MATHEMATICS

(Dept. of S&H)

Table MA-1

M.Sc (Mathematics) - 2017 Batch (90 credits)
Course Components
Table -1

Programme Core – 56 credits & a Part semester project			
Sl.No.	**Sub. Code**	**Name of the Subject**	**Credits**
1	17MA3019	Algebra	3:1:0
2	17MA3020	Ordinary Differential Equations	3:1:0
3	17MA3021	Classical Mechanics	3:1:0
4	17MA3022	Real Analysis	3:1:0
5	17MA3023	Complex Analysis	3:1:0
6	17MA3024	Linear Algebra	3:1:0
7	17MA3025	Topology	3:1:0
8	17MA3026	Partial Differential Equations	3:1:0
9	17MA3027	Field Theory	3:1:0
10	17MA3028	Advanced Calculus	3:1:0
11	17MA3029	Numerical Analysis	3:1:0
12	17MA3030	Functional Analysis	3:1:0
13	17MA3031	Calculus of Variations and Integral Equations	3:1:0
14	17EN3032	Executive English Lab	0:0:2
15		Value Education	2:0:0
16	PSP3998	Part Semester Project	12:0:0
Total			68

Table-2

Soft Core – I (Applications of Mathematics) Min. of 11 credits to be earned			
S.No.	**Sub. Code**	**Name of the Subject**	**Credits**
1	17MA3001	Matrix Computations	3:0:0
2	17MA3002	Finite Element Methods	3:0:0
3	17MA3008	Computational Mathematics	3:0:0
4	17MA3010	Graph Theory and Algorithms	3:0:0
5	17MA3032	Tensor Algebra and Tensor Calculus	3:1:0
6	17MA3033	Control Theory	3:1:0
7	17MA3034	Differential Geometry	3:1:0
8	17MA3035	Mathematics For Competitive Examinations	3:0:0
Total			27

Soft Core – II (Applied Mathematics) Min. of 11 credits to be earned			
S.No.	**Sub. Code**	**Name of the Subject**	**Credits**
1	17MA3007	Applied Statistics	3:0:0
2	17MA3018	Optimization Techniques	3:0:0
3	17CE3066	Fundamentals of MATLAB programming	3:0:0

5	17MA3036	Probability and Distributions	3:1:0
6	17MA3037	Stochastic Processes	3:1:0
7	17MA3038	Formal Languages and Automata Theory	3:1:0
8	17MA3039	Fuzzy Set Theory and its Applications	3:1:0
Total			25

Credits Classification

Details	Credits
Programme Core	68
Soft core-I	11
Soft core-II	11
Total	90

Table MA-2

LIST OF COURSES

Course Code	Name of the Course	Credits
17MA1001	Basic Mathematics for Engineering	3:1:0
17MA1002	Calculus and Statistics	3:1:0
17MA1003	Basic Mathematics for Sciences	3:1:0
17MA1004	Calculus and Transforms	3:1:0
17MA1005	Basic Mathematics for Computer Science	3:1:0
17MA2001	Vector Calculus and Complex Analysis	3:1:0
17MA2002	Fourier Series and Applications	3:1:0
17MA2003	Mathematical Transforms	3:1:0
17MA2004	Laplace Transforms, Fourier Series and Transforms	3:1:0
17MA2005	Mathematical Foundation[#]	3:0:0
17MA2006	Numerical Mathematics and Computing	3:1:0
17MA2007	Probability and Random Process	3:1:0
17MA2008	Probability and Statistics	3:1:0
17MA2009	Statistical Data Analysis and Reliability Engineering	3:1:0
17MA2010	Discrete Mathematics	3:1:0
17MA2011	Probability and Queuing Theory	3:1:0
17MA2012	Numerical Methods	3:1:0
17MA2013	Applied Linear Algebra	3:1:0
17MA2014	Fuzzy Sets and Logic	3:1:0
17MA2015	Probability, Random Process and Numerical Methods	3:1:0
17MA2016	Sampling Techniques	3:1:0
17MA2017	Operations Research-I	3:1:0
17MA2018	Operations Research-II	3:1:0
17MA2019	Analytical Geometry, Fourier Series and Transforms	3:1:0
17MA2020	Probability, Random Variables and Statistics	3:1:0

17MA2021	Applied Mathematics	3:1:0
17MA2022	Quantitative Techniques	3:1:0
17MA2023	Operations Research – III	3:1:0
17MA2014	Business Mathematics	3:1:0
17MA3001	Matrix Computations	3:0:0
17MA3002	Finite Element Methods	3:0:0
17MA3003	Foundations of Mathematics and Statistics	3:0:0
17MA3004	Advanced Calculus and Numerical Methods	3:0:0
17MA3005	Calculus of Variations and Vector Spaces	3:0:0
17MA3006	Graph Theory and Random Process	3:0:0
17MA3007	Applied Statistics	3:0:0
17MA3008	Computational Mathematics	3:0:0
17MA3009	Applied Graph Theory and Queuing Theory	3:0:0
17MA3010	Graph Theory and Algorithms	3:0:0
17MA3011	Biostatistics and Quality Control	3:0:0
17MA3012	Numerical Methods and Biostatistics	3:0:0
17MA3013	Graph Theory and Probability	3:0:0
17MA3014	Fundamentals of Statistics	3:0:0
17MA3015	Operations Research Techniques	3:0:0
17MA3016	Statistics and Numerical Mathematics	3:0:0
17MA3017	Discrete Mathematics	3:0:0
17MA3018	Optimization Techniques	3:0:0
17MA3019	Algebra	3:1:0
17MA3020	Ordinary Differential Equations	3:1:0
17MA3021	Classical Mechanics	3:1:0
17MA3022	Real Analysis	3:1:0
17MA3023	Complex Analysis	3:1:0
17MA3024	Linear Algebra	3:1:0
17MA3025	Topology	3:1:0
17MA3026	Partial Differential Equations	3:1:0
17MA3027	Field Theory	3:1:0
17MA3028	Advanced Calculus	3:1:0
17MA3029	Numerical Analysis	3:1:0
17MA3030	Functional Analysis	3:1:0
17MA3031	Calculus of Variations and Integral Equations	3:1:0
17MA3032	Tensor Algebra and Tensor Calculus	3:1:0
17MA3033	Control Theory	3:1:0
17MA3034	Differential Geometry	3:1:0
17MA3035	Mathematics for Competitive Examinations	3:0:0
17MA3036	Probability and Distributions	3:1:0
17MA3037	Stochastic Processes	3:1:0
17MA3038	Formal Languages and Automata Theory	3:1:0
17MA3039	Fuzzy Set Theory and its Applications	3:1:0
17MA3040	Research Methodology	3:1:0
17MA3041	Mathematical Theory of Elasticity	3:1:0

17MA3042	Semigroups of Linear Operators and Applications	3:1:0
17MA3043	Computational Methods and Applications	3:0:0
17MA3044	Applied Operations Research	3:1:0

17MA1001 BASIC MATHEMATICS FOR ENGINEERING

Credits: 3:1:0

Course Objective:

- To provide the students with the basic knowledge and an understanding of algebra.
- To equip the students with the knowledge of calculus.
- To train the students thoroughly in Mathematical concepts of partial differential equations
- To understand expansions of standard functions through Taylor series of one and two variables.
- To teach the student about Cartesian and vector form of line and plane equation.
- To teach the students about the techniques of matrix algebra.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.
- Students are able to understand the techniques involved in differentiation.
- Developing the skills in solving problems in integral calculus.
- Students are able to expand the function using Taylor series.
- Students are able to compute dot, cross products, length of vectors and find the shortest distance between two lines.
- Students are able to know the applications of determinant and Eigen values and Eigen vectors.

Unit I: Algebra

Simple functions and equations- Trigonometric identities- Coordinate geometry-Partial fractions-Binomial expansions-

Unit II: Calculus

Differentiation from the first principle-Rules of differentiation-Implicit differentiation-Logarithmic differentiation-Methods of integration-Integration by parts.

Unit III: Taylors Series and Partial Differentiation

Taylor's series for functions of one variable-Standard Maclaurin's series-Partial derivatives-Taylor's series for functions of two variables.

Unit IV: Vectors

Scalars and vectors- Operations on vectors- Magnitude of a vector- Equations of lines and planes.

Unit V: Matrix Algebra

Introduction -Matrix operations- The trace and the determinant of a matrix- Properties of determinants(excluding the proof)- The inverse and the rank of a matrix- Special types of square matrices-Eigen values and Eigen vectors(problems only).

Reference Books

1. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. James Steward, "Calculus", 5th Edition, Thomson Brooks/Cole, Micro Print Pvt. Ltd, Chennai, 2003.
3. Riley K.F, Hobson M.P, and Bence S.J, "Mathematical Methods for Physics and Engineering, 2nd Edition, Cambridge Low – Price Editions, Cambridge University Press, 2004.
4. Hepzibah Christinal A, Selvamani R, and Porselvi K, "Basic Engineering Mathematics", HIS Publications, Coimbatore, 2011.
5. "Lecture Notes on Basic Mathematics for Engineering", Department of Mathematics, Karunya University, Karunya Nagar, Coimbatore, 2013.

17MA1002 CALCULUS AND STATISTICS
(Common to all branches in B.Tech)

Credits: 3:1:0

Course Objective:

- To provide the students with the concept and an understanding of Differential equations.
- Formulate and solve differential equation problems in the field of Industrial Organization Engineering.
- To teach the students about the art of multiple integrations.
- Introduce students to how to solve linear Partial Differential with different methods
- To enlighten the students about the use of statistical parameters
- To investigate the interrelationships between two variables through regression and correlation.

Course Outcome:

Students will be able to

- Relate their subject knowledge with their engineering subjects during their course of study.
- Analyze real world scenarios to recognize when ordinary differential equations or systems of ODEs are appropriate, formulate problems and in order to solve the problems using multiple approaches.
- Develop their skills in evaluating multiple integrals.
- Solve linear partial differential equations of first order.
- Know the applications of statistics to modeling and analysis.
- Analyze data sets commonly found in the biological and life sciences and describe a data set graphically and numerically with a meaningful numeric summary.

Unit I: Ordinary differential equations
Higher order linear differential equations with constant Coefficients-Methods of variation of parameters-Simultaneous first order linear equations withconstant coefficient.

Unit II: Multiple integrals
Double integrals – Area of bounded region - Triple integrals – Volume.

Unit III: Beta and gamma integrals
Definitions-Properties-Relation between beta and gamma integrals-Evaluation of definite integrals in terms of beta and gamma functions.

Unit IV: Partial differential equations
Formations -Solution of partial differential equations-Lagrange's linear equation-Non-linear equations of first order (excluding Charpit's method)-Homogenous linear equations with constant coefficients.

Unit V: Statistics
Introduction–Graphical representation of data-Measures of central tendency-Measures of dispersion- Correlation-Regression-Rank Correlation.

Reference Books

1. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2012.
2. Veerarajan T, " Engineering Mathematics", Tata McGraw Hill, New Delhi, 2011.
3. Kandasamy P, Thilagavathi K and Gunavathi K, "Engineering Mathematics", 9th Revised Edition, S Chand & Co, New Delhi, 2010.
4. DassH.K., "Advanced Engineering Mathematics", (18th Revised Edition), S. Chand & Co., New Delhi, 2008.
5. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.

