

Biostatistics and Biomodeling

Course code: BT41

Prerequisite: Calculus & Probability

Course Coordinators: Dr. Monica Anand & Dr. Ramprasad S

Course Credits: 3:1:0

Contact Hours: 42+14

➤ Course Objectives:

The students will

1. Learn the concepts of random variable and probability distributions.
2. Learn the concepts of joint probability, stochastic process and genetic applications of probability.
3. Acquire the knowledge of sampling distributions and test of significance of samples.
4. Discuss the concepts of analysis of variance and optimization models relating to Biology and Medicine.
5. Learn to model problems relating to biology using mathematical concepts.

Unit I

Random variables and Probability distributions: Random variables, Discrete and continuous random variables, Mean and variance, Binomial distribution, Poisson distribution, Geometric distribution, Exponential distribution, Uniform distribution, Normal distribution.

Unit II

Joint Probability Distributions: for discrete and continuous random variables, Conditional and marginal distributions

Stochastic Process: Classification, Unique fixed probability vector, Regular stochastic matrix, Transition probability matrix, Markov chain.

Genetic application of probability: Genetic Applications of Probability, Hardy - Weinberg law, multiple alleles and application to blood groups.

Unit III

Sampling and Statistical inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type 1 and type 2 errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's t-test: for single mean, for difference between two means, F-test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes

Unit IV

ANOVA and Optimization models: Analysis of variance (One way and Two-way classifications): Case studies of statistical designs of biological experiments (RCBD and RBD), Single and double – blind experiments, Limitations of experiments, Optimization models in Biology and Medicine – Medical diagnosis problem, Hospital diet problem.

Unit V

Biomodeling: Microbial growth in a chemostat, Growth equations of microbial populations, Models of commensalisms, Mutualism, Predation and Mutation, Population Models: Single Species logistic equation, simple prey-predator model, Multispecies population model: Lotka - Volterra's model for n interacting species, Basic models for inheritance, Selection and Mutation models, Genetic inbreeding models – Selfing, Sibmating.

Text Books:

1. Marcello Pagano and Kimberlee Gauvreau – Principles of Biostatistics – Thompson Learning – 2nd edition – 2007.
2. B.S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 44th edition – 2017.
3. J. N. Kapur – Mathematical Models in Biology and Medicine- East-West Press Private Ltd. – New Delhi – 2010.

Reference Books:

1. Murray R. Spiegel, John Schiller, R. Alu Srinivasan – Schaum's Outline of Probability and Statistics – The McGraw hill Company – 4th edition - 2016
2. Warren J. Ewens, Gregory R. Grant – Statistical Methods in Bioinformatics: An Introduction – Springer Publications – 2nd edition – 2006.
3. Wayne W. Daniel – Biostatistics: A Foundation for Analysis in the Health sciences – John Wiley & Sons – 10th edition – 2014.

➤ Course Outcomes:

At the end of the course, the student will be able to

1. Analyze the given random data and its probability distribution. (PO-1,2 & PSO-1)
2. Calculate the marginal and conditional distributions of bivariate random variables and apply the concept of Markov Chain in the prediction of future events and the probable characteristics possessed by the off springs of the n th generation. (PO-1,2 & PSO-1)
3. Choose an appropriate test of significance and make inference about the population from a sample. (PO-1,2 & PSO-1)
4. Use one way and two way ANOVA to compare sample means. (PO-1,2 & PSO-1)
5. Explain various genetic models and biological phenomena mathematically. (PO-1,2 & PSO-1)

Engineering Mathematics-IV

Course Code: CH41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42 L+14T = 56

Course Coordinators: Dr. G. Neeraja & Dr. Vijaya Kumar

➤ Course Objectives:

The students will

1. Learn the concepts of finite differences, interpolation and their applications.
2. Understand the concept of PDE and its applications to engineering and the concepts of random variables.
3. Learn the different probability distributions for discrete and continuous random variables and joint probability distribution.
4. Determine whether there is enough statistical evidence in favor of the hypothesis about the population parameter.
5. Learn the concept of experimental design and able to analyze the experimental yield.

Unit I

Finite Differences and Interpolation: Forward and Backward differences, Interpolation, Newton-Gregory Forward and Backward Interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule (no proof).

Unit II

Solution of PDE's using Finite difference method: Classification of second order PDE, Solution of one dimensional heat equation using implicit and explicit methods, one dimensional wave equation using explicit method & two dimensional Laplace and Poisson equations.

