- | --- | --- |
| **Course code** | **Subject Name** | **Credit Hours** | |
| **3rd Semester** | | **Theory** | **Practical** |
| **MATH 205** | **Differential Equations & Fourier Series** | **3** | **0** |
| **MATH 210** | **Linear Algebra** | **3** | **0** |
| **ECO 230** | **Economics** | **3** | **0** |
| **ENG 215** | **Technical Report Writing & Presentation Skills** | **3** | **0** |
| **MATH 250** | **Classical Mechanics and Vector Analysis** | **3** | **0** |
|  | **Total** | **15** | **00** |

**DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES**

**Courses of 2nd Year of BS (Mathematics)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course code** | **Subject Name** | **Credit Hours** | |
| **4th Semester** | | **Theory** | **Practical** |
| **MATH 255** | **Dynamics** | **3** | **0** |
| **MATH 270** | **Number Theory** | **3** | **0** |
| **MATH 260** | **C++ Programming & MATLAB** | **3** | **0** |
| **MATH 265** | **Group Theory** | **3** | **0** |
| **MATH 275** | **Topology** | **3** | **0** |
|  | **Total** | **15** | **00** |

**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject : Differential Equations and Fourier series Marks: 100 + 00**

**Discipline : Mathematics**

**Semester : 3rd semester**

**Code : MATH-205**

**Pre-requisites : Calculus-II**

**Assessment : 20% sessional work, 20% midterm, 60% final examination**

**Credit Hours : 03 Minimum Contact Hours:45**

**Objectives:** To give an idea of the formation, solution, and the physical applications of Ordinary Differential Equations (ODEs) including the concept of Fourier series.

**Course Learning Outcomes:** After completing this course, the students able to be

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of ODEs and classification | C2 | 1 |
| 2 | Solve higher order ODEs and use them for physical problems | C3 | 3 |
| 3 | Solve ODEs in power series and expand various functions in Fourier series | C3 | 2 |
|  |  |  |  |

**PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **◼** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **◼** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | ☐ | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | ☐ | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | ☐ | 12 | Lifelong Learning | ☐ |

**Contents**

**First order linear and non-linear ordinary differential equations:** Introduction, Classification, Formation of ODEs, Function versus Solution, Existence and Uniqueness of Solution of ODEs, Solution of first order and first-degree ODEs.Solution of first order and higher-degree ODEs.

**Higher order linear ordinary differential equations:** Linear equations. IVPs and BVPs. Existence and uniqueness of solutions. Homogeneous linear equations with constant coefficients. Oscillatory solutions. Differential operators. Superposition principle. Linear dependence and independence. Wronskian. Fundamental set of solutions. Nonhomogeneous equations. Complementary function and particular integral. The reduction of order method. Undetermined coefficients-superposition approach. Undetermined coefficients-Annihilator approach. Variation of parameters and green’s functions. Cauchy-Euler equation. Systems of linear differential equations and their solution by elimination method. Phase Plane.Applications of second order ODEs:

**Series Solutions:** Power series, ordinary and singular points, Existence of power series solutions, power series solutions, types of singular points, Frobenius theorem, Existence of Frobenius series solutions, solutions about singular points.

**Fourier series**: Periodic and non-periodic functions, Fourier coefficients. Convergence of Fourier series. Fourier expansions of non-periodic functions. Fourier series of odd and even functions. Fourier cosine series and Fourier sine series. Fourier half-range cosine series and Fourier half-range sine series. Fourier series over any range.

**Books Recommended (latest edition):**

1. Zill, D. G. (2016). *Differential equations with boundary-value problems*. Cengage Learning.
2. Zill, D. G. (2012). *A first course in differential equations with modeling applications*. Cengage Learning.
3. Zill, D. G. (2020). *Advanced engineering mathematics*. Jones & Bartlett Publishers.
4. Zill, D. G., & Cullen, M. R. (2009). *Differential equations*. Brooks/Cole, Cengage Learning.
5. Reshetnyak, V. Y., &Makarets, M. V. (1995). *Ordinary differential equations and calculus of variations*. World Scientific.
6. Nagle, R. K., Saff, E. B., & Snider, A. D. (2014). *Fundamentals of differential equations*. Pearson Education.
7. Brannan, J. R., & Boyce, W. E. (2015). *Differential equations: An introduction to modern methods and applications*. John Wiley & Sons.
8. Edwards, C. H. (2008). *Elementary differential equations*. Pearson Prentice Hall.
9. Bird, J. (2017). *Higher engineering mathematics*. Routledge.
10. Seeley, R. T. (2014). *An introduction to Fourier series and integrals*. Courier Corporation.