17MA1003 BASIC MATHEMATICS FOR SCIENCES

Credits: 3:1:0

Course Objectives:

- Acquire understanding trigonometric and hyperbolic functions properties.
- Develop ability to solve complex numbers related problems.
- Develop skills in solving homogenous and nonhomogeous linear equations.
- Understand the concept of correlation and regression.
- Have the knowledge of binary operations and their properties.
- Acquire the techniques of collecting, representing and interpreting data

Course Outcomes

- Have the skill of solving algebraic and transcendental equations.
- Students will be able to obtain eigen values and vectors by using algorithms.
- Ability to apply correlation and regression analysis for decision-making.
- Students will be able to obtain various properties of groups.

- Analyze the importance of probability distributions.
- Understanding the application of Baye's theorem in engineering fields

Unit I: Trigonometry
Trigonometric ratios, identities, Hyperbolic and circular functions and their relations**,** Properties of hyperbolic functions, Inverse functions

Unit II: Complex Numbers
Rectangular, polar and exponential forms of complex numbers, De-Moivre's Theorem, Powers, roots and log of complex numbers.

Unit III: Linear Algebra
Eigen values and Eigen vectors, Characteristic equation, Cayley-Hamilton Theorem, System of homogeneous and non-homogeneous linearequations,Condition for consistency

Unit IV: Group Theory and Statistics
Binary Operations − Semi groups − Monoids, Groups (Simple examples, simple Problems and properties only).**Statistics:** Introduction–Graphical representation of data-Measures of central tendency-Measures of dispersion- Correlation-Regression-Rank Correlation.

Unit V: PROBABILITY
Random experiment, Sample space, events, axiomatic approach for probability, Conditional probability, Baye's theorem.

Reference Books:

1. Robert E, Moyer Frank Ayres JR, "Trigonometry,3rdEdition", Schaum's Outlines, Tata McGraw-Hill Edition, 2005.
2. Frank Ayres Jr, Elliott Mendelson, " Calculus, 3rd Edition, Schaum's Outline series, McGraw-Hill, INC., 1990.
3. Shanti Narayan, "**.**Differential Calculus" S. Chand and Company, 2005.
4. Shanti Narayan, 'Integral Calculus" S. Chand and Company, 2005.
5. Shanti Narayan and P. K. Mittal, "Text Book of Matrices", S. Chand and Company, 2011
6. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012.
7. Dass H.K, "Advanced Engineering Mathematics", 18th edition, S. Chand and Company, 2008.
8. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
9. Gupta S.P, "Statistical Methods", Sultan Chand and sons., New Delhi, 2009.

17MA1004 CALCULUS AND TRANSFORMS

Credits: 3:1:0

Course Objectives:

- To make the students understand the importance of differential calculus in various fields of engineering
- To impart the knowledge of the applications integration.
- To equip the students with the knowledge of Laplace Transforms.
- To provide the students with the concept and an understanding of Differential equations.
- To train the students in the fundamental of Laplace and Fourier transforms
- To enable the students to apply Laplace and Fourier transforms in practical life.

Course Outcomes

- Students will be able to apply mean value theorem concept in practical life. .
- Updating the knowledge with different kind of integrations.
- Developing the skills in solving differential equations.
- Students will be able to understand the Newton's law of cooling and harmonic motions involved in real life problems.
- Students will be able to demonstrate the Kirchoff's law of electrical circuits.
- Students will be able to apply the concept of Laplace and Fourier Transformation in analysis.

Unit I: Differential Calculus

Methods of differentiations, Mean Value theorems, Taylor's theorem, Taylor's series and Maclaurian's series, Series expansions of cosx, sinx, log(1+x), $(1+x)^n$.

Unit II: Integral Calculus: Methods of integration, Gamma and beta functions, Double and triple integrals, Jacobian, Applications to areas and volumes.

Unit III: Differential Equations: Linear differential equations of first order and Linear differential equations of second order(constant coefficients only), Applications to Newton's law of Cooling, Kirchoff's law of electrical circuits, Motion under gravity, Simple harmonic motion.

Unit IV: Laplace Transforms and Fourier series

Basic definitions, elementary properties and simple problems only.

Unit V: Fourier transforms

Basic definitions, elementary properties and simple problems only.Half Range Fourier Transforms - Basic definitions, elementary properties and simple problems only.

Reference Books:

1. Frank Ayres Jr, Elliott Mendelson, " Calculus', 3rd Edition, Schaum's Outline series, McGraw-Hill, INC., 1990.
2. Shanti Narayan, "Differential Calculus" S. Chand and Company, 2005.
3. Shanti Narayan, 'Integral Calculus" S. Chand and Company, 2005.
4. Shanti Narayan and P. K. Mittal, "Text Book of Matrices", S. Chand and Company, 2011
5. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012.
6. Dass H.K, "Advanced Engineering Mathematics", 18th edition, S. Chand and Company, 2008.

17MA1005 BASIC MATHEMATICS FOR COMPUTER SCIENCE
(Common to B.Sc.(CS), BCA and B.Sc.(IT))

Credits: 3:1:0

Objective:

- To train the students in the fundamental of Algebra
- To orient the students to know about the application of matrices.
- Develop the skills in solving special types of square matrices.
- To make the students understand the importance of differential calculus in various fields of engineering
- To equip the students with the knowledge of Integrations.
- To enlighten the students about the use of differentiation of vectors

Course Outcome:

Students will be able to

- Relate their subject knowledge with their engineering subjects during their course of study.
- Know the applications of matrices.
- Apply the eigen values and eigen vectors in engineering problems.
- Understand the techniques involved in calculus.
- Understand the applications of integrations.
- Get the applications of vectors differentiations.

Unit I: Algebra

Set Theory – Relations and functions- Trigonometric identities- Partial fractions

Unit II: Matrices

Introduction-Matrix operations- The trace and the determinant of a matrix- Properties of determinants(excluding the proof)- The inverse and the rank of a matrix- Special types of square matrices-Eigen values and Eigen vectors(problems only).

Unit III: Calculus

Differentiation from the first principle-Rules of differentiation-Implicit differentiation-Logarithmic differentiation-Methods of integration-Integration by parts.

Unit IV: Vectors

Scalars and vectors- Operations on vectors- Magnitude of a vector-Differentiation of vectors– Curves in space-Velocity and acceleration-Scalar and Vector point functions–

Unit V: Gradient and Divergence

Gradient and Divergence - Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator.Integration of vectors.

Reference Books

1. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. James Steward, "Calculus", 5th Edition, Thomson Brooks/Cole, Micro Print Pvt. Ltd, Chennai, 2003.
3. Riley K.F, Hobson M.P, and Bence S.J, "Mathematical Methods for Physics and Engineering", 2nd Edition, Cambridge Low – Price Editions, Cambridge University Press, 2004.
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
5. T. Veerarajan., "Engineering Mathematics", (Updated Second Edition), Tata McGraw Hill, New Delhi, 2009.

17MA2001 VECTOR CALCULUS AND COMPLEX ANALYSIS

Credits: 3:1:0

Course Objective:

- To teach the students about the basic concepts of vector calculus.
- To provide the students about the application of vector fields.
- To provide the students about the basic concepts of the complex variables.
- To teach the students to solve vector calculus problems.
- To provide the students about the applications of analytic functions.
- To provides the students about the concept of complex integration.

Course Outcome:

Students are able to

- Understand the application of Stokes theorem.
- Relate their knowledge in complex variables with their engineering subjects during their course of study.
- Apply transformation techniques in engineering problems.
- Understand the main properties and examples of analytic functions and be able to compute and manipulate series expansions for analytic functions;
- Perform basic calculations relating to tangent planes, directional derivatives, curves and surfaces in three dimensional space
- Use the major integral theorems; and able to identify and classify zeroes and poles of functions and find their residues.

Unit I: Vector Differentiation

Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator.

Unit II: Vector Integration

Integration of vectors – Line Integral–Simple problems-Surface Integral–problems on Greens theorem, Stoke's theorem, Gauss divergence theorem.

Unit III: Analytic functions

Limit of a complex function–Derivative of f (z)–Cauchy Riemann equations-Harmonic functions-Construction of an Analytic function; Milne Thompson Method-Orthogonal Trajectories

Unit IV: Transformations
Standard transformations z+c, cz, 1/z,-Bilinear transformation-Conformal transformation-Special conformal transformations-Schwarz-Christoffel Transformation.

Unit IV: Complex Integration
Line integral of f (z)-Cauchy's theorem–Cauchy'sIntegral formula– Morera's theorem-Taylor's series –Laurent's series–Zero's and Singularities of an analytic function–Residue theorem–Evaluation of real definite Integrals.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics" , (42nd Edition) Khanna Publishers, New Delhi, 2012.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
4. T. Veerarajan., "Engineering Mathematics", (Updated Second Edition), Tata McGraw Hill, New Delhi, 2009.
5. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S. Chand & Co., New Delhi, 2008.

17MA2002 FOURIER SERIES AND APPLICATIONS

Credits: 3:1:0

Course Objective:

- To provide the students about the basic concepts in Fourier series.
- To orient the students to know about the application of Harmonic analysis.
- To teach the students about the solutions of wave and heat equations.
- To teach the students about the basic concepts in Complex form of Fourier series.
- To motivate the students to know about the applications of Vibrations of stretched string
- To equip the students with the knowledge of Laplace Transforms.

Course Outcome:
Students are able to

- Relate the properties of Fourier series with their engineering subjects during their course of study.
- Gain the knowledge in vibrations of stretched strings.
- Apply the knowledge in Fourier series in science and technology.
- Students will be able to develop the fundamental ideas of D Alembert's solution of the wave equation
- Students are able to understand the concepts of Steady state conditions
- Students have the knowledge in solving engineering problems using Laplace Transforms

Unit I: Fourier series
Euler's formula – Conditions for a Fourier expansion – Functions having points of discontinuity- Change of Interval.

Unit II: Half Range Fourier series
Typical wave forms - Complex form of Fourier series –Harmonic analysis.

Unit III: One Dimensional Wave Equation
Vibrations of stretched string – D Alembert's solution of the wave equation.

Unit IV: One-dimensional heat flow
Solution of the heat equation – Steady state conditions.
Unit V: Two-dimensional heat flow
Solution of Laplace Equation (Cartesian form only) – Temperature distribution.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
4. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S.Chand & Co., New Delhi, 2008
5. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.

17MA2003 MATHEMATICAL TRANSFORMS

Credits: 3:1:0

Course Objective:
- To state the fundamental concepts& memorize the formulas of Laplace Transforms
- To illustrate the solution of differential equations using Laplace Transform
- To define and compare the formulas of Infinite, cosine, sine, finite Fourier Transform
- To enumerate the fundamental properties of Z-Transforms
- To classify the different techniques of inverse Z-Transform
- To motivate about the applications of Laplace, Fourier, Z-Transforms.

Course Outcome:
- Students discriminate &learn all the properties of Laplace Transform
- Students apply Laplace Transforms in mechanical & signal system engineering problems.
- Students evaluate certain definite integrals with infinite limits using Fourier Transform
- Students categorize Z-Transform of sequence and series.
- Students list the formulas & properties of Z-Transform & Inverse Z-Transform

- Students solve difference and differential equations problems in their engineering fields.

Unit I: Laplace transforms
Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–Transforms of derivatives–Transforms of integrals-Multiplication by t^n- Division by t–Evaluation of Integrals by Laplace transforms.