Random Variables: Random variables (Discrete and Continuous), Probability density function, Cumulative density function, Mean, Variance, Moment generating function.

Unit III

Probability Distributions: Binomial distribution, Poisson distribution, Uniform distribution, Exponential distribution, Gamma distribution, Normal distribution, Joint probability distribution (both discrete and continuous), Conditional probability, Conditional expectation.

Unit-IV

Sampling and Statistical Inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type-1 and Type-2 errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's t –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes.

Unit-V

Experimental design and ANOVA: Basics of experimental design, Completely randomized block design (CRBD), Randomized block design (RBD), Latin square design (LSD), Advantages/disadvantages of each design, Analysis of variance (ANOVA), assumptions, One way and two-way classification, Comparison of RBD with CRBD, Comparison of RBD with LSD.

Text Books:

1. B. S. Grewal - Higher Engineering Mathematics - Khanna Publishers - 44th edition-2017.
2. T. Veerarajan - Probability, Statistics and Random Processes – Tata McGraw Hill - 3rd edition-2009.
3. Douglas C. Montgomery – Design and Analysis of Experiments – Wiley publication – 10th edition- 2019.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley Publication – 10th edition-2015.
2. Kishor S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes:

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-2)
2. Solve PDE's numerically and compute various moments of random variables. (PO-1,2 & PSO-2)
3. Apply the concept of probability distributions to solve engineering problems. (PO-1,2 & PSO-2)
4. Use Sampling theory to make decision about the hypothesis. (PO-1,2 & PSO-2)
5. Decide the type of experimental design suitable for a given situation and analyze the output. (PO-1,2 & PSO-2,3)

Engineering Mathematics-IV

Course Code: CS41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42+14

Course Coordinators: Dr. N. L. Ramesh & Dr. Uma M

➤ **Course Objectives:**

The students will

1. Learn the concepts of finite differences, interpolation and their applications.
2. Learn the concepts of Random variables and probability distributions.
3. Learn the concepts of joint probability distributions and stochastic processes.
4. Learn the concepts of Markov chain and queuing theory.
5. Determine whether there is enough statistical evidence in favour of the hypothesis about the population parameter.

Unit I

Finite Differences and Interpolation: Forward, Backward differences, Interpolation, Newton-Gregory Forward and Backward Interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule.

Unit II

Random Variables: Random Variables (Discrete and Continuous), Probability density function, Cumulative distribution function, Mean, Variance, Moment generating function.

Probability Distributions: Binomial distribution, Poisson distribution, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution.

Unit III

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability, Conditional expectation, Simulation of random variable.

Stochastic Processes: Introduction, Classification of stochastic processes, Discrete time processes, Stationary, Ergodicity, Autocorrelation, Power spectral density.

Unit IV

Markov Chain: Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states, Markov and Poisson processes.

Queuing theory: Introduction, Symbolic representation of a queuing model, Single server Poisson queuing model with infinite capacity (M/M/1 : ∞ /FIFO), when $\lambda_n = \lambda$ and $\mu_n = \mu$ ($\lambda < \mu$), Performance measures of the model, Single server Poisson queuing model with finite capacity

(M/M/S : N/FIFO), Performance measures of the model, Derivations of difference equations and expressions for L_s, L_q, W_s, W_q of M/M/1 queuing model with finite and infinite capacity, Multiple server Poisson queuing model with infinite capacity (M/M/S : ∞ /FIFO), when $\lambda_n = \lambda$ for all n , ($\lambda < S\mu$), Multiple server Poisson queuing model with finite capacity (M/M/S : N/FIFO), Introduction to M/G/1 queuing model.

Unit-V

Sampling and Statistical Inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type-1 and Type-2 errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's t –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes.

Text Books:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B.S. Grewal - Higher Engineering Mathematics - Khanna Publishers – 44th edition-2017.
3. T. Veerarajan- Probability, Statistics and Random processes – Tata McGraw-Hill Education – 3rd edition -2017.