**Approved:**

Board of Studies, BSRS: 01/2022 Res. No. 2.1 Dated: 20-06-2022

Board of Faculty (FoST&H) 01/2022 Res. No. 1.3(a) Dated: 26-07-2022

Academic Council Res. No.106.3 Dated: 14-12-2023

**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Linear Algebra Marks: 100**

**Discipline: Mathematics**

**Semester : 3rd semester**

**Code: MATH-210**

**Pre-requisites: Intermediate**

**Assessment: 20% Sessional work, 20% midterm, 60% final examination**

**Credit Hours: 03 Minimum Contact Hours: 45**

**Objective:** To Develop the knowledge of matrix algebra and the system of linear equations,

Course Learning Outcomes

After completion of the course, student should be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain the basic concepts of matrix and determinant, and use of some methods for linear systems | C2 | 1 |
| 2 | Discuss the concept of vector space, its types, and operations | C2 | 2 |
| 3 | Describe properties of linear mapping and inner product spaces with related theorems | C2 | 3 |

**PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **◼** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **◼** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | ☐ | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | ☐ | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | ☐ | 12 | Lifelong Learning | ☐ |

**Contents:**

**System of Linear Equations:** Representation in matrix form, Matrices, Operations on Matrices, Echelon and Reduced Echelon Form, Inverse of a matrix (by elementary row operations), Solution of linear systems, Gauss-Jordan method, and Gaussian elimination Methods.

**Determinants**: Permutations of order two and three, Definitions of determinants of the same order, Computing of determinant, Definition of higher order determinants, Properties and Expansion of determinants.

**Vector Spaces**: Definition and examples, Subspaces. Linear combination and spanning set. Linearly Independent sets. Finitely generated vector spaces. Bases and dimension of a vector space. Operations on subspaces, Intersections, sums, and direct sums of subspaces. Quotient Spaces.

**Linear mappings**: Definition and examples. Kernel and image of a linear mapping. Rank and nullity. Reflections, projections, and homotheties. Change of basis. Eigenvalues and eigen vectors.

Theorem of Hamilton-Cayley.

**Inner product Spaces:** Definition and examples. Properties. Projection. Cauchy inequality. Orthogonal and orthonormal basis. Gram Schmidt Process. Diagonalization.

**Recommended Books:**

1. Ch. W. Curtis, *Linear Algebra*, Springer.(Latest Edition)

2. T. Apostol, *Multi Variable Calculus and Linear Algebra*, 2nd ed., John Wiley and sons.(Latest Edition)

3. H. Anton, C. Rorres,*Elementary Linear Algebra: Applications Version*, 10th Edition, John Wiley and sons, 2010.

4. S. Friedberg, A. Insel, Linear Algebra, 4th Edition, Pearson Education Canada.(Latest Edition)

5. S. I. Grossman, *Elementary Linear Algebra*, 5th Edition, Cengage Learning.(Latest Edition)

**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject : Economics Marks: 100 + 00**

**Discipline : Mathematics**

**Semester : 3rd semester**

**Code : ECO-230**

**Pre-requisites : Intermediate**

**Assessment : 20% sessional work, 20% midterm, 60% final examination**

**Credit Hours : 03 Minimum Contact Hours:45**

**Objectives:** To familiarize students with demands and supply analysis consumer and firm

behavior, production cost and market structures.

**PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **◼** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **◼** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | ☐ | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | ☐ | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | ☐ | 12 | Lifelong Learning | ☐ |

**Contents:**

**Introduction to Economics:**

Studying Choice in a World of Scarcity: The No-Free-Lunch Principle, The Cost-Benefit Principle, Reservation Prices, Economic Surplus, Opportunity Cost, The Role of Economic Models, To What Extent should an Activity be Perused, Micro Economic Versus Macro Economics, Economic Naturalism, Positive Versus Normative Economics, Some common Pitfalls for Decision Makers, Conclusion.