Unit II: Inverse Laplace transforms
Inverse Laplace transforms of standard functions**-**Method of Partial fractions – properties -Convolution theorem – Solving Differential Equations.

Unit III:Fourier transforms:
Fourier integral Theorem–Inverse transform-Properties– Convolution– Parseval's Identity–Relation between Fourier and Laplace transforms–Fourier transforms of the derivatives of a function.

Unit IV: Z-transforms
Standard z transforms–Standard results – Shifting U_n to the Right–Multiplication by n -Initial value and Final value theorems–Convolution theorem-Convergence of z- transforms.

Unit V: Inverse Z-transforms
Inverse Z-transforms of standard functions**-**Method of Partial fractions – properties -Convolution theorem – Solving Difference Equations.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics", (42^{nd} Edition), Khanna Publishers, New Delhi, 2012.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
3. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
4. H.K.Dass., "Advanced Engineering Mathematics", (18^{th} Revised Edition), S. Chand & Co., New Delhi, 2008.
5. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2^{nd} Edition), Cambridge University Press, 2004.

17MA2004 LAPLACE TRANSFORMS, FOURIER SERIES AND TRANSFORMS

Credits: 3:1:0

Course Objective:
- To teach the students about the fundamental concepts of Fourier series,
- To introduce the students about the fourier series and its application to the solution of partial differential equations

- To equip the students with the knowledge of the Laplace and Fourier transforms.
- To develop the students in acquiring transform techniques.
- To explain the general linear system theory for continuous-time signals and systems using the Laplace transform
- To explain the general linear system theory for continuous-time signals and systems using convolution

Course Outcome:

- Students have the knowledge of applying Laplace and Fourier Transforms in a growing number of fields.
- Students can calculate the output of a linear system using convolution and the Fourier transform
- Students can analyze the spectral characteristics of continuous-time periodic and periodic signals using Fourier series.
- Students have the capacity to apply the knowledge gathered in the subject to Signal processing.
- Students can solve a Cauchy problem for the wave or diffusion equations using the Fourier Transform.
- Students apply the transform techniques to their engineering subjects.

Unit I: Laplace transforms

Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–

Unit II: **Transforms of derivatives**

Transforms of integrals-Multiplication by t^n- Division by t –Evaluation of Integrals by Laplace transforms.

Unit III: Inverse Laplace transforms

Inverse transforms of standard functions**-**Method of Partial fractions–properties–Convolution theorem–Application to Differential Equations.

Unit IV: Fourier series

Euler's formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series**:** – Typical wave forms – Complex form of Fourier series–Harmonic analysis.

Unit V:Fourier transforms

Fourier integral Theorem– Inverse transform-Properties–Convolution–Parseval's Identity–Relation between Fourier and Laplace transforms–Fourier transforms of the derivatives of a function.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publishers New Delhi, 2012.

2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
3. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
4. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S. Chand & Co., New Delhi, 2008.
5. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.

17MA2005 MATHEMATICAL FOUNDATION

Credits: 3:1:0

Course Objective:

- To understand and remember the basic formulas in trigonometry.
- To understand and know the basic operations in matrices
- To understand and remember the basic formulas in differentiation.
- To understand and remember the basic formulas in integration.
- To understand the curvature of curve
- To understand the methods of solving ordinary differential equations

Course Outcome:

Students will be able to

- Apply the knowledge of trigonometry in engineering
- Apply the knowledge of matrices in computing
- Solve engineering problems using differentiation
- Solve engineering problems using integration
- Solve engineering problems using ODE solutions
- Apply the knowledge of curvature

Unit I: Trigonometry

Expansions of $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$. Hyperbolic functions–Separating real and imaginary parts.

Unit II: Matrices

Rank of a matrix–Eigen values and Eigen vectors – Cayley Hamilton theorem.

Unit III: Calculus

Differentiation from the first principle–Rules of differentiation: Addition rule–Product Rule–Quotient rule–Chain rule–Implicit differentiation–Logarithmic differentiation–Curvature in Cartesian coordinates.

Unit IV: Integration

Integration of standard functions- Bernoulli's Formula.

Unit V: Differential equations

Second order linear differential equations with constant coefficients.

Reference Books:

1. Veerarajan T., "Engineering Mathematics", (4th Edition) Tata McGraw Hill, New Delhi, 2009.
2. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S.Chand & Co.New Delhi, 2009.
3. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.
4. A. Hepzibah, R. Selvamani, K. Porselvi, "Basic Engineering Mathematics", HSI Publications, Coimbatore, 2011.
5. A. Singaravelu, Engineering Mathematics, Meenakshi Publications, 2001.
6. Moorthy M B K, Subramaniyam N, Engineering Mathematics II, VRB Publishers, 2005.

17MA2006 NUMERICAL MATHEMATICS AND COMPUTING

Credits: 3:1:0

Course Objective:

- To read the uses of Taylor's series in solving problems
- To explain about representation of numbers in different bases in computer.
- To compute numerical solution for algebraic equations
- To develop interpolation of numerical values
- To determine numerical integration
- To make use of splines

Course Outcome:

Students will be able

- To identify the uses of Taylor's series in engineering fields.
- To extend the uses of representation of numbers in different bases in engineering fields.
- To produce numerical solution for transcendental equations in engineering fields.
- To illustrate the interpolation techniques in other branches
- To evaluate integration using numerical methods
- To develop the application of splines in engineering fields.

Unit I: Application of Taylor's series

Nested multiplication-Rounding and Chopping-pseudocode- Simple Numerical problems using Taylor's series- Representation of numbers in different bases.

Unit II: Locating Roots of Equations

Bisection Method-Bisection Algorithm and pseudocode--Convergence of Bisection Method-Newton's method-Geometry of Newton's method-Pseudocode-Convergence Analysis.

Unit III: Interpolation

Polynomial interpolation-Existence-Newton interpolating polynomial- Nested form- Calculating Newton interpolating formula using divided difference-Lagrange interpolating polynomial-Errors in polynomial interpolation.

Unit IV: Numerical Integration
Trapezoidal rule- Error analysis-Recursive Trapezoidal formula-Romberg Algorithm- Simpson's rule-Gaussian Quadrature Formulas.

Unit V: Approximation by Spline Functions
First degree spline–examples-Second degree splines–Natural cubic splines–B splines.

Reference Books:

1. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning Brooks/Cole Publishing Company, California, 2012.
2. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", (6^{th} Edition), New Age International.,2012.
3. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
4. Ralph G. Stanton., "Numerical Methods for Science and Engineering", (1^{st} Edition), Prentice Hall of India Pvt. Ltd., 1988.
5. Kandasamy. P., Thilagavathy K., "Numerical Methods", S. Chand & Co. Ltd., 2010.

17MA2007 PROBABILITY AND RANDOM PROCESS

Credits: 3:1:0

Course Objective:

- To develop the skills of the students in the area of Probability.
- To gain knowledge in the application of family of random variables in real life situations..
- To expose the students to the basics of probability distributions
- To provide the students with an understanding of basic concept in Random Process.
- To learn the application Central limit theorem.
- To understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity and ergodicity.

Outcome:

- The students are able to apply the knowledge gained in Probability theory in engineering fields.
- Students are able to translate real world problems into Probability models.
- Students are able to explore the random experiments specified by two random variables and study the distribution of them.
- Students are able to make simple mathematical descriptions or modeling of random signals.
- Students are able to apply the Random process techniques to signal processing.
- Students will be familiar with application of auto correlation and cross correlation functions.

Unit I: Probability Theory

Axioms of probability, Joint and conditional probabilities, Theorem of Total Probability-Baye's Theorem.

Unit II: Random Variables
One-Dimensional random variables, Two-Dimensional random variables.Functions of one random variable.

Unit III: Statistical Averages
Characteristic Function, Moment generating Function, Tchebysheff Inequality, Central limit theorem.

Unit IV: Random process
Wide-sense stationarity, Strict-sense stationarity, Mean Ergodic Process, Correlation Ergodic Process, Power Spectral Density Function.

Unit V: Special Random Processes
Linear systems, Gaussian Process, Poisson process.

Reference Books:

1. T.Veerarajan, "Probability, Statistics and Random Process" Tata Mc Graw Hill, Second edition, 2009.
2. Kapur J.N. and Saxena H.C., "Mathematical Statistics", S. Chand & Co. Ltd., New Delhi. 2003.
3. S.C.Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co., 2009.
4. Kandasamy P. , Thilagavathy, Gunavathy, "Probability, Random Process and Queuing Theory, S. Chand & Co. New Delhi, 2007.
5. H. Stark and J.W. Woods: "Probability, Random process and Estimation theory for Engineers", Pearson Education Asia, third edition, 2002.

17MA2008 PROBABILITY AND STATISTICS

Credits: 3:1:0

Course Objective:
- To develop the skills of the students in the area of Probability and Statistics.
- To equip the students with an understanding of basic concepts in Testing of Hypothesis.
- To learn the design of experiments and Latin square design.
- To learn the language and core concepts of Probability theory.
- To understand the basic principles of Statistics
- To become an informed consumer of statistical information.

Course Outcome:
- Knowledge in the Technique, Methodology and Application in Statistics.
- A basic knowledge in collection, presentation and tabulation of data.
- Students are able to apply their knowledge gathered in the subject to life sciences.

- Students are able to translate real world problems into Probability models.
- Design hypothesis tests for a given set of data and select the appropriate thresholds for the test.
- Use linear regression analysis to develop an empirical model of experimental data.

Unit I: Statistics
Frequency distribution and measures of central tendency–measures of dispersion-Linear correlation–Regression lines.

Unit II: Probability
Axioms of probability–Conditional probability –Baye's theorem and related problems.

Unit III: Theoretical distributions
Binomial, Poisson, Normal Distributions- Properties– joint distribution–conditional probability distribution–Independent random variables.

Unit IV: Testing of Hypothesis
Tests of Significance-large sample tests- difference of means- difference of proportion–small sample test– t test– Chi square test.

Unit V: Design of Experiments
Analysis of variance–one factor classification- two factors classification - completely randomized design– randomized block design– Latin square design.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
3. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
4. Veerarajan, T., Probability, Statistics and Random Processes, TataMcGrawHill, 2nd Edition, 2009.
5. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition) , Khanna Publishers New Delhi, 2012.

17MA2009 STATISTICAL DATA ANALYSIS AND RELIABILITY ENGINEERING

Credits: 3:1:0

Course Objective:
- To provide the students the concepts in statistics.
- To provide the students the concepts in Testing of Hypothesis
- To provide the students the concepts in reliability engineering.

- To learn sampling techniques
- To learn Design of Experiments
- To develop the students skill in quality control.

Course Outcome:
Students will be able to
- get the Knowledge in Statistical Data Analysis
- Solve problems in the design of experiments.
- Analyses samples for testing of Hypothesis.
- Construct control charts for process control.
- Understand the reliability engineering problems.
- Apply their subject knowledge in their engineering subjects

Unit I: Correlation Analysis
Correlation coefficient–Rank correlation-Method of least squares- Linear, Parabolic and Logarithmic curve– regression coefficients.

Unit II: Testing of Hypothesis
One tailed and two tailed tests- Large sample tests for proportion and mean – Small Sample tests.

Unit III: Design of experiments
Analysis of variance for one factor and two factors of classification - completely randomized design-– randomized block design – Simple Latin Square Design.

Unit IV: Statistical quality control
Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, Advantages and Limitations of SQC – Acceptance sampling – Single sampling plan, Double sampling plan, Construction of a OC curve – Six σ concepts.