Reference Books:

1. Erwin Kreyszig - Advanced Engineering Mathematics-Wiley-India publishers- 10th edition-2015.
2. Sheldon M. Ross – Probability models for Computer Science – Academic Press, Elsevier– 2009.
3. Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum's outlines -4th edition-2012.
4. Kishore S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-2)
2. Analyze the given random data and their probability distributions. (PO-1,2 & PSO-2)
3. Calculate the marginal and conditional distributions of bivariate random variables and determine the parameters of stationary random processes. (PO-1,2 & PSO-2)
4. Use Markov chain in prediction of future events and in queuing models. (PO-1,2 & PSO-2)
5. Choose an appropriate test of significance and make inference about the population from a sample. (PO-1,2 & PSO-2)

Engineering Mathematics-IV

Course Code: CV41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42L +14T=56

Course Coordinators: Dr. G. Neeraja & Dr. A Sreevallabha Reddy

➤ **Course Objectives:**

The students will

1. Learn the concepts of finite differences, interpolation and their applications.
2. Learn to solve one dimensional heat, wave and two dimensional Laplace equations by numerical methods.
3. Learn the concepts of Random variables and Probability distributions.
4. Apply suitable probability distribution to analyze simple data sets.
5. Acquire the knowledge of sampling distributions and test of significance of samples.

Unit I

Finite differences and interpolation: Forward and backward differences, Interpolation, Newton –Gregory forward and backward interpolation formulae, Lagrange’s interpolation formula, Newton’s divided difference interpolation formula (no proof).

Numerical differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson’s 1/3rd rule, Simpson’s 3/8th rule.

Unit II

Solution of PDE’s using Finite difference method: Classification of second order PDE, Solution of one dimensional heat equation using implicit and explicit methods, one dimensional wave equation using explicit method & two dimensional Laplace and Poisson equations.

Unit-III

Random Variables: Random Variables (Discrete and Continuous), Probability mass and density function, Cumulative density function, Mean, Variance, Moment generating function.

Probability Distributions: Binomial distribution, Poisson distribution

Unit-IV

Probability Distributions: Normal distribution, Exponential distribution, Uniform distribution, Gamma distribution, Joint probability distributions (discrete and continuous).

Unit-V

Sampling and Statistical Inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type-1 and Type-2 errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's t –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes.

Text Books:

1. Erwin Kreyszig - Advanced Engineering Mathematics-Wiley-India publishers-10th edition 2015.
2. B.S. Grewal - Higher Engineering Mathematics - Khanna Publishers – 44th edition-2017.

Reference Books:

1. B. S. Grewal – Numerical methods in engineering and science- Khanna Publishers-8th edition-2015
2. Murray R. Spiegel, John Schiller & R. Alu Srinivasan - Probability & Statistics - Schaum's outlines-3rd edition - 2007.

➤ Course Outcomes:

At the end of the Course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1)
2. Solve Partial differential equations numerically. (PO-1,2 & PSO-1)
3. Analyze the given random data and their probability distributions. (PO-1,2 & PSO-1)
4. Apply the concept of probability distributions to solve engineering problems. (PO-1,2 & PSO-1)
5. Use sampling theory to make decisions about the hypothesis. (PO-1,2 & PSO-1)

Engineering Mathematics-IV

Course Code: EC41

Course Credits:3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42+14

Course Coordinator: Dr. M.V. Govindaraju & Dr. Aruna A S

➤ **Course Objectives:**

The students will:

1. Learn the concepts of finite differences, interpolation and their applications.
2. Evaluate Fourier transforms and use Z-transform to solve difference equations.
3. Learn the concepts of random variables and probability distributions.
4. Learn the concepts of joint probability distributions, stochastic process and Markov chain.
5. Learn the concepts of series solution of differential equations.

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems. Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra-example and physical interpretation. Limitation of Fourier transforms and the need of Wavelet transforms.

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems, Application of Z-transforms to solve difference equations. Applications to Engineering problems.

Unit III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.

Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

Unit IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.

Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

Unit V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula.

Text Books:

1. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.
3. Wavelets: A Primer- AK Peters/CRC Press, 1st Edition-2002.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015
2. Glyn James- Advanced Modern Engineering Mathematics-PearsonEducation-4th edition-2010
3. Kishor S. Trivedi –Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes:

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1,3)
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. (PO-1,2 & PSO-1,3)
3. Analyze the given random data and its probability distributions. (PO-1,2 & PSO-1,3)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1,2 & PSO-1,3)
5. Obtain the series solution of ordinary differential equations. (PO-1,2 & PSO-1,3)

Engineering Mathematics-IV

Course Code: EE41

Course Credits:3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42+14

Course Coordinator: Dr. M.V. Govindaraju & Dr. Aruna A S

➤ **Course Objectives:**

The students will:

1. Learn the concepts of finite differences, interpolation and their applications.
2. Evaluate Fourier transforms and use Z-transform to solve difference equations.
3. Learn the concepts of random variables and probability distributions.
4. Learn the concepts of joint probability distributions, stochastic process and Markov chain.
5. Learn the concepts of series solution of differential equations.