**Consumer Behavior:**

Cardinal Approach/Utility Analysis, Marginal Utility, Law of Diminishing Marginal Utility, Law of Equi-Marginal Utility, Consumer Equilibrium Ordinal Approach of Consumer Behavior, Indifference Curves, Features of Indifference Curves, Budget Line, Consumer Equilibrium, Comparison between two approaches Conclusion.

**Demand & Supply:**

Demand Function, Law of Demand, Shift in Demand, Change in Demand Factors Affecting Demand, Supply Function, Law of Supply, Changes in Supply Price Equilibrium, Market Equilibrium.

**Elasticity of Demand & Supply:**

Price Elasticity of Demand & Supply, Point Elasticity of Demand & Supply Arc Elasticity of demand & Supply, Income Elasticity of Demand & Supply, Cross Elasticity of demand & Supply, Conclusion.

**Efficiency and Exchange:**

Market Equilibrium and Efficiency, Economic Surplus, the Cost of Preventing Price Adjustments, Taxes and Efficiency, Conclusion.

**The Theory of production & Theory of Cost:**

The Production Function, Total, average, and marginal product, Laws of Returns to Scale, Short run Theory of Cost, Seven family cost curves, Relationship between Production and Cost Curves. Long-run Theory of Cost: Graphical Representation of Long Run Cost Economies, Diseconomies and Constant Returns to Scale.

**Market Structure:**

Perfect Competition vs. Pure Competition, Different Possibilities of SR firm Equilibrium, Profit Maximization in the Short-run and long-run Monopoly: Short run and long run Equilibrium under Monopoly. Conclusion (Comparison of both) Imperfect Competition: Monopolistic Competition, Price and output determination in monopolistic competition, Comparison perfect competition with monopolistic competition Oligopoly: Definition, Strategic behavior and game Theory, Price Rigidity and the kinked demand curve, Conclusion (Comparison of both) Labor Markets. The Market Demand for Labor, Supply of labor, Shifts in the market demand for and supply of labor, Inefficiency wages, monopsony

**Recommended Books:**

**1. Mankiw,** “Principles of Economics” 7th Edition, (2008), Southwest Publishers

**2. Miller, R. L** –EconomicsToday-14th Edition (2005) Addison Wesley. (Latest Edition)

**Supplementary Material:**

Samuelson Nordons –Economics -18th edition (2004), McGraw-Hill, Inc.McConnell and Bruce-Principles of Economics -17th Edition, (2006), McGraw-Hill.(Latest Edition)

**MEHRAN UNIVERSITY OF ENGINEERING & TECHNOLOGY**

**ENGLISH LANGUAGE DEVELOPMENT CENTRE**

FRM-003/00/QSP-004

Dec.01, 2001

**Title of Subject: Technical Report Writing & Presentation Skills Marks: 100**

**Discipline: Mathematics**

**Semester 3rd semester**

**Code: ENG-215**

**Pre-requisites: Intermediate**

**Assessment: 20% Sessional work, 20% midterm, 60% final examination**

**Credit Hours: 03 Minimum Contact Hours: 45**

**Objectives:** Enhance presentation skills- develop turn taking manners in professional settings

Enable students to take part in discussions, ask questions, offer explanations and give comments. To write formal letters majorly including technical correspondence (Technical Reports)

**PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **◼** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **◼** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | ☐ | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | ☐ | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | ☐ | 12 | Lifelong Learning | ☐ |

**Content**: Reading: Text Analysis, critical thinking

Skimming, scanning and detailed reading

Writing: Academic Writing/Technical Report Writing

Drafting letters with different types of messages with different registers and purposes, prepare CV’s and covering letters according to job requirement

Listening: Listening Comprehension

Formal and informal lectures and presentations take notes ` and collect specific information

Speaking: Speaking in real life situations

Oral Fluency

Conversational strategies, elements of public speaking: Giving lectures and presentation on specific topics

Delivery Styles

Ask questions and explain point of view in discussions

(Demonstrate turn taking technique)

Interview Skills

**Contents:**

**Basics of Technical Writing**

* Introduction to Technical writing and communication,
* Rationale/Characteristics/Features of Technical Writing compared to other forms of writing.
* Types of technical documents

**Introduction to Writing Process**

* Technical Writing Process: Pre-writing, Writing & Revising (Demonstration & Illustration)
* Context & technical writing
* Implicit vs Explicit features of writing/ Text
* Legal & Ethical communication in technical writing

Technical Correspondence

* Using Technical Terms, definitions & descriptions
* Electronic channels of communication and their applications.

