**MEHRANUNIVERSITY OF ENGINEERING & TECHNOLOGY**

Internal office memo FRM-001/01/QSP-006

Sept. 20, 2003

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IMMEDIATE

URGENT

ROUTINE

**DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES**

**Courses of 3rd Year of BS (Mathematics) for Approval**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Third year** | | | | |
| **First Semester** | | | | |
| **S.#** | **Course Title** | **Course Code** | **Cr. Hr** | **Marks** |
| 1 | Algebraic Topology | MATH 305 | 3 | 100 |
| 2 | Differential Geometry & Tensor Analysis | MATH 310 | 3 | 100 |
| 3 | Partial Differential Equations | MATH 315 | 3 | 100 |
| 4 | Real Analysis- I | MATH 320 | 3 | 100 |
| 5 | Rings & Fields | MATH 350 | 3 | 100 |
| **Total** | | | **15** |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Third year** | | | | |
| **Second Semester** | | | | |
| **S.#** | **Course Title** | **Course Code** | **C. H.** | **Marks** |
| 1 | Introduction to Simulator Software | MATH 370 | 2+1 | 100 |
| 2 | Transforms | MATH 355 | 3 | 100 |
| 3 | Complex Analysis | MATH 360 | 3 | 100 |
| 4 | Analytical Dynamics | MATH 375 | 3 | 100 |
| 5 | Real Analysis-II | MATH 365 | 3 | 100 |
| **Total** | | | **15** |  |

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

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

**Discipline: Mathematics**

**Semester 5th semester**

**Code: MATH 305**

**Pre-requisites: Topology**

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

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

**Objective:** To give basic idea of Bases, Spaces, Homotopy and Simplicial Complexes.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Discuss different types of bases and spaces with related axioms, theorems, and examples | C3 | 1 |
| 2 | Explain basic concepts of homotopy, simplicial complexes, and homeomorphism | C2 | 1 |

**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:**

**Bases and Spaces**

Bases and Sub-bases. Sub-spaces. First and second axiom of countability. Continuous functions and Homeomorphisms. Product Spaces. Separation axioms. Completely regular spaces. Normal spaces. Compactness. Connected spaces. Convergence and completeness. Analytic topology. Baire’s theorem.

**Homotopy and Simplicial Complexes**

Introduction. The classification problem. Homotopy. Simplicial complexes, homotopy and homeomorphism of polyhedral.

**BOOKS RECOMMENDED**

**1.** Algebraic Topology; C. R. F Maunder; Cambridge University Press 1980

**2.** Yahya, S. M: Point Set Topology; Time Press Karachi.

**3.** Mohammad Amin: Introduction to General Topology; Lahore, Ilmi Kitab Khana, 1973.

**4.** Simmons, G. LF: Introduction to Topology and Modern Analysis McGraw Hill.

**5.** Armstrong M. A: Basic Topology M. Y. McGraw Hill.

**6.** Sims, B. T: Fundamentals of Topology N. Y. Machillan.

**7.** Baum: Elementary Topology; Prentice-Hall.

**8.** Sutter Land, W. A: Introduction to Metric & Topological Spaces; Oxford: Clarendon Press.

**9.** Gemignani, M. C: Elementary Topology; Reading; Mass, Addison Wesley.

**10.** Gall: Point Set Topology; Academic Press.

**Approved:**

Board of Studies, BSRS: 01/2019 Res. No. 02 Dated: 07-02-2019

Board of Faculty (FoST&H) 01/2019 Res. No. 04 Dated: 07-03-2019

Academic Council Res. No. 100.15 Dated: 24-08-2021

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Differential Geometry and Tensor Analysis Marks: 100**

**Discipline: Mathematics**

**Semester 5th semester**

**Code: MATH 310**

**Pre-requisites: Calculus-I**

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

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

**Objective:** To give classical concepts in local theory of curves and surfaces along with tensors of different ranks

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of space curves with related theorems and examples | C3 | 1 |
| 2 | Discuss different types of surfaces and fundamental forms with examples | C3 | 1 |
| 3 | Explain basic concepts of Tensor theory with properties, operations, and theorems | C2 | 1 |

**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:**

**Theory of Space Curves**

Introduction, index notation and summation convention. Space curves, arc length, tangent, normal and binormal. Osculating, normal, and rectifying planes. Curvature and Torsion. The Frenet-Serret theorem. Natural equation of a curve. Involutes and evolutes, helices. Fundamental existence theorem of space curves.