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems. Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra-example and physical interpretation. Limitation of Fourier transforms and the need of Wavelet transforms.

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems, Application of Z-transforms to solve difference equations. Applications to Engineering problems.

Unit III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.

Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

Unit IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.

Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

Unit V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula.

Text Books:

1. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.
3. Wavelets: A Primer- AK Peters/CRC Press, 1st Edition-2002.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015
2. Glyn James- Advanced Modern Engineering Mathematics-PearsonEducation-4th edition-2010
3. Kishor S. Trivedi –Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes:

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1,2)
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. (PO-1,2 & PSO-1,2)
3. Analyze the given random data and its probability distributions. (PO-1,2 & PSO-1,2)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1,2 & PSO-1,2)
5. Obtain the series solution of ordinary differential equations. (PO-1,2 & PSO-1,2)

Engineering Mathematics-IV

Course Code: EI41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42+14

Course Coordinator: Dr. M.V. Govindaraju & Dr. Aruna A S

➤ **Course Objectives:**

The students will:

1. Learn the concepts of finite differences, interpolation and their applications.
2. Evaluate Fourier transforms and use Z-transform to solve difference equations.
3. Learn the concepts of random variables and probability distributions.
4. Learn the concepts of joint probability distributions, stochastic process and Markov chain.
5. Learn the concepts of series solution of differential equations.

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems. Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra-example and physical interpretation. Limitation of Fourier transforms and the need of Wavelet transforms.

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems, Application of Z-transforms to solve difference equations. Applications to Engineering problems.

Unit III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.

Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

Unit IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.

Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

Unit V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula.

Text Books:

1. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.
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3. Kishor S. Trivedi –Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes:

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1,3)
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. (PO-1,2 & PSO-1,3)
3. Analyze the given random data and its probability distributions. (PO-1,2 & PSO-1,3)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1,2 & PSO-1,3)
5. Obtain the series solution of ordinary differential equations. (PO-1,2 & PSO-1,3)

Engineering Mathematics-IV

Course Code: ET41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42+14

Course Coordinator: Dr. M.V. Govindaraju & Dr. Aruna A S

➤ **Course Objectives:**

The students will:

1. Learn the concepts of finite differences, interpolation and their applications.
2. Evaluate Fourier transforms and use Z-transform to solve difference equations.
3. Learn the concepts of random variables and probability distributions.
4. Learn the concepts of joint probability distributions, stochastic process and Markov chain.
5. Learn the concepts of series solution of differential equations.

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems. Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra-example and physical interpretation. Limitation of Fourier transforms and the need of Wavelet transforms.

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems, Application of Z-transforms to solve difference equations. Applications to Engineering problems.

Unit III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.

Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

Unit IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.

Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

Unit V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula.

Text Books:

1. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.
3. Wavelets: A Primer- AK Peters/CRC Press, 1st Edition-2002.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015
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3. Kishor S. Trivedi – Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes:

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1)
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. (PO-1,2 & PSO-1)
3. Analyze the given random data and its probability distributions. (PO-1,2 & PSO-1)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1,2 & PSO-1)
5. Obtain the series solution of ordinary differential equations. (PO-1,2 & PSO-1)

Engineering Mathematics – IV

Course Code: IM41

Course Credits: 3:1:0

Prerequisite: Calculus

Contact Hours: 42 L+14T = 56

Course Coordinators: Dr. Dinesh P A

➤ **Course Objectives:**

The students will

1. Learn the concepts of finite difference, interpolation and their applications.
2. Learn the concepts of Fourier and Z – transforms.
3. Understand the concepts of PDE and their applications to engineering.
4. Understand the concepts of Graph theory, matrix representation of graphs and their applications to Engineering with algorithms.

Unit I

Finite Difference and Interpolation: Forward, Backward differences, Interpolation, Newton's – Gregory Forward and Backward Interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton's – Gregory forward and backward interpolation formulae, Newton – Cote's quadrature formula, Trapezoidal rule, Simpson's $1/3^{\text{rd}}$ rule, Simpson's $3/8^{\text{th}}$ rule.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transforms, Convolution theorem, Parseval's identities (statements only), Limitations of Fourier transform and needs of Wavelet transform.

Z-Transforms: Definition, Standard Z – transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial value and Final value theorems, Inverse Z – transforms, Application of Z – transforms to solve difference equations.