**Writing a Technical Document**

* Analyzing, anticipating and adapting
* Researching, organizing and composing
* Revising, proofreading and evaluating
* Elements of technical document

**Formal Technical Reports**

* Problem solving documentation in formal reports
* Components of formal reports
* Feasibility report
* Recommendation report
* Evaluation Report
* Internship Reports

**Recommended Books & Readings**

1. Rise B. Axelrod and Charles R. Cooper,1996 *The Concise Guide to Writing technique*.
2. Yate Martin,2004,*The Ultimate Job Search Letters Book*.Great Britian
3. Perelman, L. C., J. Paradis, and E. Barrett. *Mayfield Handbook of Technical and Scientific Writing*, Mountain View, Mayfield, 1997
4. Sharma, S. D. *A Text Book of Scientific and Technical Communication Writing for Engineers and Professionals*. Sarup & Sons, 2007.
5. Glasman, Hilary. *Science research writing: For non-native speakers of English*. Imperial College Press: London, UK, 2010.
6. Van Aken, David C., and William F. Hosford. *Reporting Results*. Cambridge University Press, 2008.
7. Alred, Gerald J., Charles T. Brusaw, and Walter E. Oliu. *Handbook of technical writing*. Macmillan, 2009.
8. *[Effective Communication Skills for Scientific and Technical Professionals](https://www.questia.com/library/96972033/effective-communication-skills-for-scientific-and)* By Harry E. Chambers Perseus Publishing, 2001

**MEHRANUNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject : Classical Mechanics and Vector Analysis Marks: 100+00**

**Discipline : Mathematics**

**Semester : 3rd semester**

**Code : MATH-250**

**Pre-requisites : Calculus II and Physics I**

**Assessment : 20% sessional work, 20% midterm, 60% final examination**

**Credit Hours : 03 +00 Minimum Contact Hours:45**

**Objectives:** To give idea about classical mechanics (statics, dynamics, and vectors), and enable students to recognize quantum mechanics, statistical, continuum and fluid mechanics, spaceflight, and Astro dynamics.

Course Learning Outcomes

After completion of the course, student should be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Understand basics of Kinematics and kinetics, and solve related problems | C3 | 1 |
| 2 | Discuss the basics of harmonic oscillators, central forces, planetary motion and solve related problems | C3 | 4 |
| 3 | Describe basic concepts of vector calculus and extension to gradient, divergence, and curl with physical applications | C3 | 2 |

**PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **◼** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | ☐ | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | **◼** | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | ☐ | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | ☐ | 12 | Lifelong Learning | ☐ |

**Contents:**

**Contents**:

**Kinematics:** Rectilinear motion of particles, Uniform rectilinear motion, uniformly accelerated rectilinear motion. Curvilinear motion of particle, rectangular components of velocity and acceleration. Tangential and normal components. Radial and transverse components. Projectile motion.

**Kinetics**: Work, power, kinetic energy, conservative force fields. Conservation of energy, impulse, torque. Conservation of linear and angular momentum. Non-conservative forces.

**Simple** **Harmonic** **Motion**: The simple harmonic oscillator, period, frequency. Resonance and energy. The damped harmonic oscillator, over damped, critically damped and under damped. Motion, forces, and vibrations.

**Central** **Forces** **and** **Planetary** Motion: Central force fields, equations of motion, potential energy, orbits. Kepler’s law of planetary motion. Apsides and apsidal angles for nearly circular orbits. Motion in an inverse square field.

**Vector** **Analysis**: Gradient, Divergence, Curl, and their applications.

**Recommended Books:**

1. E. DiBenedetto, Classical Mechanics. Theory and Mathematical Modeling, ISBN: 978-0-8176-4526-7, Birkhauser Boston, 2011.