**Theory of Surfaces**

Coordinate transformation. Tangent plane and surface normal. The first fundamental form and the metric tensor. The second fundamental form. Principal, Gaussian, mean, geodesic, and normal curvatures. Gauss and Weingarten equations. Gauss-Codazzi equations.

**Tensor Analysis**

Einstein summation convention. Tensors of different ranks. Contravariant, covariant, and mixed tensors. Addition, subtraction, inner and outer products of tensors. Contraction theorem, quotient law. The line element and metric tensor. Christoffel symbols.

**Recommended Books**

1. R. S. Millman and G. D. Parker, *Elements of Differential Geometry*, Prentice-Hall, New Jersey.(Latest Edition)

2. A. Goetz, *Introduction to Differential Geometry*, Addison-Wesley.(Latest Edition)

3. E. Kreyzig, Differential Geometry, Dover.(Latest Edition)

4. M. M. Lipschutz, *Schaum’s Outline of Differential Geometry*,McGraw Hill.(Latest Edition)

5. Nawazish Ali Shah, Vector and Tensor Analysis, A – One Publisher, Lahore, 2005

**Approved:**

Board of Studies, BSRS: 01/2019 Res. No. 02 Dated: 07-02-2019

Board of Faculty (FoST&H) 01/2019 Res. No. 04 Dated: 07-03-2019

Academic Council Res. No. 100.15 Dated: 24-08-2021

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Partial Differential Equations Marks: 100**

**Discipline: Mathematics**

**Semester 5th semester**

**Code: MATH 315**

**Pre-requisites: Ordinary differential equations**

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

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

**Objective:** To give an idea about methods of solution of PDEs

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of PDEs and use separation variables method in cartesian and cylindrical coordinates with applications | C3 | 2 |
| 2 | Solve in series some important types of ODEs with examples | C3 | 3 |
| 3 | Understand and classify Sturm-Liouville problems and solve related examples | C3 | 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:**

**First order PDEs**

Introduction, formation of PDEs, solutions of PDEs of first order. The Cauchy’s problem for quasilinear first order PDEs, First order nonlinear equations, Special types of first order equations

**Second order PDEs**

Basic concepts and definitions, Mathematical problems, Linear operators, Superposition, Mathematical models: The classical equations, the vibrating string, the vibrating membrane, conduction of heat solids, canonical forms, and variable, PDEs of second order in two independent variables with constant and variable coefficients, Cauchy’s problem for second order PDEs in two independent variables.

**Methods of separation of variables**

Solutions of elliptic, parabolic, and hyperbolic PDEs in Cartesian and cylindrical coordinates.

**Sturm-Liouville problems**

The Bessel, modified Bessel Legendre and Hermite equations and their solutions. Introduction to Eigen value problem, adjoint and self-adjoint operators, self-adjoint differential equations, Eigen values and Eigen functions, Sturm-Liouville (S-L) boundary value problems, regular and singular S-L problems, properties of regular S-L problems.

**Recommended Books (latest edition)**

1. Dennis G. Zill and Michael R., Differential equations with boundary-value problems by Cullin 5th Edition Brooks/Cole. (Latest Edition)
2. William E. Boyce and Richard C. Diprima, Elementary differential equations and boundary value problems, Seventh Edition John Wiley & Sons, Inc
3. Jeffrey, A. (2003). *Applied partial differential equations: an introduction*. Academic Press.
4. Coleman, M. P. (2016). *An introduction to partial differential equations with MATLAB*. CRC Press.
5. Wazwaz, A. M. (2002). *Partial differential equations*. CRC Press.
6. Shah, N. H. (2015). *Ordinary And Partial Differential Equations: Theory and Applications*. PHI Learning Pvt. Ltd.
7. Articolo, G. A. (1998). *Partial Differential Equations & Boundary Value Problems with Maple V* (Vol. 1). Academic Press.