Unit V: Reliability engineering
Concepts of reliability, hazard function, series and parallel systems, reliability of Markovian systems, maintainability, preventive maintenance.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
3. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
4. Balagurusamy, E., "Reliability Engineering", Tata McGraw-Hill Publishing Co., New Delhi, Fourth Reprint, 2003.
5. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publishers New Delhi, 2012.

17MA2010 DISCRETE MATHEMATICS

Credits: 3:1:0

Course Objective:

- To provide the student with the concept and the understanding of basic concepts in logical relations and digraphs.
- To analyze basic mathematical proofs and discriminate between valid and unreliable arguments.
- To learn lattices and Boolean algebra.
- To equip the students with the basic concepts in Graph theory.
- Demonstrate different traversal methods for trees and graphs.
- To show students how discrete mathematics can be used in modern computer science (with the focus on algorithmic applications).

Course Outcome:

Students will be able to

- Understand the fundamental mathematical concepts and terminology.
- Use and analyze recursive definitions.
- Use techniques for constructing mathematical proofs.
- Understand the concepts of coding and decoding.
- Develop modeling for computer science and engineering problems.
- Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

Unit I: Basic Algebra

Sets and subsets – operation on sets – sequences – division in the integers – matrices – logical operations–conditional statements –Mathematical induction – Recurrence relation.

Unit II: Relations and digraph

Products sets and partitions – relations and digraphs – paths in Relations and digraphs– properties of relations – equivalence relations– operations on relations – transitive closure and Warshall's algorithm.

Unit III: Order relations and structures

Partially ordered sets – external elements of partially ordered sets–lattices–finite Boolean algebras–functions on Boolean algebra.

Unit IV: Trees

Labeled trees– undirected trees – minimal spanning trees. Graph theory: Graphs –Euler paths and circuits–Hamiltonian Paths and circuits–transport networks-Coloring Graphs.

Unit V: Groups and coding

Semi-groups and groups: binary operations revisited – semi-groups–groups–Groups and coding: coding of binary information.

Reference Books:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.
2. Iyengar N.Ch.S.N., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., "Discrete mathematics", Vikas Publishing, 2003.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 5th Edition, 2003.
4. Swapan Kumar Sarkar, "A Text Book of Discrete Mathematics", S.Chand & Company, 2009.
5. Nanda S, "Discrete Mathematics", Allied Publishers, 2002.

17MA2011 PROBABILITY AND QUEUING THEORY

Credits: 3:1:0

Course Objective:

- To develop the skills of the students in the area of Probability.
- To develop the skills of the students in the area of Conditional Probability
- To provide the students the concepts in one dimensional Random variables.
- To provide the students about the basic concepts in two dimensional Random variables.
- To provide the students about the basic concepts in testing of hypothesis
- To equip the students about the techniques in Queuing theory.

Course Outcome:

Students will be able to

- Gain knowledge in Probability.
- Get knowledge in Conditional Probability
- Get the knowledge in Random variables
- Analyses samples for Testing of Hypothesis
- Make simple mathematical descriptions or modeling.
- Solve the problems in Queuing theory

Unit I: Probability

Axioms of probability – Joint and conditional probabilities –Independent events-Theorem of Total Probability-Baye's Theorem

Unit II: Random Variables

One-Dimensional discrete random variables- One-Dimensional continuous random variables-Two-Dimensional discrete random variables-Two-Dimensional continuous random variables.

Unit III: Testing of hypothesis

One tailed and two tailed tests – Tests based on large samples –proportion and mean

Unit IV: Tests based on Small samples:

Tests based on t, F, chi square test of Goodness of fit, chi square test of independence of attributes.

Unit V: Queuing theory

Characteristics of Queueing systems, Representation a queuing Model, Problems on the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO).

Reference Books:

1. T.Veerarajan, "Probability statistics and Random Process" Tata Mc Graw Hill, Second edition, 2009.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics Sultan Chand & Co., 2009.
3. Kapur J.N. and Saxena H.C., "Mathematical Statistics", S. Chand & Co. Ltd., New Delhi. 2003.
4. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edition. 2008.
5. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.

17MA2012 NUMERICAL METHODS

Credits: 3:1:0

Course Objective:

- To provide the knowledge in solving different types of equations.
- To apply appropriate numerical methods to solve a linear system of equations
- To equip the students with interpolation techniques.
- To learn numerical differentiation and numerical integration.
- To code various numerical methods in a modern computer language
- To apply curve fitting to experimental data.

Course Outcome:

- Students will be able to relate their subject knowledge with their experiments during their course of study.
- Students be aware of the use of numerical methods in modern scientific computing with finite precision computation.
- Students can solve an algebraic or transcendental equation using an appropriate numerical method.
- Students are able to solve their engineering problems using interpolation techniques.
- Students are familiar with calculation and interpretation of errors in numerical methods.
- Students are able to identify the numerical techniques for their engineering problem.

Unit I: Empirical formulae and curve fitting

Principle of least squares - fitting a straight line, a parabola and exponential curve.

Unit II:Solutions of algebraic and transcendental equations

Newton- Raphson method, Gauss elimination method, Gauss-Jordan method, Gauss-Jacobi, Gauss-Seidel method.

Unit III: Interpolation

Finite differences - Newton forward Interpolation, Newton backward Interpolation, Gauss forward interpolation formula, Gauss backward interpolation formula, Lagrange's Interpolation formula.

Unit IV: Numerical integration
Trapezoidal rule-Geometrical interpretation and error of Trapezoidel rule - Simpsons one third rule and three eighth rule formulae -Truncation errors in Simpsons rule.

Unit Numerical solution for ordinary differential equation
Solution of first order ODE by Taylor series method - Solution of first order ODE by Euler method- Improved Euler method -Modified Euler method **-** Runge Kutta method of second, third and fourth order

Reference Books:

1. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
2. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010
3. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", (6th Edition), New Age International, 2012.
4. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
5. Ralph G. Stanton., "Numerical Methods for Science and Engineering", (1st Edition), Prentice Hall of India Pvt. Ltd., 1988.

17MA2013 APPLIED LINEAR ALGEBRA

Credits: 3:1:0

Course Objective:

- Explaining the basic concepts in linear transformations and advanced matrix theory.
- Generating the plan to describe the skills of students in Linear Algebra.
- Designing the applications of Linear Algebra.
- Identifying the application of computer graphics in Linear Algebra.
- To justify the skills of students in applying linear differential equations in Linear Algebra.
- Learn to predictthe applications of singular value decomposition in Linear algebra.

Course Outcome:
Students will be able to

- Relate the concepts of vectors and matrices in their engineering subjects.
- Apply their knowledge in the subject to Computer graphics.
- Summarize Matrix decompositions.
- Interpret the applications of systems of Linear Differential Equations .
- Generalizing the concepts of Markov Chain.
- Understand the concept of Inner Product Space.

Unit I: Vector Spaces
Vectors in R^n- Linear combinations and Linear independence- Vector spaces-subspaces-Basis and dimension- coordinates and change of basis. Application to Differential equations.

Unit II: Linear transformations
The null space and Range- Isomorphisms-Algebra of linear transformation- Matrix representation of a Linear transformation- Similarity- Application to Computer graphics-simple problems.

Unit III: Eigen Values and Eigen Vectors
Introduction– properties of Eigen values- Diagonalization- Reduction of a matrix to a canonical forms-Application to the system of linear differential equations- and Markov chains.

Unit IV: Inner Product Spaces
The dot product in R^n-Located Vectors, Hyperplanes,Lines,curves R^n in Inner product spaces-Orthonormal spaces- Orthogonal complements- Application to least squares approximation-Simple problems.

Unit V: Quadratic Forms
Diagonalization of symmetric matrices- Quadratics forms- Bilinear forms and matrices – Alternating Bilinear Forms-simple problems- Application to Singular Value Decomposition.

Reference Books:

1. Jim Defranza and Daniel Gagliardi, "Introduction to Linear Algebra with applications", Tata McGraw-Hill Edition, New Delhi, 2012.
2. Seymour Lipschutz, Marc Lipson, "Schaum's Outline of Theory and Problems of Linear Algebra", Schaum's outline series, 2001.
3. Kumaresan.S., "Linear Algebra: A Geometric Approach", PHI Pvt., Ltd., 2001.
4. Jimmie Gilbert, Linda Gilbert., " Linear Algebra and Matrix Theory" (1^{st} Edition), Academic Press, 2005.
5. Kenneth Hoffman, Ray Kunze, "Linear Algebra", (2^{nd} Edition), Prentice Hall of India Pvt., Ltd., 2002.

17MA2014 FUZZY SETS AND LOGIC

Credits: 3:1:0

Course Objective:
- Learn about formal methods to represent "vague" and "less" mathematical knowledge.
- To teach the fundamental concepts of fuzzy sets and fuzzy logic.
- Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories.
- Provide a brief introduction to fuzzy arithmetic concepts.
- To provide the students about the applications fuzzy sets and fuzzy logic.
- To learn fuzzification and defuzzification.

Course Outcome:
Students will

- Be able to distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function.
- Be capable of representing a simple classical proposition using crisp set characteristic function and likewise representing a fuzzy proposition using fuzzy set membership function.
- Have the knowledge of applying fuzzy sets and fuzzy logic in their fields.
- Have the knowledge of fuzzification of a crisp concept.
- Have the knowledge of defuzzification of a fuzzy concept.
- Be knowledgeable of conditional fuzzy propositions and fuzzy inference systems.

Unit I: Classical to Fuzzy
Introduction- Crisp sets- an overview- fuzzy sets and types- fuzzy sets and basic concepts- Alpha cuts- Representation of fuzzy sets. Operations on fuzzy sets- Types of operations- fuzzy complements-

Unit II: Operations
Fuzzy intersections and t-Norms - fuzzy union and t-Co-norms

Unit III: Fuzzy Arithmetic
Fuzzy Numbers- Linguistic variables- Arithmetic operations on intervals-arithmetic operations on fuzzy numbers- lattice of fuzzy numbers- fuzzy equations.

Unit IV: Fuzzy Logic
Classical Logic-an overview-Multivalued logics-fuzzy propositions- fuzzy quantifiers-Linguistic Hedges-conditional fuzzy propositions- inferences.

Unit V: Fuzzy Systems
Fuzzy controllers- an overview- fuzzification-defuzzification-fuzzy rule base- fuzzy inference-defuzzification methods- fuzzy neural networks- fuzzy automata.

Reference Books:

1. George J. Klir and Bo Yuan "Fuzzy Sets and Fuzzy Logic, Theory and Applications", Prentice – Hall of India, Pvt. Ltd., New Delhi, 2005.
2. James J. Buckley, Esfaniar Eslami., "An Introduction to Fuzzy Logic and Fuzzy Sets", (3rd Edition), Springer-Verlog, 2011.
3. Ganesh M., "Introduction to Fuzzy sets and Fuzzy Logic", (1st Edition), Prentice Hall of India Pvt., Ltd., 2006.
4. H J Zimmermann, Hans Jurgen Zimmerman, "Fuzzy Set Theory- And Its Applications", Springer, 2001.
5. Timothy J. Ross., "Fuzzy Logic with engineering applications", 3rd Edition, John Wiley, 2010.