Unit III

Partial Differential Equations and its Solutions using Finite Difference Method: Classification of second order PDE, Derivation of one – dimensional heat and wave equations, Solution of one dimensional heat equation using implicit and explicit methods, one dimensional wave equation using explicit method & two dimensional Laplace and Poisson equations.

Unit IV

Graph Theory - I: Introduction - Finite and Infinite graphs, Incidence and Degree, Isolated vertex, Pendant vertex and Null graph, Operations on graphs, Walk, Paths and Circuits. Connected graphs, Disconnected graphs and Components. Euler and Hamiltonian graphs, Trees – Properties of trees, Pendant vertices in a tree, Distance and centers in a tree, Rooted and binary trees, Spanning trees, Kruskal's and Prims algorithm to find the minimal spanning tree.

Unit V

Graph Theory - II: Matrix representation of graphs: Adjacency matrix, Incidence matrix, Rank of the incidence matrix, Path matrix, Circuit matrix, Fundamental circuit matrix, Rank of the circuit matrix, Cut-set matrix, Fundamental cut-set matrix, Relationships among fundamental incidence, circuit and cut-set matrices.

Text Books:

1. Erwin Kreyszig – Advanced Engineering Mathematics – Wiley publication – 10th edition – 2015.
2. B. S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 44th edition – 2017.
3. Narsingh Deo – Graph Theory with Applications to Engineering and Computer Science – Prentice Hall of India – 2014.

References:

1. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4th edition – 2010.
2. Dennis G. Zill and Michael R. Cullen – Advanced Engineering Mathematics, Jones and Barlett Publishers Inc. – 3rd edition – 2009.
3. Reinhard Diestel – Graph Theory – Springer - 4th edition – 2010.

➤ Course Outcomes

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data.
2. Evaluate Fourier transforms and use Z – transforms to solve difference equations.
3. Solve partial differential equations numerically.
4. Identify different types of graphs and determine minimal spanning tree of a given graph using algorithms.
5. Analyze characteristics of a graph through its matrix representations.

Engineering Mathematics-IV

Course Code: IS41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42+14

Course Coordinators: Dr. M. Girinath Reddy & Dr. Nancy Samuel

➤ **Course Objectives:**

The students will

1. Learn the concepts of finite differences, interpolation and their applications.
2. Learn the concepts of Random variables and probability distributions.
3. Learn the concepts of joint probability distributions and stochastic processes.
4. Learn the concepts of Markov chain and queuing theory.
5. Determine whether there is enough statistical evidence in favour of the hypothesis about the population parameter.

Unit I

Finite Differences and Interpolation: Forward, Backward differences, Interpolation, Newton-Gregory Forward and Backward Interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule.

Unit II

Random Variables: Random Variables (Discrete and Continuous), Probability density function, Cumulative distribution function, Mean, Variance, Moment generating function.

Probability Distributions: Binomial distribution, Poisson distribution, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution.

Unit III

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability, Conditional expectation, Simulation of random variable.

Stochastic Processes: Introduction, Classification of stochastic processes, Discrete time processes, Stationary, Ergodicity, Autocorrelation, Power spectral density.

Unit IV

Markov Chain: Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states, Markov and Poisson processes.

Queuing theory: Introduction, Symbolic representation of a queuing model, Single server Poisson queuing model with infinite capacity (M/M/1 : ∞ /FIFO), when $\lambda_n = \lambda$ and $\mu_n = \mu$ ($\lambda < \mu$), Performance measures of the model, Single server Poisson queuing model with finite capacity

(M/M/S : N/FIFO), Performance measures of the model, Derivations of difference equations and expressions for L_s, L_q, W_s, W_q of M/M/1 queuing model with finite and infinite capacity, Multiple server Poisson queuing model with infinite capacity (M/M/S : ∞ /FIFO), when $\lambda_n = \lambda$ for all n , ($\lambda < S\mu$), Multiple server Poisson queuing model with finite capacity (M/M/S : N/FIFO), Introduction to M/G/1 queuing model.

Unit-V

Sampling and Statistical Inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type-1 and Type-2 errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's t –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes.

Text Books:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B.S. Grewal - Higher Engineering Mathematics - Khanna Publishers – 44th edition-2017.
3. T. Veerarajan- Probability, Statistics and Random processes – Tata McGraw-Hill Education – 3rd edition -2017.

