**MEHRANUNIVERSITY OF ENGINEERING & TECHNOLOGY**

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URGENT

ROUTINE

**DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES**

**Courses of 4th Year of BS (Mathematics) for Approval**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fourth Year** | | | | |
| **First Semester** | | | | |
| **S.#** | **Course Title** | **Course Code** | **C.H.** | **Marks** |
| 1 | Numerical Analysis-I | MATH 405 | 3+1 | 150 |
| 2 | Functional Analysis | MATH 410 | 3 | 100 |
| 3 | Fluid Mechanics | MATH 415 | 3 | 100 |
| 4 | Optimization Techniques | MATH 420 | 3 | 100 |
| 5 | Mathematical Physics | MATH 425 | 3 | 100 |
| **Total** | | | **16** |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fourth Year** | | | | |
| **Second Semester** | | | | |
| **S.#** | **Course Title** | **Course Code** | **C.H.** | **Marks** |
| 1 | Inferential Statistics | MATH 470 | 3 | 100 |
| 2 | Numerical Analysis-II | MATH 480 | 3+1 | 150 |
| 3 | Integral Equations | MATH 465 | 3 | 100 |
| 4 | Econometrics | MATH 455 | 3 | 100 |
| 5 | Operations Research | MATH 460 | 3 | 100 |
| 6 | Comprehensive Examination | MATH 499 | 3 | 100 |
| **Total** | | | **19** |  |

**MEHRANUNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject : Numerical Analysis-I Marks: 100+50**

**Discipline : Mathematics**

**Semester : 7th semester**

**Code : MATH 405**

**Pre-requisites : Calculus-I, Linear Algebra.**

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

**Credit Hours : 03 +01 Minimum Contact Hours:45+45**

**Objectives:** Introduce the concept of numerical computation.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Asses the root of non-linear equations f (x) = 0 with numerical computation, and iterative methods for the solution of simultaneous linear algebraic equations | C4 | 2 |
| 2 | Apply and evaluate methods of interpolation and extrapolation, numerical differentiation, and integration | C4 | 2 |
| 3 | Compute and analyze numerical solution of ordinary differential equations | C4 | 4 |
| 4 | Perform computations of the numerical schemes in software environment | P3 | 9 |

**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**

**Error analysis:** Introduction, floating points, errors, types of errors.

**Solution of non-linear equation:** Bisection method, Regula-Falsi method, Newton-Raphson method, Fixed-Point iterative method.

**Solution of System of Linear Algebraic equation:** Iterative methods: Jacobi’s method, Gauss-Seidel method.

**Eigen values and Eigen vectors: P**ower method.

**Interpolation and Extrapolation:** Differences: Forward, backward, central, operators and their relations. Newton’s forward interpolation formula. Newton’s backward interpolation formula, Newton’s divided difference formula, Lagrange’s interpolation formula. Stirling’s formula.

**Numerical differentiation:** Newton’s forward and backward differentiation formulae.

**Numerical quadrature:** Trapezoidal rule, Simpson’s one-third rule, Simpson’s three-eighth rule, Weddle’s rule, Gaussian quadrature.

**Numerical solution of ordinary differential equations:** Taylor series method, Euler’s, and its modified methods, Runge-Kutta methods, Predictor Corrector Methods; Milline’s method, Adam-Bash forth method.

**Books Recommended (Latest Edition)**

* Chapra, S. C., & Canale, R. P. (2011). *Numerical methods for engineers* (Vol. 1221). New York: Mcgraw-hill.
* Gerald, C. F. (2004). *Applied numerical analysis*. Pearson Education India.
* Kreyszig, E., Stroud, K., & Stephenson, G. (2008). Advanced engineering mathematics. *Integration*, *9*, 4.Dr.SaeedAkhterBhatti, A first course in numerical analysis.
* Van Iwaarden, J. L. (1985). *Ordinary differential equations with numerical techniques*. Harcourt.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

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

**Discipline: Mathematics**

**Semester 7th semester**

**Code: MATH 410**

**Pre-requisites: Analysis-I**

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

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

**Objective:** To develop idea of normal & inner product spaces

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Extend the concept of metric spaces to explain convergence, complete metric and separable spaces, and Baire category theorem | C2 | 1 |
| 2 | Explain normed linear spaces with examples, properties and applications to Banach spaces | C2 | 1 |
| 3 | Explain inner product spaces with examples, properties and applications to Hilbert spaces | 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:**

**Metric Space**: Review of metric spaces, Convergence in metric spaces, Complete metric spaces, Dense sets and separable spaces, No-where dense sets, Baire category theorem.