17MA2015 PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS

Credits: 3:1:0

Course Objective:

- To develop the skills of the students in the area of Probability and Random Process.
- To equip the students with the basic concepts of various distributions.
- To equip the students with the basic concepts of Random process.
- To equip the students to solve the problems based on central limit theorem
- To learn numerical methods.
- To develop the skills of solving first and second order differential equations using numerical methods.

Course Outcome:

- Students will be able to gain knowledge in Probability theory.
- Students will get knowledge on various distributions.
- Students will be able to make simple mathematical descriptions or modeling of random signals.
- Students will be able to solve problems based on central limit theorem
- Students are able to apply numerical methods for scientific computing.
- Students are able to solve differential equations using numerical methods

UNIT I: Probability

Axioms of probability – conditional probability –Independent events-Theorem of Total Probability-Baye's Theorem.

UNIT II: Distributions

Random variables, Binomial, Poisson, Normal and exponential distributions.

UNITIII: **Moments**

MGF, Moments, Tchebysheff Inequality, Problems based on Central limit theorem.

UNIT IV: Random process

Basics of Random Processes, wide sense, strict Sense stationary processes, Ergodicity, Mean Ergodic Process-Correlation Ergodic Process.

UNIT V: Numerical Methods

Newton's forward and backward difference formula, Trapezoidal rule and Simpson's rule, Taylor series, Euler's method, Fourth order Runge-Kutta method to solve first and second order differential equations.

Reference Books:

1. Veerarajan, T., "Probability, Statistics and Random Process" Tata McGraw Hill, Second edition, 2009.
2. Stark, H. and J.W. Woods: "Probability, Random process and estimation theory for Engineers", Pearson Education Asia, Third edition, 2002.

3. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.
4. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
5. Curtis F-Gerald, "Applied Numerical Analysis", 5th edition, Addison Wesley Publishing Company, 2001.

17MA2016 SAMPLING TECHNIQUES

Credits: 3:1:0

Course Objective:

- To develop skills of the students in the area of Random Sampling.
- To provide the students the concepts in Testing of Hypothesis
- To develop the students skill in quality control
- To understand the applications of the design experiments.
- To learn ANOVA.
- To develop skills of the students in the area of statistics using SPSS.

Course Outcome:

Students will be able to

- Relate their subject knowledge in techniques, methodology and statistics with their engineering subjects during the course of study
- Analyses samples for Testing of Hypothesis
- Construct control charts for process control
- Apply sampling plans in quality control
- Use ANOVA to their engineering problem.
- Use SPSS packages to their engineering problems

Unit I: Random Sampling

Stratified, Systematic and Cluster Samplings, Non-random sampling, Judgment, Quota, Convenience sampling.

Unit II: Testing of Hypothesis

Large sample tests, Difference of Means, Difference of proportion, Small Samples, Student's t test, F Test, Chi square test.

Unit III: Statistical quality control

Types of variation – Types of control charts – X, R, Sigma and C charts- Acceptance Sampling:, Single and Double sampling plans.

Unit IV: Design of Experiments

Basic Principles of Experimental Design - Completely randomized design-– Randomized block design – Simple Latin Square Design.

Unit V: Statistical Package for the Social Science

Basics of SPSS, data creation and saving, opening of the Data file, defining the attributes of variables, Univariate Analysis, Graphs (Bar, Line, Area and Pie), Comparing the Means of independent samples Paired t-test, One way ANOVA using SPSS.

Reference Books:

1. Gupta S.C. and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand Sons, 2007.
2. Gupta S.C. and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2007.
3. Gupta S.P., "Statistical Methods", Sultan Chand and sons, New Delhi, 2009.
4. Vijay Gupta, SPSS for Beginners SPSS versions 7.x through 10.0., VJ Books Inc, 1999.
5. Dennis Howitt and Duncan Cramer "Introduction to SPSS in Psychology", 3rd Edition, PHI, 2005.

17MA2017 OPERATIONS RESEARCH –I

Credits: 3:1:0

Course objective:

To provide the student with the concept and an understanding of basic concepts in

- Linear Programming techniques,
- Duality Principles
- Job sequencing problems,
- Transportation
- Assignment problems
- Application of all the above in practical problems

Course outcome:

Students will be able to

- Explain the basic concepts of optimization and to formulate and solve linear programming problems
- Apply the concepts of Transportation Problem and Assignment Problem
- Participate in the class room discussion on Transportation algorithm
- Explain and apply the concepts of sequencing problem
- Explain and demonstrate the basic concepts of sequencing problem and their application
- Apply duality principle in day to day life style

Unit I: Linear Programming Problem

Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two-phase simplex method.

Unit II Duality

Duality - Dual and simplex method - Dual Simplex Method

Unit III : Sequencing

Job sequencing - n jobs through two machines - n jobs through m machines and two jobs through m machines.

Unit IV:Transportation problem
Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit V:Assignment Problem
Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Reference Books:

1. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
2. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edn.2008.
3. Natarajan A.M., Balasubramani P., Thamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
4. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
5. Winston, "Operations Research, Applications and Algorithms" – Cengage Learning, 4th Edition, 2004.

17MA2018 OPERATIONS RESEARCH –II

Credits: 3:1:0

Course objective:
To provide the student with the concept and an understanding of basic concepts in
- Inventory models,
- PERT/CPM and Simulation,
- Queuing theory,
- Game theory,
- Replacement problems Application of all the above in practical problems

Course outcome:
- Explain the basic concepts of optimization and to formulate and solve inventory problems
- Apply the concepts of queueing theory
- Participate in the class room discussion on Simulation Models and application
- Explain and apply the concepts of Game theory
- Explain and Demonstrate the basic concepts of PERT- CPM and their application
- Reproduce the network model

Unit I : Inventory models
Economic order quantity models-techniques in inventory management-ABC analysis.

Unit II: Network analysis

PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis.

Unit III: Simulation models
Elements of simulation model -Monte Carlo technique – applications.

Unit IV: Queuing model and Game Theory
Problems involving (M\M\1): (∞\FIFO) , (M\M\c): (∞\FIFO) Models.
Game theory –two person Zero sum game,-graphical solution-algebraic solution

Unit V: Replacement models
Models based on models that gradually detoriate with time-whose maintenance cost increase with time-Replacement of items that fail suddenly and completely.

Reference Books:

1. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
2. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edn.2008.
3. Natarajan A.M., Balasubramani P., Thamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
4. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
5. Winston, "Operations Research, Applications and Algorithms" – Cengage Learning, 4th Edition, 2004.

17MA2019 ANALYTICAL GEOMETRY, FOURIER SERIES AND TRANSFORMS

Credits: 3:1:0

Course Objective:
- To teach the students about the fundamental concepts of Analytical Geometry.
- To teach the fundamental concepts of Laplace Transforms to the students
- To provide the students about the basic concepts in Fourier series.
- To orient the students to know about the application of Harmonic analysis.
- To enable the students to analyze the spectral characteristics of continuous-time periodic and periodic signals using Fourier series.
- To motivate about the applications of Half Range Fourier Transforms.

Course Outcome:
Students will be able to
- Have the knowledge of applying Laplace and Fourier Transforms in a growing number of fields.
- Calculate the output of a linear system using convolution and the Fourier transform
- Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier series.
- Have the capacity to apply the knowledge gathered in the subject to Signal processing.

- Evaluate certain definite integrals with infinite limits using Fourier Transform
- Apply the transform techniques to their engineering subjects.

Unit I: Analytical Geometry
Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planar lines – Shortest distance between skew lines.

Unit II: Laplace Transforms
Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–Transforms of derivatives–Transforms of integrals-Multiplication by t^n- Division by t–Evaluation of Integrals by Laplace transforms –

Unit III: Inverse Laplace transforms
Inverse Laplace transforms of standard functions**-**Method of Partial fractions.

Unit IV: Fourier Series
Euler's formula – Conditions for a Fourier expansion – Functions having points of discontinuity-Change of Interval. **Half Range Fourier series:** Typical wave forms –Harmonic analysis.

Unit V: Fourier transforms
Fourier integral Theorem–Inverse transform-Properties- simple problems.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
4. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S.Chand& Co., New Delhi, 2008
5. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.

17MA2020 PROBABILITY, RANDOM VARIABLES AND STATISTICS

Credits: 3:1:0

Course Objective:
- To develop the skills of the students in the area of Probability and Statistics.
- To equip the students with an understanding of basic concepts in Testing of Hypothesis.
- To learn the design of experiments and Latin square design.
- To learn the language and core concepts of Probability theory.
- To understand the basic principles of Statistics
- To become an informed consumer of statistical information.

Course Outcome:

- Knowledge in the Technique, Methodology and Application in Statistics.
- A basic knowledge in collection, presentation and tabulation of data.
- Students are able to apply their knowledge gathered in the subject to life sciences.
- Students are able to translate real world problems into Probability models.
- Design hypothesis tests for a given set of data and select the appropriate thresholds for the test.
- Use linear regression analysis to develop an empirical model of experimental data.

Unit I: Statistics and Probability

Moments, Skewnesss, Kurtosis - Axioms of probability–Conditional probability –Baye's theorem and related problems.

Unit II: Random Variables

Probability mass function – probability density function – properties – Joint Distribution – marginal and conditional distributions - Independent random variables

Unit III: Theoretical distributions

Binomial, Poisson, Normal Distributions-Exponential Distribution - properties – problems.

Unit IV: Testing of Hypothesis

Tests of Significance-large sample tests- difference of means- difference of proportion–small sample test– t test– F test - Chi square test.

Unit V: Design of Experiments

Analysis of variance–one factor classification- two factors classification - completely randomized design– randomized block design– Latin square design.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
3. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
4. Veerarajan, T., Probability, Statistics and Random Processes, TataMcGrawHill, 2nd Edition, 2009.
5. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition) , Khanna Publishers New Delhi, 2012.

17MA2021 APPLIED MATHEMATICS

Credits: 3:1:0

Course Objectives:

- To provide the students about the knowledge of three dimensional geometry.

- To orient the students to know the techniques in differential calculus.
- To understand the concepts of partial derivatives.
- To apply partial derivatives in finding maxima and minima
- To teach the students about the applications of matrices.
- To understand the concepts of multiple integrals.

Course Outcomes:

- To relate the properties of sphere, cone and cylinder with their subjects during the course of study.
- To apply the knowledge of orthogonal transformation in solving equations.
- To find curvature, evolutes and envelopes of different curves.
- To calculate the area and volume of the regions using double and triple integrals.
- To recognize the partial derivative techniques.
- To apply the ideas of partial derivatives and find maxima and minima of a function.

Course Descriptions:

Unit I: Analytical Geometry

Sphere, Plane section of a sphere, Tangent plane, Cone, Right circular cone, Cylinder, Right circular cylinder.

Unit II: Matrices

Types and operations of matrices, Rank and inverse matrix, Eigen values and Eigen vectors, Properties, Cayley-Hamilton Theorem, Orthogonal transformation, Diagonal form, Quadratic form, Canonical form.

Unit III: Differential Calculus

Curvature**,** Centre and radius of curvature, Circle of curvature, Evolutes, Envelopes, Evolutes as envelope of normal.

Unit IV: Partial derivatives

Introduction, Euler's theorem, Total derivatives, Jacobians, Taylor's expansion, Maxima and minima.

Unit V: Integral calculus

Double integrals: Change the order of integration, Area as double integral, Triple integrals Volume as triple integral.