Reference Books:

1. Erwin Kreyszig - Advanced Engineering Mathematics-Wiley-India publishers- 10th edition-2015.
2. Sheldon M. Ross – Probability models for Computer Science – Academic Press, Elsevier– 2009.
3. Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum's outlines -4th edition-2012.
4. Kishore S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-2)
2. Analyze the given random data and their probability distributions. (PO-1,2 & PSO-2)
3. Calculate the marginal and conditional distributions of bivariate random variables and determine the parameters of stationary random processes. (PO-1,2 & PSO-2)
4. Use Markov chain in prediction of future events and in queuing models. (PO-1,2 & PSO-2)
5. Choose an appropriate test of significance and make inference about the population from a sample. (PO-1,2 & PSO-2)

Engineering Mathematics-IV

Course Code: ME41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42 L + 14T

Course Coordinators: Dr. Basavaraj M S & Mr. B Azghar Pasha

➤ Course Objectives:

The students will

1. Learn the concepts of finite differences, interpolation and their applications.
2. Learn the concepts of Fourier transforms & applications
3. Learn Z-transforms & numerical solution of PDE
4. Learn probability distributions for discrete and continuous random variables and joint probability distribution.
5. Determine whether there is enough statistical evidence in favor of the hypothesis about the population parameter

Unit I

Finite Differences and Interpolation: Forward and Backward differences, Interpolation, Newton-Gregory Forward and Backward Interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule (no proof).

Unit II

Fourier Transforms & Its Applications: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, properties, Inverse transforms, Convolution theorem, Parseval's identities (statements only). Fourier transform of ordinary and partial derivatives. Solution of Boundary value problems using Fourier transform method. Limitations of Fourier transforms and the need of Wavelet transform.

Unit III

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial value and final value theorems, Inverse Z-transforms, Application of Z-transforms to solve difference equations.

Solution of PDE's using Finite difference method: Classification of second order PDE, Solution of one dimensional heat equation using implicit and explicit methods, one dimensional wave equation using explicit method & two dimensional Laplace and Poisson equations.

Unit IV

Probability Distributions: Review of random variables. Binomial distribution, Poisson distribution, Uniform distribution, Exponential distribution, Gamma distribution, Normal distribution, Joint probability distribution (both discrete and continuous), Conditional probability, Conditional expectation.

Unit V

Sampling and Statistical Inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type-1 and Type-2 errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's t –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes.

Text Books:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal - Higher Engineering Mathematics - Khanna Publishers - 44th edition-2017.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley Publication – 10th edition-2015.
2. Kishor S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2016.
3. K Sankara Rao – Introduction to Partial Differential Equations – PHI Learning Pvt. Ltd. – 3rd edition - 2011

➤ Course Outcomes:

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1,2)
2. Evaluate Fourier transforms and use it to solve BVP's. (PO-1,2 & PSO-1,2)
3. Solve PDE's numerically and use Z-transform to solve difference equations. (PO-1,2 & PSO-1,2)
4. Apply the concept of probability distributions to solve engineering problems. (PO-1,2 & PSO-1,2)
5. Use Sampling theory to make decision about the hypothesis. (PO-1,2 & PSO-1,2)

Engineering Mathematics-IV

Course Code: ML41

Course Credits: 3:1:0

Prerequisite: Calculus & Probability

Contact Hours: 42+14

Course Coordinator: Dr. M.V. Govindaraju & Dr. Aruna A S

➤ **Course Objectives:**

The students will:

1. Learn the concepts of finite differences, interpolation and their applications.
2. Evaluate Fourier transforms and use Z-transform to solve difference equations.
3. Learn the concepts of random variables and probability distributions.
4. Learn the concepts of joint probability distributions, stochastic process and Markov chain.
5. Learn the concepts of series solution of differential equations.

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems. Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra-example and physical interpretation. Limitation of Fourier transforms and the need of Wavelet transforms.

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems, Application of Z-transforms to solve difference equations. Applications to Engineering problems.

Unit III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.

Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

Unit IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.

Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

Unit V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula.

Text Books:

1. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.
3. Wavelets: A Primer- AK Peters/CRC Press, 1st Edition-2002.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015
2. Glyn James- Advanced Modern Engineering Mathematics-PearsonEducation-4th edition-2010
3. Kishor S. Trivedi –Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

➤ Course Outcomes:

At the end of the course, students will be able to

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1)
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. (PO-1,2 & PSO-1)
3. Analyze the given random data and its probability distributions. (PO-1,2 & PSO-1)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1,2 & PSO-1)
5. Obtain the series solution of ordinary differential equations. (PO-1,2 & PSO-1)