**Normed Spaces:** Normed linear spaces, Banach spaces, Equivalent norms, Linear operator, Finite dimensional normed spaces, Continuous and bounded linear operators, Dual spaces.

**Inner Product Spaces:** Definition and examples, Orthonormal sets and bases, Annihilators, projections, Linear functionals on Hilbert spaces. Reflexivity of Hilbert spaces.

**Recommended Books** (Latest Edition)**:**

1. A. V. Balakrishnan, *Applied Functional Analysis*, 2ndedition, Springer-Verlag, Berlin.

2. J. B. Conway, *A Course in Functional Analysis*, 2nd ed.,Springer-Verlag,Berlin.

3. K. Yosida, *Functional Analysis*, 5th ed., Springer-Verlag,Berlin.

4. E. Kreyszig, *Introduction to Functional Analysis with Applications*, John Wiley and Sons, 2004.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Fluid Mechanics Marks: 100**

**Discipline: Mathematics**

**Semester 7th semester**

**Code: MATH 415**

**Pre-requisites: Statics and Vector analysis**

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

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

**Objective:** To develop idea of Kinetics and Kinematics of fluids

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Understand and use basic concepts of Kinematics of fluids and solve related applied problems | C3 | 2 |
| 2 | Explain conservation laws and equations of momentum with proofs and examples | C3 | 1 |
| 3 | Understand different concepts and theorems on irrotational motion of fluids with applications | 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:**

**Kinematic:** Lagrangian and Eulerian methods of specification in continuous media, local convective and total rates of change; acceleration; conservation of mass. Incompressible fluids. Stream functions and streamlines. Boundary conditions. Vortex lines and tubes; Circulation; Vortex sheet; line vortices. Rate of change of circulation (Kelvin’s theorem). Irrotational or potential motion, the velocity potential. Two dimensional and axially symmetric motion; stokes stream function.

**Equation of Motions:** Conservation of linear momentum. Equation of Motion. Bernoulli’s theorem and its applications. Impulsive motion.

**Irrotational Motion:** General Theory. Kelvin’s minimum energy theorem. Complex potential and some potential flows; sources, sinks and doublets; Circle theorem. Method of images. Blasius theorem. Aerofoils and the theorem of Kutta and Joukowski. Moving cylinders. Vortex Motion, Karman’s Vortex Street.

**BOOKS RECOMMENDED:**

**1.** Besant, W.H. & A.S. Ramsey: A Treatise on Hydro-mechanics Part-II; paper Back C.U.P.

**2.** J. Williams: Fluid Mechanics; George Allen and Unwin ltd. London.

**3.** Milne-Thomson, L.M.: Theoretical Hydrodynamics; MacMillan

**4.** D. F. Lawden: A course of Applied Mathematics

**5.** D. E. Rutherford: Fluid Dynamics; Oliver and Boyd.

**6.** Aris, R. Vectors, Tensors and Basic Equations of Fluid Mechanics; Prentice Hall. 7. Merzkersh, W.: Flow Visualisation; Academic Press.

**8.** Massey, B. S.: Mechanics of Fluids; Van NostrandRenhild.

**9.** Allen, T &Ditsworth, R.L. Kogakusha: Fluid Mechanics; McGraw-Hill

**10.** Streeter, V.L. &Kogakusha, Wylie, E. B.: Fluid Mechanics; Mcgraw Hill.

**11.** Goldstein, S. & Burgers, J.M.: Lectures of Fluid mechanics; Providence, AMS R.I

**12.** Landan, L. D. Lifshitz, E.M.: Fluid Mechanics; Pergamon Press.

**13.** Curle,W& Davies, H.J.: Modern Fluid Dynamics, vol. I. Van Nostrand Reinhold.

**14.** Batchelor, G. K.: An introduction to Fluid Dynamics; C.U.P.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Optimization Techniques Marks: 100**

**Discipline: Mathematics**

**Semester 7th semester**

**Code: MATH 420**

**Pre-requisites: Calculus-I, Linear Algebra.**

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

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

**Objective:** To give idea of optimization problems and their solution methods.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Understand basics of optimization problems and techniques, derive existence conditions, and solve application problems | C3 | 2 |
| 2 | Understand and apply line, direct and univariate search methods for unconstrained optimization | C3 | 1 |
| 3 | Understand optimization of functionals, solve variational problems, and use Rayleigh-Ritz method with 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:**

**Introduction:** Definition of Optimization problems and techniques. Mathematical Models. Local and global Extrema (Optima) of a function of one and more than one variable and inflexion points. Types of optimization techniques. Derivation of Necessary and Sufficient conditions for an extremum of a function of one and more than one variable. Lagrange’s Multipliers techniques.