**Approved:**

Board of Studies, BSRS: 01/2022 Res. No. 3.1 Dated: 20-06-2022

Board of Faculty (FoST&H) 01/2022 Res. No. 1.3 (b) 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: Real Analysis-I Marks: 100**

**Discipline: Mathematics**

**Semester 5th semester**

**Code: MATH 320**

**Pre-requisites: Calculus-II**

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

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

**Objective:** To give the idea of fundamental concepts of analysis and axiomatic foundation of real number system

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of number system and topology of real numbers with related theory | C2 | 1 |
| 2 | Discuss sequences and series, and apply convergence tests with examples | C3 | 1 |
| 3 | Understand uniform continuity, monotone functions, discontinuity, and differentiation with related theorems and examples | C2 | 1 |

**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:**

**Number Systems:** Ordered fields. Rational, real, and complex numbers. Archimedean property, supremum, infimum, and completeness.

**Topology of real numbers:** Convergence, completeness, completion of real numbers. Open sets, closed sets, compact sets. Heine-Borel Theorem. Connected sets.

**Sequences and Series of Real Numbers:** Limits of sequences, algebra of limits. Bolzano Weierstrass Theorem. Cauchy sequences, liminf, limsup. Limits of series, convergences tests, absolute and conditional convergence. Power series.

**Continuity:** Functions, continuity and compactness, existence of minimizers and maximizers, uniform continuity. Continuity and connectedness, Intermediate mean Value Theorem. Monotone functions and discontinuities.

**Differentiation**: Mean Value Theorem, L’Hôpital’s Rule, Taylor’s Theorem.

**Recommended Books**

1. S. Lang, Analysis *I*, Addison-Wesley Publ. Co., Reading, Massachusetts.(Latest Edition)

2. W. Rudin, *Principles of Mathematical Analysis*, 3rd ed., Mc. Graw Hill.(Latest Edition)

3. B. S. Thomson, J. B. Bruckner and A. M. Bruckner, *Elementary Real Analysis*, 2nd Ed. 2008.

4. G. Boros, V. Moll, *Irresistible Integrals: Symbolics, Analysisan Experiments in the Evaluation of Integrals*, Cambridge University Press.(Latest Edition)

5. J. Borwein, D. Bailey, R. Girgenson, *Experimentation in Mathematics: Computational Paths to discovery*, Wellesley, MA,A.K. Peters.(Latest Edition)

6. G. Bartle , R. Sherbert , *Introduction to Real Analysis,* 3rdedition, John Wiley, New York.(Latest Edition)

**Approved:**

Board of Studies, BSRS: 01/2019 Res. No. 02 Dated: 07-02-2019

Board of Faculty (FoST&H) 01/2019 Res. No. 04 Dated: 07-03-2019

Academic Council Res. No. 100.15 Dated: 24-08-2021**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Rings and Fields Marks: 100**

**Discipline: Mathematics**

**Semester 5th semester**

**Code: MATH 350**

**Pre-requisites: Algebra-I**

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

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

**Objective:** Introduce the basic concepts of rings and fields.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of Rings and Ideals with operations, properties, types, and theorems | C2 | 1 |
| 2 | Discuss basic concepts of integral domain and fields with related properties and theorems and their extension to polynomials | C2 | 1 |

**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:**

**Rings:** Introduction, Quadratic integer rings. Examples of non-commutative rings. The Hamilton quaternions. Polynomial rings. Matrix rings. Units, zero-divisors, nilpotent, idempotents. Subrings, Ideals. Maximal and prime Ideals. Left, right and two-sided ideals. Operations with ideals. The ideal generated by a set. Quotient rings. Ring homomorphism. The isomorphism theorems, applications. Finitely generated ideals. Rings of fractions.

**Integral Domain:** The Chinese remainder theorem. Divisibility in integral domains, greatest common divisor, least common multiple. Euclidean domains. The Euclidean algorithm. Principal ideal domains. Prime and irreducible elements in an integral domain. Gauss Lemma, irreducibility criteria for polynomials. Unique factorization domains. Finite fields. Polynomials in several variables. Symmetric polynomials. The fundamental theorem of symmetric polynomials.