Reference Books:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing House, New Delhi, 2007.
2. Glyn James, " Advanced Engineering Mathematics", 7th Edition, Pearson Education, 2007.
3. Jain R.K and Iyenger S.R.K, " Advanced Engineering Mathematics" 3rd Edition, Narosa Publishing House, 2007.

4. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.
5. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
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17MA2022 QUANTITATIVE TECHNIQUES

Credit 3:1:0

Course Objectives:

- To enable the students to acquire knowledge of matrices
- To acquire the knowledge of set theory.
- To provide the concepts of financial analysis.
- To teach the students about the statistical parameters.
- To know the different methods of time series analysis.
- To understand the concepts of time series analysis.

Course Outcomes:

- To apply matrix techniques to the Business models.
- To recognize different types of sets and operations of sets.
- To calculate the simple and compound interests.
- To apply measures of central tendency and variations in data analysis.
- To apply different methods in time series analysis.
- To recognize the use of index numbers.

Course Descriptions:

Unit I: Matrices
Introduction, Types of matrices, Operations of matrices, Determinants, Rank of a square matrix, Solving Simultaneous linear equations using Inverse method.

Unit II: Set theory
Introduction, types of sets, Operations of sets, Venn Diagrams, Relations and functions.
Problems on Finance: Mathematics of Finance, Simple and Compound Interests.

Unit III: Statistics
Meaning, Scope, Limitations of Statistics, Data Collection, Presentation of data by Diagrammatic and Graphical Methods, Formation of Frequency Distribution.

Unit IV: Data Analysis
Measures of Central tendency: Mean Median and Mode, Measures of deviations: standard deviation, Measures of Variation, coefficient of variation.

Unit V: Time Series

Methods of Measuring Trend: Graphical method, average method, least square principle and Index numbers.

Reference Books:

1. J.K Thukral, "Business Mathematics for BBA", Scholar Tech Press, 2015.
2. J.K.Singh, "Business Mathematics", Himalaya Publishing House Pvt Ltd, 2013.
3. Sundaresan and Jayaseelan, "An Introduction to Business Mathematics and Statistical Methods", Sultan Chand and Sons , 2010.
4. S.P.Gupta , "Statistical Methods", Sultan Chand and Sons, 2012.
5. Grewal B.S, "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.

17MA2023 OPERATIONS RESEARCH - III

Credit 3:1:0

Course Objective:

- To acquire knowledge of the linear programming problems.
- To solve LPP using graphical and simplex method.
- To formulate and solve transportation problems.
- To formulate and solve Assignment problems.
- To learn solving procedures of games.
- To acquire knowledge of Queuing models.

Course Outcomes:

- To formulate Linear programming problems.
- To apply graphical and simplex method in solving LPP.
- To recognize different procedures for finding initial and optimal solutions of transportation problems.
- To apply Hungarian method to solve assignment problems.
- To solve game theory using graphic methods.
- To recognize the queuing models.

Course Descriptions:

Unit I: Linear programming

Mathematical formulation, Graphical solution, Simplex method, Duality in linear programming, Applications in management decision making.

Unit II: Transportation problem

Introduction, Initial solution, North west corner method, Least cost method, Vogel's approximation method, Optimal solution, MODI method, Degeneracy in transportation problem.

Unit III: Assignment problem

Introduction, Hungarian method, unbalanced assignment problems, travelling salesman problem.

Unit IV: Game theory
Two person zero-sum games, Maximum- minimum principle, Games without saddle points, Mixed strategies, Graphic method.

Unit V: Queuing theory
Introduction, characteristics of a queuing system, service system, behavior of queue members, Notation of Queuing model, (M/M/1):(∞/FIFO) model.

Reference Books:

1. Bhaskar S, "Operations Research", Anurradha Publications, 2013.
2. Kapoor V.K, "Operations Research", Sultan Chand & sons, New Delhi, 2013.
3. Vittal P.R, "Operations Research", Margham Publications, 2012.
4. Kanti Swarup, Gupta and Manmohan, "Operations Research", Sultan Chand, New Delhi , 2011.
5. Gupta P.K and. Hira D.S, "Operations Research", Sultan Chand, New Delhi, 2008.

17MA2024 BUSINESS MATHEMATICS

Credits 3:1:0

Course Objectives:
- To know different types of progressions.
- To understand the different financial methods.
- To know about set theory and matrix methods.
- To learn the concepts of differential and integral calculus.
- To acquire the knowledge of LPP and finding solutions.
- To apply different mathematical methods in business problems.

Course Outcomes:
Ability to
- To apply progression techniques in business models.
- To recognize different methods of solving finance problems.
- To solve the modern business problems using set theory and matrices.
- To develop business problems using calculus and solving using differential and integral calculus.
- To formulate the business problems in terms of LPP.
- To solve LPP using graphical method.

Course Descriptions:

Unit I: Progressions
Numerical sequences, Arithmetic progression, Geometric progression, Summations and applications of progressions in solving finance problems.

Unit II: Finance

Simple and Compound Interests, Effective rate of Interest, Sinking Fund, Annuity, Present Value, Discounting of Bills, True Discount, Banker's Gain**.**

Unit III: Set Theory
Introduction, types of sets, Operations of sets, Relations, Functions, Constants and Variables. Matrices: Introduction, Types of matrices, Operations of matrices, Inverse of a Matrix, Rank of Matrix.

Unit IV: Calculus
Differentiation and integration of Algebraic Functions, e^x and logx, second Order Derivatives, Maxima and Minima, Integration by Parts.

Unit V: Linear Programming Problem
Introduction, Mathematical formulation of an LPP, Graphical method: Types of solutions, solving an LPP by Graphical Method.

Reference Books:

1. Navanitham P.A, "Business Mathematics & Statistics", Jai Publishers, Trichy, 2013.
2. Sundaresan and Jayaseelan, "Introduction to Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2010.
3. Sanchetti D.C and Kapoor V.K, "Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2014.
4. Ranganath G.K, Sampamgiram C.S and Rajan Y, "A Text book of Business Mathematics", Himalaya Publishing House,2014.
5. Jayaprakash Reddy R, "Business Mathematics", APH Publishing Corporation, 2012.

17MA3001 MATRIX COMPUTATIONS

Credits: 3:0:0

Course Objective:

- To provide the students with the understanding of linear equations and their applications.
- To equip the students with the concept of Cholesky matrix decomposition.
- To learn about the LU decomposition method.
- To develop the skills with the QR decomposition methods.
- To understand the various methods of Gram-Schmidt model.
- To understand the various matrix decomposition algorithms.

Course outcome:

- Students will be able to apply linear equations in their core subjects.
- Updating the knowledge with the advanced matrix theory.
- Developing the skills in solving higher order matrices.
- Students will be able to understand the mathematical principles involved in real life problems.
- Students will be able to apply the concept in modeling and analysis.
- Students will be able to demonstrate the mathematical model with experimental data.

Unit I: Cholesky Decomposition
Linear Equations-Simple Electrical circuit problem-partitioning matrices- Systems of linear equations-Triangular systems- Positive Definite Systems- Cholesky Decomposition- Cholesky Decomposition Theorem- Cholesky algorithm.

Unit II: LU Decomposition
Gaussian Elimination Method- LU Decomposition Theorem- LDV Decomposition Theorem- Gaussian Elimination with pivoting.

Unit III: QR Decomposition
The discrete least squares problem-orthogonal matrices-Rotators-Reflectors-QR decomposition-Solving least squares problems by using QR decomposition-Complex rotators-complex reflectors.

Unit IV: The Gram-Schmidt Method
Orthonormal vectors- Classical Gram Schmidt Algorithm- Modified Gram Schmidt Algorithm-The discrete least squares problems- The continuous least squares problems. Singular Value

Unit V: Decomposition (SVD)
SVD Theorems- Computing the SVD- SVD and the least squares problems-The pseudo inverse.

Reference Books:

1. David S.Watkins, "Fundamentals of Matrix Computations", John Wiley & Sons, Singapore. 2004.
2. Richard Bronson, "Matrix Operations", (2nd Edition), Schaum's Outline Series, McGraw Hill, New Delhi 2011.
3. David W. Lewis., "Matrix Theory", (1st Edition), Allied Publishers Pvt., Ltd., 1995.
4. Jimmie Gilbert, Linda Gilbert, "Linear Algebra and Matrix Theory", (1st Edition), Academic Press, 2005.
5. L. N. Trefethen and D. Bau, Numerical Linear Algebra, SIAM, 1997.
6. G. H. Golub and C. F. Van Loan, Matrix Computations, 3rd Ed., John Hopkins University Press, 1996.
7. J. W. Demmel, Applied Numerical Linear Algebra, SIAM, 1997.

17MA3002 FINITE ELEMENT METHODS

Credits: 3:0:0

Course Objective:
- To acquire knowledge about Mathematical Modeling and Finite Element Methods.
- To understand the Finite Element Methods with example of heat transfer, solid mechanic problems, discrete systems, Eigen value problems.
- To apply the Finite Element Methods in solving discrete systems, Eigen value problems.
- To analyze the real time situations and convert in to finite element methods and find solution
- To formulate governing equations and solve using finite element methods.

- To evaluate finite element problems using numerical integration.

Course Outcome:
Students will be able
- To define mathematical modeling and finite element methods
- To demonstrate the steps of finite element methods in finding solution of Dynamic, Heat transfer, solid mechanic, discrete systems, fluid mechanics and eigen value problems.
- To analyze and construct mathematical modeling using Euler equation and Hamilton's principle.
- To use boundary conditions to solve problems constructed by finite element method.
- To apply calculus of variation, boundary conditions in finite element problems
- To apply numerical integration in evaluating finite element problems.

Unit I: Introduction to FEM
Mathematical Models-Dynamic, heat transfer and solid mechanic problems, Introduction to Finite Element Method -The basic idea and features – Advantages and applications.

Unit II: Calculus of variation
Fundamentals of calculus of variation- variational operation and First iteration - Fundamental lemma of variational calculus -Euler Equation-Natural and Essential Boundary Conditions-Hamilton's Principle.

Unit III: Discrete Systems
Linear Elastic Spring-Torsion of Circular Shafts-Heat Transfer: Governing equations and Finite element Models.**Fluid Mechanics**: Governing Equations and Finite Element models-Analysis of Beams element.

Unit IV: Eigen value problems
Formulation: Parabolic equation, hyperbolic equation - Finite Element Formulation - Heat transfer and Bar-like problem-Natural Vibration of Beams: Euler-Bernoulli beam theory-Stability of Beam.

Unit V: Numerical Integration
Introduction - Coordinate Transformations- Integration over a Master Rectangular Element: Gauss points for linear, quadratic and cubic quadrilateral elements – Integration over a Master triangular element: Quadrature points and weights for triangular elements.

Reference Books:

1. 1.J.N. Reddy, "An introduction to the finite element method", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. O.C.Zienkiewicz. "The Finite Element method",.Tata Mc Graw Hill.1989.
3. C. S. Desai and John F.Abel., Introduction to Finite Elements Method, Litton Educational Publishing Inc.,2004
4. Erik G. Thompson. Introduction to Finite Element Method, John Wiley & Sons, 2000.
5. T. R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", 2nd Edition, Prentice Hall, New Jersey, 1997.

6. Daryl L. Logan, "A First Course in the Finite Element Method", 2nd Edition, PWS Publishing Company, Boston, 1993.
7. K. C. Rockey, H. R. Evan, D. W. Griffiths, and D. A. Nethercot, "The Finite Element Method: A Basic Introduction", 2nd Edition, William Collins Sons & Co. Ltd., 1983.