**Unconstrained Optimization for Functions:** Decent methods (line search methods):

Gradient of a function. Quadratic forms of a function. Hessian matrix. Positive and negative definite matrices indefinite matrices. Steepest-Descent method. Newton’s Method. Convergence criteria. Variable metric method. Avidon-Fletcher –Powell Method.

**Direct Search Methods:** Unimodal function. Simplex Method of Nelder - Mead Method. Hook-Jeaves method. Fibonacci Method. Quadratic Interpolation Powell’s method. Univariate search and Powell’s method.

**Optimization of Functionals:** Functionals. Extrema of a functional. Variational Problems. Variational Problems in n-dimensions. The Euler-Lagrange’s equation. Rayleigh-Ritz Method.

**BOOKS RECOMMENDED** (Latest Edition)**:**

**1.** S.S.Rao: Optimization theory and applications; Wiley Eastern limited New Delhi.

**2.** M.A.Wolf: Numerical Methods for Unconstrained Optimization an introduction; Van Nostrand Reinhold Company.

**3.** G.R.Walsh: Methods of optimization; John Wiley & Sons.

**4.** Delia, Koo: Elements of optimization with Applications in Economics & Business; Springer-Verlag New York Inc.

**5.** Sagan, H.: Boundary and Eigenvalue problems in Mathematical Physics.

**6.** Butkov, E.: Mathematical Physics; Addison Wesley.

**7.** L. Elsgolt: Differential Equations and the Calculus of Variations; Mir Publishers Moscow.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Mathematical Physics Marks: 100**

**Discipline: Mathematics**

**Semester 7th semester**

**Code: MATH 425**

**Pre-requisites: Transform**

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

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

**Objective:** To develop idea of solution of physical models.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Apply Fourier methods for analysis of generalized and Green’s functions, and solve partial differential equations with applications | C3 | 2 |
| 2 | Use perturbation methods for algebraic and differential equations, and apply variational methods for Euler-Lagrange equations | 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:**

**Fourier Methods:** The Fourier transforms. Fourier analysis of the generalized functions. The Laplace transforms. Hankel transforms for the solution of PDEs and their application to boundary value problems.

**Green’s Functions and Transform Methods:** Expansion for Green’s functions. Transform methods. Closed form Green’s functions.

**Perturbation Techniques:** Perturbation methods for algebraic equations. Perturbation methods for differential equations.

**Variational Methods:** Euler-Lagrange equations. Integrand involving one, two, three and *n* variables. Special cases of Euler-Lagrange’s equations. Necessary conditions for existence of an extremum of a functional. Constrained maxima and minima.

**Recommended Books** (Latest Edition)**:**

1. D. L. Powers, *Boundary Value Problems and PartialDifferential Equations*, 5th edition, Academic Press.

2. W. E. Boyce, *Elementary Differential Equations*, 8thedition,John Wiley and Sons.

3. M. L. Krasnov, G. I. Makarenko and A. I. Kiselev, *Problemsand Exercises in the Calculus of Variations*, Imported Publications,Inc.

4. J. W. Brown and R. V. Churchil, Fourier Series and Boundary Value Problems, McGraw Hill.

5. A. D. Snider, *Partial Differential Equations: Sources and Solutions*, Prentice Hall Inc.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Inferential Statistics Marks: 100**

**Discipline: Mathematics**

**Semester 8th semester**

**Code: MATH 470**

**Pre-requisites: Statistics and Probability**

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

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

**Objective:**  To develop idea about Probability Distribution, Hypothesis and Estimation

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Understand sampling distribution of means with replacement, without replacement for finite and infinite population with applications | C3 | 2 |
| 2 | Classify and use special probability distributions for parameter estimation with applications | C3 | 2 |
| 3 | Classify and use special probability distributions for hypothesis testing and associations with 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:**

**Sampling distribution:** Sampling distribution of means with replacement and without replacement; central limit theorem.