2. John R. Taylor, Classical Mechanics, ISBN: 978-1-891389-22-1, University of Colorado.(Latest Edition)

3. H. Goldstein, Classical Mechanics, Addison-Wesley PublishingCo.(Latest Edition)

4. C. F. Chorlton, Text Book of Dynamics, Ellis Horwood.(Latest Edition)

5. M. R. Spiegel, Theoretical Mechanics, 3rd Edition, Addison-Wesley Publishing Company.(Latest Edition)

6. G. R. Fowles and G. L. Cassiday, Analytical Mechanics, 7thEdition, Thomson Brooks/COLE, USA.(Latest Edition)

**Approved:**

Board of Studies, BSRS: 01/2022 Res. No. 1.1 Dated: 20-06-2022

Board of Faculty (FoST&H) 01/2022 Res. No. 1.2 Dated: 26-07-2022

Academic Council Res. No.106.3 Dated: 14-12-2023

**MEHRANUNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject : Dynamics Marks: 100+00**

**Discipline : Mathematics**

**Semester : 4th semester**

**Code : MATH-255**

**Pre-requisites : Differential Equations & Fourier Series**

**Assessment : 20% sessional work, 20% midterm, 60% final examination**

**Credit Hours : 03 +00 Minimum Contact Hours:45**

**Objectives:** To give idea about Dynamics, and enable students to recognize quantum mechanics, statistical, continuum mechanics and fluid, space-flight, astro dynamics.

**Course Learning Outcomes**

After completion of the course, student should be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Discuss planar motion of rigid bodies and related theorems | C3 | 1 |
| 2 | Explain motion of rigid bodies in three dimensions and solve related problems | C3 | 1 |
| 3 | Understand free rotation of rigid bodies and the Euler Equation and related derivations | C3 | 1 |

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **☐** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **☐** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | **☐** | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | **☐** | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | **☐** | 12 | Lifelong Learning | ☐ |

**Course Contents:**

**Planer Motion of Rigid Bodies:** Introduction to rigid and elastic bodies, degree of freedom, translations, rotations, instantaneous axis and center of rotation, motion of the center of mass. Euler’s theorem and Chasles’ theorem. Rotation of a rigid body about a fixed axis, moments and products of inertia. Parallel and perpendicular axis theorem.

**Motion of Rigid Bodies in Three Dimensions:** General motion of rigid bodies in space. The momental ellipsoid and equi-momental systems. Angular momentum vector and rotational kinetic energy. Principal axes and principal moments of inertia. Determination of principal axes by diagonalizing the inertia matrix.

**Euler Equations of Motion of a Rigid Body:** Force free motion. Free rotation of a rigid body with an axis of symmetry. Free rotation of a rigid body with three different principal moments. The Eulerian angles, angular velocity, and kinetic energy in terms of Euler angles. Motion of a spinning top and gyroscopes-steady precession, sleeping top.

**Recommended Books:**

1. E. DiBenedetto, *Classical Mechanics. Theory andMathematical Modeling*, ISBN: 978-0-8176-4526-7,Birkhauser Boston, 2011.

2. John R. Taylor, *Classical Mechanics*, ISBN: 978-1-891389-22-1, University of Colorado.(Latest Edition)

3. H. Goldstein, *Classical Mechanics*, Addison-Wesley PublishingCo.(Latest Edition)

4. C. F. Chorlton, *Text Book of Dynamics*, Ellis Horwood.(Latest Edition)

5. M. R. Spiegel, *Theoretical Mechanics*, 3rd Edition, Addison-Wesley Publishing Company.(Latest Edition)

6. G. R. Fowles and G. L. Cassiday, *Analytical Mechanics,* 7thEdition, Thomson Brooks/COLE, USA.(Latest Edition)

**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject : Number Theory Marks: 100 + 00**

**Discipline : Mathematics**

**Semester : 4th semester**

**Code : MATH-270**

**Pre-requisites : Linear Algebra**

**Assessment : 20% sessional work, 20% midterm, 60% final examination**

**Credit Hours : 03 Minimum Contact Hours:45**

**Objectives:** To give idea of numbers system and basic theorems, Diophantine equations and the theory of congruence.

Course Learning Outcomes

After completion of the course, student should be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Discuss principle of induction and divisibility theory | C3 | 1 |
| 2 | Solve linear congruences using the Diophantine equations, explain arithmetic function, and prove related theorems | C3 | 1 |
| 3 | Explain primitive roots, indices, and quadratic residues with examples | C2 | 1 |

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **☐** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **☐** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | **☐** | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | **☐** | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | **☐** | 12 | Lifelong Learning | ☐ |

**Course Contents:**

**Preliminaries:** Well-ordering principle. Principle of finite induction.

**Divisibility theory:** The division algorithms. Basis representation theorem. Prime and composite numbers. Canonical decomposition. The greatest common divisor. The Euclidean algorithm. The

fundamental theorem of arithmetic. Least common multiple.