**Recommended Books**

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

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

7. VivekSahai and VikasBist, *Algebra*, NarosaPublishingHouse.(Latest Edition)

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

**Approved:**

Board of Studies, BSRS: 01/2019 Res. No. 02 Dated: 07-02-2019

Board of Faculty (FoST&H) 01/2019 Res. No. 04 Dated: 07-03-2019

Academic Council Res. No. 100.15 Dated: 24-08-2021

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Introduction to Simulation Software Marks: (50+50)**

**Discipline: Mathematics**

**Semester 6th semester**

**Code: MATH 370**

**Pre-requisites: Introduction to computers**

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

**Credit Hours: 02 Minimum Contact Hours: 30+30**

**Objectives:** To explore the applications of Mathematics using various packages.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Solve problems from matrix theory in linear algebra using MATLAB | C3 | 5 |
| 2 | Explain basic concepts of SPSS and use them for descriptive statistics and regression analysis | C3 | 5 |
| 3 | Explain basic concepts of MATHEMATICA and use them for matrix theory in linear algebra using MATHEMATICA | C3 | 5 |
| 4 | Utilize programming knowledge of simulation software for applied problems | P3 | 12 |

**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:

**MATLAB:** Introduction of MATLAB, Arithmetic operations, percentage, ratios, addition, subtraction, multiplication and inverse of matrices, and linear algebra on MATLAB (Finding inverses, determinants, powers and exponentials, eigenvalues and eigenvectors Solving linear systems of equations, etc.), Sparse matrices, Solving algebraic and transcendental equations numerically, Polynomials and interpolations.

Data analysis and curve fitting on MATLAB (Descriptive statistics, linear regression, correlation analysis, Time series methods and tools, Basic curve fitting)

### Finding the roots of equations, limit of functions, derivative and integration, maximum, minimum of functions, symbolic summations, solving ordinary differential equations (ODEs) using different solvers. Plotting 2D and 3D graphs of functions, Annotating and editing graphs, Figure properties, Creating specialized plots, Creating mesh and Contour plots, Animation and animation Control.

### SPSS: Environment of SPSS and basic Commands, Averages: arithmetic Mean, Median, Mode, standard deviation. Regression analysis.

### Mathematica: Environment of Mathematica, Basic operations and commands of MATHEMATICA to manipulate numbers, Mathematical functions, Equations, Calculus, Series and Residues, Linear algebra and data analysis, Formula gallery, Graphics gallery, and Standard packages of MATHEMATICA

**Recommended Books (latest edition)**

1. Mirza, S. M. (2010). Introduction to Matlab®. *Beginner Resource*.
2. Pratap, R. (1998). *Getting Started with MATLAB 5-A Quick Introduction for Scientists and Engineers* (p. 240).
3. Sarma, K. K. (2010). *Matlab: Demystified Basic Concepts and Applications*. Vikas Publishing House.
4. Enns, R. H., & McGuire, G. C. (2001). *Nonlinear physics with Mathematica for scientists and engineers*. Springer Science & Business Media.
5. Hoste, J. (2008). *Mathematica demystified*. McGraw Hill Professional.
6. Salcedo, J., & McCormick, K. (2020). *SPSS Statistics for Dummies*. John Wiley & Sons.
7. Yockey, R. D. (2016). *SPSS demystified: A simple guide and reference*. Routledge.
8. te Grotenhuis, M., & Matthijssen, A. (2015). *Basic SPSS tutorial*. Sage Publications.

**Approved:**

Board of Studies, BSRS: 01/2019 Res. No. 02 Dated: 07-02-2019

Board of Faculty (FoST&H) 01/2019 Res. No. 04 Dated: 07-03-2019

Academic Council Res. No. 100.15 Dated: 24-08-2021

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Transforms Marks: 100**

**Discipline: Mathematics**

**Semester 6th semester**

**Code: MATH 355**

**Pre-requisites: Ordinary and partial differential equations.**

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

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

**Objective:** Introduce the basic concepts of Laplace& Fourier transforms

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of Laplace transform and related properties with examples and applications | C3 | 3 |
| 2 | Explain basic concepts of Fourier transform and related properties with examples and applications | C3 | 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:**

**Laplace transform:** Introduction and properties of Laplace transform, transforms of elementary functions, periodic functions, error function and Dirac delta function, inverse Laplace transform, convolution theorem, solution of PDEs by Laplace transform, Diffusion, and wave equations

**Fourier transform**: Fourier integral representation, Fourier sine and cosine representation, Fourier transform pair, transform of elementary functions and Dirac delta functions, finite Fourier transforms, solutions of heat, wave and by Fourier transforms.