17MA3003 FOUNDATIONS OF MATHEMATICS AND STATISTICS

Credits: 3:0:0

Course Objective:

- To acquire knowledge about different kind of functions.
- To equip the students with the concept of Differential calculus
- To develop the students skills of the area of probability and statistics.
- To provide the students with the understanding of Testing of Hypothesis
- To know more about descriptive and inferential statistics.
- To understand the various application design of experiments.

Course Outcome:

Students will be able to

- Understand the basic concepts of binomial theorem.
- Classify the linear and quadratic equations.
- Apply the concept of integration in their engineering subjects**.**
- Apply the concept of probability in real life.
- Understand the properties of various distributions.
- Test the hypothesis of large sample problems

Unit I: Algebra

Linear and quadratic equations**-** Binomial Theorem- Summation of series – coefficient of x^n - exponential function-logarithmic function.

Unit II: Differential Calculus

Limits and Continuity**-** Differentiation–Product and Quotient Rule –Maxima and Minima of f(x).

Unit III:Integral Calculus

Integration of standard functions – Methods of Integration – Integration by parts – Definite Integrals - Bernoulli's formula.

Unit IV: Probability and distributions

Probability – Axiomatic definition of probability – Independent events –Binomial, Poisson Distributions — Normal Distribution – Properties of Normal Distribution —Importance of Normal Distribution —Normal probability curve – fitting Binomial, Poisson Distributions – problems (proofs and derivations not included).

Unit V: Testing of hypothesis

One tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Reference Books:

1. Gupta S.P., "Statistical Methods", New Delhi, S.Chand & Co., 37th Edition 2009.
2. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
3. Kandasamy P., Thilagavathi K and Gunavathy K., "Numerical Methods", S.Chand & Co., 2009.
4. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.
5. Kapoor J.N. & Saxena H.C. "Mathematical Statistics", S.Chand & Company, 2006.
6. Kandasamy P., Thilagavathi K and Gunavathy K., "Engineering Mathematics", Volume I, S.Chand & Co., 2001.
7. Manickavasagam Pillai, "Algebra" , Volume I & II, S. Viswanathan publishers, 2002.

17MA3004 ADVANCED CALCULUS AND NUMERICAL METHODS

Credit 3:0:0

Course Objectives

- Generating plan for the students in the field of advanced calculus, application of Partial Differential Equations.
- To recall the Numerical integration techniques.
- To justify Eigen and boundary value problems with engineering applications.
- To predict the first and higher order derivatives and several independent variables.
- To familiarize the students in the field of Calculus of Variations.
- Discriminate the application of Gaussian Quadrature in engineering Fields.

Course Outcomes

Students will be able to

- Relate their subject knowledge with their core subjects during their course of study.
- Revising the skills in solving heat and wave equations
- Recalling Gaussian quadrature formula and its derivations in the engineering fields.
- Identifying the skills in applying the Numerical Integrations.
- Apply higher order derivatives and several independent variables.
- Reconstructing the skills in application of Boundary Valued Problems.

Unit I: One dimensional wave and heat equation

String, rods. Two-dimensional heat equation-finite, infinite, semi-circular and circular plates, simple problems in one dimensional wave equations.

Unit II: Two-dimensional wave equations

Vibrating membrane, rectangular membrane, circular membrane, finding the steady state solutions ,Transmission line , simple problems.

Unit III: Calculus of variation

Euler's equation, Isoperimetric problems,Functional dependant on its first and higher order derivatives and several independent variables, moving boundaries,

Unit IV: Boundary value problems
Power, Jacobi methods, Given's method, Raleigh-Ritz, collocation, Galerkin methods, simple problems using boundary conditions.

Unit V: Numerical integration
Simpson's rules, Romberg's method, Gaussian quadrature, Natural cubic spline functions formula, simple problems in numerical integrations.

Reference Books:

1. P.Kandasamy, K.Thilagavathy and K, Gunavathy, "Numerical methods", S.Chand & Company Ltd, Revised Edition, 2010.
2. Naveenkumar, "An Elementary course on Variational problems in calculus", Narosa Publishing House, 2003.
3. B.S.Grewal, "Higher Engineering Mathematics" 42th Edition Khanna publisher, Delhi, 2012.
4. M.K.Venkataraman, "Higher Mathematics for engineering and Science", National Publishing Company, 2002.
5. Curtis F-Gerald, "Applied Numerical Analysis", 5th Edition, Adison Wesley Publishing Company, 2001.
6. E.Balagurusamy, "Computer Oriented Statistical and Numerical Methods", MacMillan series, Madurai, 1988.
7. M.K.Jain, S.R.K.Iyengar and R.K.Jain, "Numerical methods for scientific and Engineering Computation", 6th Edition, New Age International, 2005.

17MA3005 CALCULUS OF VARIATIONS AND VECTOR SPACES

Credits: 3:0:0

Course Objectives
To discover the knowledge of the students with the understanding of basic concepts of set theory.

- Relating the Z-transform to its applications.
- Explaining the students with skills in variational problems.
- Summarizing the students skills in linear integral equations.
- Reconstructing the concepts of functions and vector spaces.
- Planning to prepare in finding the relation between differential and integral equations.

Course Outcomes:
Students will be able to

- Relate their subject knowledge with their engineering subjects during the course of study
- Students are able to identify the application of integral equations in their engineering fields.
- Choose the orthogonalization techniques.
- Students are able to interpret the results in the vector spaces and Inner Product Spaces.
- Justify the Z-Transforms and their applications in the engineering fields.

- Discover the interactive methods of solving equations of second kind.

Unit I: Calculus of variations
Variational problems of fixed boundaries only simplest Variational problems – Euler equation - Brachisto Chrone problem – Variational problems involving several unknown functions .

Unit II: Functional involving higher order derivatives
Functional involvingfirst and second order derivations –Functional involving two or more independent variables – Isoperimetric problems.

Unit III: Linear integral equations
Fredholm and Volterra integral equations – Relation between differential and integral equations-Green's function.Fredholm equation with separable kernal – Interactive method of solving equation of second kind –Properties of symmetric kernels.

Unit IV: Vector spaces
Sets – Relations – Functions – Vector Spaces - Definition and examples of linear space – Linear dependence and independence –Basis and Dimension– definitions-simple problems .Inner product spaces- Orthogonalisation process.

Unit V: Z–Transforms
Introduction, definition, linear property, damping rule, some standard results,Z-Transforms of standard functions, convolution theorem, convergence of Z-transforms, Inverse Z-Transform - Applications

Reference Books:

1. Grewal B S, "Higher Engineering Mathematics"42th Edition Khanna publishers, New Delhi, 2012.
2. Venkataraman M.K., "Higher Mathematics for engineering and Science", National Publishing Company, 2002.
3. Hoffmann and Kunze, "Linear Algebra" second edition, Prentice Hall India Limited, 2002.
4. Tremblay J.P. and Manohar R., "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill, 1997.
5. John Proakis G., "Digital Signal Processing", Prentice Hall of India (P) Ltd., 1995.
6. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2005.
7. Kumaresan. S, "Linear Algebra", Prentice-Hall of India Private Limited, 2000

17MA3006 GRAPH THEORY AND RANDOM PROCESS

Credits: 3:0:0

Course Objective:
- To provide the students with the main concepts of graph theory, graph representations and the basic classes of graphs.

- To represent real-life situations with mathematical graphs.
- To introduce the fundamentals of probability theory and random processes and illustrate these concepts with engineering applications.
- To present the basic principles of random variables and random processes needed in applications such as signal processing, digital communications etc.
- To get exposed to basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
- To develop analytical capability and to impart knowledge in and Queuing theory and their applications in Engineering and Technology

Course Outcome:
Students will

- Be able to apply the abstract concepts of graph theory in modeling and solving non-trivial problems in different fields of study.
- Be able to understand the description and behavior of random processes.
- Be able to characterize probability models and function of random variables based on single & multiples random variables.
- Be able to define, illustrate and apply the concepts of discrete and continuous random variables.
- Be able to describe a random process in terms of its mean and correlation functions.
- Be able to understand the concept of Queuing models and apply appropriate queuing modeling their subjects

Unit I: Graph Theory
Graphs, Euler graph, Hamiltonian graph, Transportation network, coloring,

Unit II: Trees
Trees - Minimal Spanning Trees – Prims Algorithm – Kruskal's Algorithm – Prim's Algorithm using Matrices

Unit III: Random processes
Special classes, Stationary, Analytical representations, Weiner Process function, Auto correlation, cross Correlation, Properties,

Unit IV: Ergodicity
Ergodicity, Mean Ergodic theorem, Correlation Ergodic process, Power spectral density and its properties.

Unit V: Introduction of Queuing theory
Queuing model involving M/M/I: ∞/FIFO, M/M/C: ∞/FCFS, M/M/I: N/FCFS, M/M/C: N/FCFS (Derivations are not included – simple problems to be asked).

Reference Books:
1. Bernard Kolman, Robert C.busby, Sharo Cutler Ross, Discrete Mathematical Structures, Prentice Hall of India, 2004, 5th edition.

2. T.Veerarajan, Probability, Statistics and Random processes, Tata McGraw Hill Publishing company lt, 2006, 2nd edition.
3. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
4. Alan Doerr, Kenneth Levasseur, Applied Discrete Structures For Computer Science, Galgotia Publishers Pvt.Ltd, 1st Edition, 1998.
5. Kenneth H. Rosen,Discrete Mathematics and Its Applications, Mcgraw Hill, 3rd Edition, 2005.
6. Murugesan K,Probability Theory and Random Processes, Anuradha Agencies, 1st Edition, 1998.
7. Henry Stark, John W. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education Asia, 3rd Edition, 2012.

17MA3007 APPLIED STATISTICS

Credits: 3:0:0

Course Objective:

- To develop skills of the students in the area of probability and statistics.
- To know more about descriptive and inferential statistics.
- To understand the various application of Time Series and Design of experiments
- To use estimated time series models to predict unknown observations ahead in time
- To recognize the difference between a population and a sample, and between a parameter and a statistic; identify the experimental unit in a sample.
- To understand and use the multiple linear regression model.

Course Outcome:

Students are able to

- Understand the technique, methodology and Application of statistics.
- Understand the basic concept of Time series.
- Apply regression analysis to their engineering problems
- Explain the essential components of experimental design.
- Design an experiment and conduct analysis of variance on experimental data, interpret the results and present them meaningfully.
- Analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models

Unit I: Statistics

Probability, Binomial, Poisson and Normal Distributions, Concepts of reliability, Serial and parallel systems .

Unit II: Empirical Laws and Curve Fitting

Method of least squares, fitting a straight line, fitting exponential and power curve.

Unit III: Time Series

Components of Time Series, Measurement of Trend, Method of Semi averages, Method of Moving Average, Method of Simple Averages, Ratio to Moving Average Method.

Unit IV: Statistical Analysis
Multiple Regression of X_1 on X_2 and X_3, Tests based on large samples, Small samples. The Mann Whitney U test.

Unit V: Design of Experiments
Randomized block design, Latin square design, comparison of RBD and LSD.