**Linear Diophantine equations:** Congruences. Linear congruences. System of linear congruences. The Chinese remainder theorem. Divisibility tests. Solving polynomial congruences. Fermat's and

Euler's theorems. Wilson's theorem.

**Arithmetic functions:** Euler's phi-function. The functions of J and sigma. The Mobius functions. The sieve of Eratosthenes. Perfect numbers. Fermat and Mersenne primes.

**Primitive Roots and Indices:** The order of an integer mod n. Primitive roots for primes. Composite numbers having primitive roots.

**Quadratic residues:** Legendre symbols and its properties. The quadratic reciprocity law.

Quadratic congruences with composite moduli. Pythagorean triples. Representing numbers as sum of two squares.

**Recommended Books:**

1. D.M. Burton, *Elementary Number Theory*, McGraw-Hill, 2007.

2. W.J. Leveque, *Topics in Number Theory*, vols. I and II, Addison- Wesley.(Latest Edition)

3. S.B. Malik ,*Basic Number Theory*, Vikas Publishing house.(Latest Edition)

4. K.H. Rosen, *Elementary Number Theory and its Applications*, 5th edition, Addison-Wesley.(Latest Edition)

5. I. Niven, H.S. Zuckerman, H.L. Montgomery, *An Introduction to the theory of Numbers*, John Wiley and Sons.(Latest Edition)

6. A. Adler, J.E. Coury, *The Theory of Numbers*, Jones and Bartlett Publishers.(Latest Edition)

**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject : C++ Programming & MATLAB Marks: 100**

**Discipline : Mathematics**

**Semester : 4th semester**

**Code : MATH-260**

**Pre-requisites : Intermediate**

**Assessment : 20% Sessional work, 20% midterm, 60% final examination**

**Credit Hours : 03 Minimum Contact Hours: 45**

**Objective:** To give basic idea of programming.

**Course Learning Outcomes**

After completion of the course, student should be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Understand basic concepts of C++ and execute functionalities of C++ programming | C3 | 5 |
| 2 | Understand basic concepts and execute functionalities of MATLAB | C3 | 5 |

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | ☐ | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | ☐ | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | ☐ | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | ☐ | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | ◼ | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | ☐ | 12 | Lifelong Learning | ☐ |

**Contents:**

**Introduction to C++:** Getting started, parts of a C++ Program, variable and constant, expression and statements, functions,

**Classes:** Basic Classes, more about classes, advanced program flow,

**Memory Management:** Pointers, Advanced pointers, references, advances reference and pointers.

**Power Tools:** Advanced functions, Operator overloading, Arrays

**MATLAB:** Introduction, Basic features, starting MATLAB, using MATLAB as a calculator, quitting MATLAB, creating MATLAB variables, overwriting variables, error message, making correction, managing workspace, entering multiple statements per line, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, Entering matrix and vectors, matrix generators.

**Recommended Books (latest edition):**

1. Houcque, D. (2005). Introduction to Matlab for engineering students. *Northwestern University*, (1).
2. Dukkipati, R. V. (2008). *MATLAB: an introduction with applications*. New Age International.
3. Sarma, K. K. (2010). *Matlab: Demystified Basic Concepts and Applications*. Vikas Publishing House.
4. Valentine, D. T., & Hahn, B. (2019). *Essential MATLAB for engineers and scientists*. Academic Press.
5. Katsikis, V. (Ed.). (2012). *MATLAB: A Fundamental Tool for Scientific Computing and Engineering Applications-Volume 3*. BoD–Books on Demand.