**Recommended Books**

1. McLachlan, N. W. (2014). *Laplace transforms and their applications to differential equations*. Courier Corporation.
2. Spiegel, M. R. (1965). *Schaum's Outline of Laplace Transforms*. McGraw Hill Professional.
3. Beerends, R. J., ter Morsche, H. G., Van den Berg, J. C., & Van de Vrie, E. M. (2003). *Fourier and Laplace transforms* (p. 458).
4. Laplace, Fourier And Z Transforms with Application for BS 4 Years by ZR Bhatti

**Approved:**

Board of Studies, BSRS: 01/2019 Res. No. 02 Dated: 07-02-2019

Board of Faculty (FoST&H) 01/2019 Res. No. 04 Dated: 07-03-2019

Academic Council Res. No. 100.15 Dated: 24-08-2021

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Complex Analysis Marks: 100**

**Discipline: Mathematics**

**Semester 6th semester**

**Code: MATH 360**

**Pre-requisites: Real Analysis-I**

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

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

**Objective:** Introduce the concept of complex numbers and complex variables.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of complex numbers and functions of complex variables with operations, properties, theorems, and examples | C2 | 1 |
| 2 | Discuss complex integrals over different contours and apply the complex integral theorems to solve related examples | C3 | 2 |
| 3 | Explain basics of complex series and types of singularities with related theorems and 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:**

**Introduction**: The algebra of complex numbers, Geometric representation of complex numbers, Powers, and roots of complex numbers.

**Functions of Complex Variables:** Definition, limit and continuity, Branches of functions, Differentiable and analytic functions. The Cauchy-Riemann equations, Entire functions, Harmonic functions, Elementary functions: The exponential, Trigonometric, Hyperbolic, Logarithmic, and Inverse elementary functions, Open mapping theorem. Maximum modulus theorem.

**Complex Integrals:** Contours and contour integrals, Cauchy-Goursat theorem, Cauchy integral formula, Liouville’s theorem, Morera’s theorem.

**Series:** Power series, Radius of convergence and analyticity, Taylor’s and Laurent’s series, Integration, and differentiation of power series. Singularities, Poles and residues: Zero, singularities, Poles and Residues, Types of singular points, Calculus of residues, contour integration, Cauchy’s residue theorem with applications. Mobius transforms, conformal mappings, and transformations.

**Recommended Books**

1. R. V. Churchill, J. W. Brown, *Complex Variables and Applications ,*5th edition, McGraw Hill, New York. (Latest Edition)   
2**.** J. H. Mathews and R. W. Howell, *Complex Analysis for Mathematics and Engineering*.(Latest Edition)

3. S. Lang, *Complex Analysis*, Springer-Verlag. (Latest Edition)

4. R. Remmert, *Theory of Complex Functions*, Springer-Verlag. (Latest Edition)

5. W. Rudin, *Real and Complex Analysis*, McGraw-Hill. (Latest Edition)

6. Zill, D. G., & Shanahan, P. D. (2013). *Complex analysis: A first course with applications*. Jones & Bartlett Publishers.

**Approved:**

Board of Studies, BSRS: 01/2019 Res. No. 02 Dated: 07-02-2019

Board of Faculty (FoST&H) 01/2019 Res. No. 04 Dated: 07-03-2019

Academic Council Res. No. 100.15 Dated: 24-08-2021

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

**DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES**

**Title of Subject: Analytical Dynamics Marks: 100**

**Discipline: Mathematics**

**Semester 6h semester**

**Code: MATH 375**

**Pre-requisites: Calculus-I**

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

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

**Objective:** To understand the idea of various coordinate systems and their use.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Extend basic concepts of dynamics to understand variable motion, forced oscillations and variable mass problems with applications | C3 | 4 |
| 2 | Discuss advanced topics of analytical dynamics and related theorems with examples and applications | C3 | 4 |

**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:**

**Kinematics:**

Moving axes Velocity and Acceleration Components in cylindrical and spherical polar coordinates.