**Estimation of parameters:** Confidence interval of one population mean, estimation a population mean; estimating the difference between two population means. The Chi-square distribution; estimating a population standard deviation. The f-distribution; estimating the ratio of two variances.

**Testing of Hypothesis:** Testing a statistical hypothesis, Type I & II errors, one and two

tailed tests, test concerning means and variances, testing the difference between two means, Good-ness of fit test; test of independence.

**Books Recommended:**

* M. Anwar Solangi; Statistical Methods and Estimations
* Spiegel, M. R., & Stephens, L. J. (2017). *Schaum's outline of statistics*. McGraw Hill Professional.
* Ronald Walpole, Introductory Statistics
* Sher Muhammad Choudhry, Introduction to Statistics vol. I & II
* Iqbal Bhatti, Elements of Statistics
* Douglas C. Montgomery, Applied Statistics and Probability for Engineering.
* Statistical Methods and Probability;(Latest Edition) M.U Shaikh

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

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

**Discipline: Mathematics**

**Semester 8th semester**

**Code: MATH 480**

**Pre-requisites: Partial differential equations; Numerical Analysis-I**

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

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

**Objective:** To develop idea of formation, solution and physical applications of partial differential equations

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Understand numerical solution of partial differential equations and use finite difference method with applications | C3 | 2 |
| 2 | Solve applied boundary-value problems for Laplace, Poisson, Heat, Wave and Burger equations | C3 | 4 |
| 3 | Perform computations of the numerical schemes in software environment | P4 | 5 |

**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 partial differential equations and numerical methods for solving PDEs. Forward, Backward, and Central finite difference approximations. Iterative techniques for solving linear system of equations. Finite difference solution of Elliptic, Parabolic, and Hyperbolic partial differential equations employing Euler, Modified Euler, two-step predicator-corrector and Runge-Kutta (third and fourth order) algorithms. Explicit, Implicit and Crank-Nicolson finite difference methods.

Applications of partial differential equations with boundary value problems such as Heat (Diffusion) equation. Laplace equation. Poisson equation, Wave equation. Linear and non-linear Burger equations.

**Recommended Books:**

1. Burden, R.L. and Faires , J.D., Numerical Analysis, PWS Publishing Company Boston.(Latest Edition)
2. Kreyszig, E., Advanced Engineering Mathematics, Sixth Edition. John Wiley &Sons.(Latest Edition)
3. G.D.Smith: Numerical Solution of P.D.E. (Finite Difference Merthod), Oxford University Press.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Integral Equations Marks: 100**

**Discipline: Mathematics**

**Semester 8th semester**

**Code: MATH 465**

**Pre-requisites: Ordinary Differential Equations**

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

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

**Objective:** To give idea about solving physical problems by using integral equations.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Explain basic concepts of integral equations and relationship with differential equations | C2 | 1 |
| 2 | Solve Fredholm and Volterra integral equations under various conditions with applications | C3 | 2 |
| 3 | Solve Abel’s integral equations and understand Hilbert-Schmidt theory and regularization techniques | C3 | 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:**

Linear integral equations of the first kind, linear integral equations of the second kind. Relationship between differential equation and Volterra integral equation. Neumann series. Fredholm Integral equation of the second kind with separable Kernels. Eigen values and Eigen vectors. Iterated functions. Quadrature methods. Least square methods. Homogeneous integral equations of the second kind. Fredholm integral equations of the first kind. Fredholm integral equations of the second kind. Abel’s integral equations. Hilbert Schmidt theory of integral equations with symmetric Kernels. Regularization and filtering techniques.

**Recommended Books:**

1. C. T. H. Baker, *Integral Equations*, Clarendon Press.(Latest Edition)

2. F. Smithies, *Integral Equations*, Cambridge University Press.(Latest Edition)

3. A. M. Wazwaz, *A first Course in Integral Equations*, WorldScientificPub.(Latest Edition)

4. W. V. Lovitt, *Linear Integral Equations*, Dover Publications.(Latest Edition)

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Econometrics Marks: 100**

**Discipline: Mathematics**

**Semester 8th semester**

**Code: MATH 455**

**Pre-requisites: Calculus-I, Linear Algebra, Probability**

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

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

**Objective:** Introduce concepts of Regression Analysis and Simultaneous equation models.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Understand basic concepts of econometric modelling, and apply multiple regression and correlation for simple and general linear model with applications | C3 | 2 |
| 2 | Classify different problems in regression analysis and their causes, and solve simultaneous equations models with 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 to Econometric and Econometric model:**

Nature and scope of Econometrics. Multiple Regression. Correlation. Estimators and their properties. Simple linear Model. General Linear Model. Ordinary and General least squares Estimators.