**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Group Theory Marks: 100**

**Discipline: Mathematics**

**Semester 4th semester**

**Code: MATH-265**

**Pre-requisites: Set Theory**

**Assessment: 20% sessional work, 20% midterm, 60% final examination**

**Credit Hours: 03 Minimum Contact Hours: 45**

**Objective:** Introduce the basic concepts of groups and homomorphism

Course Learning Outcomes

After completion of the course, student should be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Discuss groups and its types with theoretical description | C2 | 1 |
| 2 | Explain group morphism (homo, iso, and auto) and permutations with examples | C2 | 1 |

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **☐** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **☐** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | **☐** | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | **☐** | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | **☐** | 12 | Lifelong Learning | ☐ |

**Contents:**

**Groups:** Definition of a group, subgroup, subgroup generated by a set. The cyclic groups, cosets and Lagrange’s theorem. Normalizer centralizer. The center of a group. Equivalence relation in a group, conjugacy classes. Normal subgroups, quotient group.

**Group homomorphism**: Homomorphism and isomorphism and Automorphism. Kernel and image of homomorphism. Isomorphism theorems. Permutation groups. The cyclic decomposition of a permutation group. Cayley’s theorem. Direct product of two groups and examples.

**Recommended Books:**

1. J. Rose, *A Course on Group Theory*, Cambridge University Press.(Latest Edition)

2. I. N. Herstein, *Topics in Algebra*, Xerox Publishing Company.(Latest Edition)

3. P. M. Cohn, *Algebra*, John Wiley and Sons, London.(Latest Edition)

4. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, *Basic Abstract Algebra*, Cambridge University Press. (Latest Edition)

5. J. B. Fraleigh, *A First Course in Abstract Algebra*, Addison- Wesley Publishing Company.(Latest Edition)

6. VivekSahai and VikasBist, *Algebra*, Narosa Publishing House.(Latest Edition)

7. D. S. Dummit and R. M. Foote, *Abstract Algebra*, 3rd Edition, Addison-Wesley Publishing Company.(Latest Edition)

**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Topology Marks: 100**

**Discipline: Mathematics**

**Semester 4th semester**

**Code: MATH-275**

**Pre-requisites: Set Theory**

**Assessment: 20% sessional work, 20% midterm, 60% final examination**

**Credit Hours: 03 Minimum Contact Hours: 45**

**Objective:** Introduce the concept of topological and metric space

**Course Learning Outcomes**

After completion of the course, student should be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Describe basic concepts of topological spaces, and use these for maps and homeomorphism | C3 | 1 |
| 2 | Extend basic concepts to demonstrate metric, compact and connected spaces | C3 | 2 |

The course is designed so that students will achieve the following PLOs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Mathematics Knowledge | **◼** | 7 | Environment and Sustainability | ☐ |
| 2 | Problem Analysis | **◼** | 8 | Ethics | ☐ |
| 3 | Design/Development of Solutions | **☐** | 9 | Individual and Teamwork | ☐ |
| 4 | Investigation | **☐** | 10 | Communication | ☐ |
| 5 | Modern Tool Usage | **☐** | 11 | Task Management | ☐ |
| 6 | The Mathematician and Society | **☐** | 12 | Lifelong Learning | ☐ |

**Course Outline:**

**Topological spaces:** Introduction to topology; open and closed subsets, metric spaces, neighborhoods. Limit points and accumulation points. Interior, closure, dense subsets. Constructing new topological spaces: Cartesian products, induced topology, and quotient topology. Continuous maps, open and closed maps, homeomorphisms. Examples: R, RxR, S1, S2, torus and cylinder.

Cauchy sequences, complete metric spaces. Separation axioms. Compact spaces. Properties. Power of Compactness. Image of a compact’s set through a continuous map. Compactness and completeness of metric spaces Connected spaces, connected components. Properties. Image of a connected set through a continuous map. Path-connectedness.

**Recommended Books:**

1. J. Kelly, *General Topology*, Springer. (Latest Edition)

2. K. Janich, *Topology*, Springer. (Latest Edition)

3. J. Hocking, G. Young, *Topology*, Dover Publications. (Latest Edition)

4. J. R. Munkres, *Topology - A First Course*, Prentice-Hall. (Latest Edition)

5. G. Simmons, *Topology and modern analysis*, McGraw-Hill. (Latest Edition)

6. S. Lipschutz, *General Topology*, McGraw-Hill. (Latest Edition)

7. J. Dugundji, *Topology*, Allyn and Bacon,.(Latest Edition)