**Particle Dynamics:**

Damped and forced vibrations. Resisted motion. Changing mass problems.

**Mechanics of a Rigid Body:**

Coordinate transformations and the rotation matrix. Euler’s theorem for rotation about a fixed point. Euler’s angles and angular velocity components in terms of Euler's angles and their derivatives. Moments and product of Inertia tensor and inertia ellipsoid. Motion of a rigid body about an axis parallel to a plane. Euler’s dynamical equations and their solution in special cases. Motion relatives to the rotating earth. Motion of a top. Conservation Laws. Constraints. Lagrange’s Generalized coordinates. Real and virtual displacements. Principle of virtual work and equilibrium problems. D’ Alembert’s principle. Holonomic and Non-holonomic systems. Lagrange's equations of motion. Ignorable coordinates and Routh's equations of motion. Hamilton’s canonical equations of motion. Hamilton’s Principle. Central forces. Small oscillations. Normal coordinates and normal modes. Principle of least action. Canonical transformations. Lagrange’s and Poisson Brackets. Hamilton-Jacobi theory and action-angle variables.

**RECOMMENDEDBOOKS:**

**1.** Goldstein, H: Classical Mechanics; Addison Wesley.

**2.** Synge and Griffth: Principles of Mechanics; McGraw Hill. **3.** Rosenberg, R. M: Analytical Dynamics of Discrete systems; Plenu.

**4.** Pars, L. A: Analytical Dynamics; Heixemann Press, London.

**5.** Saletan, E. J: Theoretical Mechanics; John Wiley and Cromer A. A.

**6.** Neimark, Ju, I. and Fuvev, M.A: Dynamics of non-holonomic systems.

**7.** Symon: Mechanics; Addison Wesley.

**8.**Marion, J. B: Classical Dynamics of Particle and systems; Academic Press

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Academic Council Res. No. 100.15 Dated: 24-08-2021**MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Real Analysis-II Marks: 100**

**Discipline: Mathematics**

**Semester 6th semester**

**Code: MATH 365**

**Pre-requisites: Real Analysis-I**

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

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

**Objective:** Introduce the advanced concepts of Real Analysis.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of the Riemann-Stieltjes Integrals and functions of bounded variation, existence theory, properties, and related examples | C2 | 2 |
| 2 | Extend the concept of integrals to improper integrals and convergence tests with examples | C2 | 2 |
| 3 | Extend the concept of convergence of sequences and series of functions to pointwise and uniform convergence | C2 | 4 |

**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:**

**The Riemann-Stieltjes Integrals:** Definition and existence of Integrals. Properties of integrals. Fundamental theorem of calculus and its applications. Change of variable theorem. Integration by parts.

**Functions of Bounded Variation:** Definition and examples. Properties of functions of bounded variation.

**Improper Integrals:** Types of improper integrals, tests for convergence of improper integrals. Beta and gamma functions. Absolute and conditional convergence of improper integrals.

**Sequences and Series of Functions:** Power series, definition of pointwise and uniform convergence. Uniform convergence and continuity. Uniform convergence and differentiation. Examples of uniform convergence.

**Recommended Books**

1. S. Lang, *Analysis I, II*, Addison-Wesley Publ. Co., Reading, Massachusetts. (Latest Edition)

2. W. Rudin, *Principles of Mathematical Analysis*, 3rd Ed., McGraw-Hill. (Latest Edition)

3. K. R. Davidson and A. P. Donsig, *Real Analysis with Real Applications*, Prentice Hall Inc., Upper Saddle River. (Latest Edition)

4. G. B. Folland, *Real Analysis*, 2nd Edition, John Wiley and Sons, New York. (Latest Edition)

5. E. Hewitt and K. Stromberg, *Real and Abstract Analysis*, Springer-Verlag, Berlin Heidelberg New York. (Latest Edition)

6. H. L. Royden, *Real Analysis*, 3rd Edition, Macmillan, New York. (Latest Edition)

7. G. Bartle, R. Sherbert, *Introduction to Real Analysis,* 3rdEdition, John Wiley, New York. (Latest Edition)

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