**Problem in Regression Analysis:**

Serial correlation. Applications. Heteroskedasticity. Multicollinearity Errors in variables.

**Simultaneous equation models:**

Simultaneous Equations models. Identification (Rank and order conditions). Two-stage and three-stage least squares.

**BOOKS RECOMMENDED:**

**1**. Henri Thail: Principles of Econometrics; Wiley.

**2.** Malin Vaud: Statistical Methods of Econometrics

**3.** Wonnacott, R and Wonnacott, T.: Econometric; Wiley.

**4.** Johnston: Econometric Methods; McGraw Hill New York.

**5.** Graybill: An Introduction to Linear Statistical Models McGraw Hill New York.

**6.** Gold berger: Econometric Theory; John Wiely New York.

**7.** Dominick Salvatore: Statistics & Econometrics; Schaum’s outline series in Economics, McGraw Hill

Book Co.

**8.** P.J. Dhrymes: Econometrics, Statistical Foundation and Applications.

**9.** Klein, L. R., A Text Book of Econometric, Illinois.

**10.** Madansky A.: Foundation of Econometrics.

**11.** Surrey, M. J. C.: An Introduction of Econometrics.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Operations Research Marks: 100**

**Discipline: Mathematics**

**Semester 8th semester**

**Code: MATH 460**

**Pre-requisites: Linear Algebra**

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

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

**Objective:** To introduce concept of Dual Simplex and L.P Problems.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Apply Simplex method and variants for solution of linear programming problems with applications | C3 | 2 |
| 2 | Solve integer programming problems by different methods with applications | C3 | 2 |
| 3 | Use dynamic programming and network analysis methods for shortest route, project scheduling, control, and time chart simulation | 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**

Dual Simplex method and revised simplex methods for the solution of L.P problems. Integer programming, dynamic programming network (shortest route) project scheduling (PERT-CPM) methods. Project control, Time chart Simulation.

**BOOKS RECOMMENDED:**

**1.** H.A. Taha: operation Research: An introduction; Macmillan publisher.

**2.** Saaty: Mathematical methods of operation Research; McGraw Hill Book company, New York.

**3.** Churchman, Cheff: Introduction to operation Research; &Arnoff John Wiley and Sons

**4.** G. Hadley: Linear Programming; Addison Wesley Publishing Company.

**5.** Dont. Phillips, A. Ravindran& James Solberg: Operations Research Principles and practice; Wiley & Sons.

**6.** Hillier & Lieberman: Introduction to Operation Research; Holden-Day, Inc.

**7.** Richard Schaum’s Outline Theory and Problems of Operations Research; McGrawHill Schaum’s Outline Series.

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

**DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES**

**Title of Subject: Comprehensive Examination Marks: 100**

**Discipline: Mathematics**

**Semester: 8th semester**

**Code: MATH 499**

**Pre-requisites: All Courses**

**Assessment: 40% Project work, 30% Comprehensive Test, and 30% Comprehensive Viva-voce**

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

**Objective:** To introduce concept of Dual Simplex and L.P Problems.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CLO | Description | Maximum Taxonomy  Level | PLOs |
| 1 | Carry out a mini project and presentation on an approved topic under supervision of the concerned supervisor. | P3 | 6, 7 9,11, 12 |
| 2 | Analyze the knowledge gained throughout the BS program in form of objective type test | C4 | 1 |
| 3 | Evaluate the knowledge gained throughout the BS program in form of viva-voce | C5 | 1, 6 |

**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**

**Project and Presentation**

To carry out a mini project and presentation on an approved topic under supervision of the concerned supervisor/co-supervisor.

**Comprehensive Test**

MCQs/True-False/Blanks from all courses of BS (Mathematics).

**Comprehensive Viva-voce**

Viva-voce from all courses of BS (Mathematics).