Reference Books:

1. Gupta S.P., "Statistical Methods", New Delhi, S.Chand & Co., 37th Edition 2009.
2. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
3. Kandasamy P., Thilagavathi K and Gunavathy K., "Numerical Methods", S.Chand & Co., 2009
4. Richard A. Johnson, "Probability and Statistics For Engineers", Prentice Hall of India, 2005.
5. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.
6. Kapoor J.N. & Saxena H.C. "Mathematical Statistics", S.Chand & Company, 2006.
7. David P.Doane, Lori E.Seward, "Applied Statistics in Business and Economics", Tata McGraw Hill Publishing Company, 2007.

17MA3008 COMPUTATIONAL MATHEMATICS

Credits: 3:1:0

Course objective:
- To provide the students with the understanding of basic concepts in Variations.
- To equip the students with the concept of Partial Differential Equations.
- To learn about the Initial value problems.
- To develop the skills with Eigen value problems.
- To understand the various methods in Boundary value problems.
- To equip the students with the knowledge in Numerical Methods for analysis and modeling.

Course outcome:
- Students are able to understand the application of variations in engineering.
- Updating the knowledge with Partial Differential Equations and its applications.
- Developing the skills in solving heat and wave equations.
- Students will be able to understand the mathematical principles involved in real life problems.
- Students will be able to apply the concept in modeling and analysis.
- Students will be able to demonstrate the mathematical model with experimental data.

Unit I: Calculus of variations

Euler's equation, Functional dependant on its first and second order derivatives.

Unit II: Classification of partial differential equation of second order
Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method.

Unit III: Initial value problems
Picard's method – Euler, Improved Euler and modified Euler methods.

Unit IV: Eigen value problems
Power & Inverse power methods – Jacobi methods.

Unit V: Boundary value problems
Raleigh-Ritz, collocation methods, Horner's, Muller's and Chebyshev's method, Graffe's root square method ,Gauss elimination, Gauss-Jordan, Relaxation methods, Newton Raphson methods, Newton-Cotes quadrature formula – Simpson's $1/3^{rd}$ and $3/8^{th}$ rules – Weddle's rule (Single & Double integral) – Gaussian quadrature formula, Natural cubic spline functions.

Reference Books:

1. Naveenkumar, "An Elementary course on Variational problems in calculus", Narosa Publishing House, 2003.
2. Veerarajan T., Ramachandran T., "Numerical Methods", Tata McGraw Hill, 2003.
3. Curtis F-Gerald, "Applied Numerical Analysis", 5th edition, Addison Wesley Publishing Company, 2001.
4. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
5. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Third edition, Brooks/Cole Publishing Company, California, 1994.
6. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
7. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", 6th Edition, New Age International, 2005.

17MA3009 APPLIED GRAPH THEORY AND QUEUING THEORY

Credits: 3:0:0

Course Objective:

- To provide the knowledge about the basic knowledge in number theory, graph theory and automata theory
- To understand the logics of different matrix representations of graphs
- To equip the students with the applications in software technology
- To learn about the soft computing techniques from random processes.
- To learn about the different kind of correlations. .
- To understand the various idea of queuing theory models.

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Course Outcome:

- Students will be able to apply shortest path algorithm in practical problems.
- Updating the knowledge with properties of numbers.
- Developing the skills in solving state machine.
- Students will be able to understand the different correlation involved in real life problems.
- Students will be able to apply the concept of Gaussian process and its properties.
- Students will be able to apply Queuing theory in practical problems.

Unit I: Graph theory

Basic Terminology, Some special simple graphs, Representations of graphs, Connectivity, Shortest path algorithm and Trees.

Unit II: Number theory

Divisibility, primes, fundamental theorem of arithmetic, Division Algorithm, G.C.D & LCM.

Unit III: Automata theory

Languages& Grammars, Phrase Structure Grammars & Types, Derivation trees, backus-Naur Form, Finite-state machines with outputs & types, Finite-state machines with no outputs, Regular sets, Kleene's theorem, Regular grammars.

Unit IV: Random process

Classification of random processes, Special Classes, Average values of Random processes, Stationary, Autocorrelation Function, Cross-correlation Function & their properties, Ergodicity, Mean Ergodic Theroem – Gaussian Process & its properties.

Unit V: Queuing theory

Characteristics of Queuing systems, Representation a queuing Model, Properties of the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO) – simple problems

Reference Books:

1. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2012.
2. Veerarajan T., "Probability, Statistics and Random Processes", Second edition, Tata McGraw-Hill, Sixth reprint 2009.
3. Bernard Kolman, Robert Busby C., Sharon Cutler Ross, "Discrete Mathematical Structures", Fifth Edition, Pearson Education, 2004.
4. Richard Williams H., "Probability, Statistics and Random Process for Engineers", CENGAGE Learning, 2009.
5. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Prentice-Hall of India Private Ltd. 2004.
6. Handy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.

7. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.

17MA3010 GRAPH THEORY AND ALGORITHMS

Credits: 3:0:0

Course Objective:

- To provide the student with the understanding of basic concepts in Graph theory.
- To represent real-life situations with mathematical graphs.
- To recognize patterns that arises in various graph problems.
- To learn linear programming problems.
- To expose to the concepts of modeling and optimization.
- To set up optimization models from problem description and solving linear programming problems using the simplex method.

Course Outcome:

Students will

- Be able relate their subject knowledge with their engineering subjects during the course of study.
- Be able to apply the abstract concepts of graph theory in modeling and solving non-trivial problems in different fields of study.
- Understanding Graph network problems.
- Develop a fundamental understanding of linear programming models
- Able to apply optimization techniques in their engineering subjects.
- Able to develop a linear programming model from problem description and apply the simplex method for solving linear programming problems.

Unit I: Basics of graph theory

Graphs – Data structures for graphs – Sub graphs – Operations on Graphs Connectivity – Networks and the maximum flow – Minimum cut theorem –

Unit II: Trees

Trees – Spanning trees – Rooted trees – Matrix representation of graphs.Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula –

Unit III: Coloring of Graphs

Five color theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs. Graph algorithm**:** Computer Representation of graphs –

Unit IV Basic graph algorithms

Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – Dijsktra's algorithm.

Unit V: Linear Programming

Graphical methods – Simplex method (Artificial variables not included).

Reference Books:

1. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2002.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 2004.
3. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2012.
4. Kanti Swarup, Man Mohan, Gupta P.K., "Operations Research", Sultan Chand &Sons, 2000.
5. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists".Pearson Education, first Indian reprint, 2002.
6. Gupta S.C., Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
7. Veerarjan T., "Theory of Probability and Random Process", Tata McGraw Hill Publishing Company Science, PHI, 2005.

17MA3011 BIOSTATISTICS AND QUALITY CONTROL

Credits: 3:0:0

Course Objective:

- To provide the student with the understanding of basic concepts in Statistics, Distributions.
- To explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations.
- To learn Testing of Hypothesis for analysis, design of experiments.
- To learn various available statistical tools of quality monitoring.
- To equip the students with the knowledge in quality control.
- To understand basic principles of statistical inference and prepare for further coursework or on-the-job study.

Course Outcome:

Students will be able to

- Relate their subject knowledge with their engineering subjects during the course of study.
- Apply sampling techniques to biological data.
- Design and conduct experiments, as well as to analyze and interpret data.
- Apply various techniques on examples/data in industries and modern engineering tools necessary for engineering practice using design of experiment.
- Understand and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations.
- Apply the techniques in SQC to biological data.

UNIT – I: Statistics

Measures of central tendency, Dispersion, Binomial, Poisson, Normal distributions.

UNIT – II: Distributions
Population, sample, one tailed and two tailed tests, Tests based on large samples, proportion and mean. Tests based on t, F, chi square distributions.

UNIT – III: Design of experiments
Completely randomized design, and Randomized block design, Latin square design –comparison of RBD and LSD.

UNIT – IV:Quality Control
Types of variation, types of control charts X chart, R Chart, C Chart, Advantages and Limitations of SQC

UNIT –V: Acceptance sampling
Single acceptance sampling plan, double sampling plan, construction of a OC curve, AQL and LTPD.

Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and sons., New Delhi, 2009.
2. T.Veerarajan, Probability, Statistics and Random Processes, TataMcGraw Hill, second edition, 2009.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd, 2007.
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II (First revised and enlarged edition), S. Chand & Co., New Delhi, 2000.
5. Gupta S.C., Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
6. Veerarjan T., "Theory of Probability and Random Process", Tata McGraw Hill, 2005.
7. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists" Pearson Education, first Indian reprint, 2002

17MA3012 NUMERICAL METHODS AND BIOSTATISTICS

Credits: 3:0:0

Objective:

- To provide the students with the knowledge in numerical problems.
- To learn the problems related with Eigen values and Eigen vectors.
- To enable the students to solve various engineering problems using numerical methods.
- To equip the students with statistical techniques for biological data.
- To introduce the concept of probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations.
- Perform data analysis efficiently and accurately using data fitting methods.

Outcome:

- At the end of the course, the students would be acquainted with the basic concepts in numerical methods and their uses.
- Upon completion of this course, students will understand and be able to apply basic techniques in descriptive statistics.
- Students will be able to analyze and interpret data.
- Students are able to apply statistics in biological field.
- To analyze data pertaining to attributes and to interpret results.
- Students will be able to solve different kinds of problems that occur in engineering.

UNIT – I: Numerical Methods
Bisection method, Newton-Raphson method, Gauss-Seidel iteration method, Gauss-Jordan method - Eigenvalues and Eigenvectors.

UNIT II: Interpolation
Linear Interpolation, polynomial interpolation, Difference tables, Gregory-Newton interpolation.

UNIT – III: Solution of differential equations
Trapezoidal rule, Simpson's rule, Newton's Three-eights rule. Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution.

UNIT – IV: Statistics
Sampling, frequency distribution, measure of central tendency- Mean median and mode, measure of dispersion, Probability Distribution, binomial, Poisson.

UNIT – V: Curve fitting and correlation
Linear least square fit, nonlinear fit, polynomial fit, coefficient of correlation, multiple correlation, partial correlation, rank correlation.

Reference Books:

1. Balagurusamy E., "Computer Oriented Statistical and Numerical Methods", MacMillan series, Madurai, 2000.(Theory and problems only).
2. Rajaraman V., "Computer oriented numerical methods", Prentice-Hall publications, 2007.
3. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", 6th Edition, New Age International, 2012.
4. Thangaraj . P, "Computer Oriented Numerical Methods", Prentice hall of India Pvt. Ltd, New Delhi, 2008.
5. Grewal B.S, "Higher Engineering Mathematics", 42th Edition, Khanna publishers, New Delhi 2012.
6. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010.
7. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley Publications, 2008.

17MA3013 GRAPH THEORY AND PROBABILITY

Credits: 3:0:0

Objective:

- Understand Graphs and their properties in depth.
- Understand different types of graphs and their limitations.
- Learn graph algorithms for construction and application.
- Learn axioms of probability and distribution functions.
- Knowledge on sampling theory. Their need and areas of application.
- Learn the nuances of fitting the distributions appropriately to get the best estimate.

Outcome:

- Convert real life problems into appropriate graphs to find suitable solutions.
- Students can identify the graph structures applied in the existing fields and improve the efficiency of their application.
- Students can create new algorithms or improve the existing ones to get better efficiency.
- Apply probability concepts in day to day activities since most of the things are probabilistic.
- Apply the right distribution to the problems and give best solutions.
- Use Sampling Distributions for modeling their projects for getting best fit of the statistical averages.

Unit I:Graph Theory

Graph terminology – Representing Graphs and Graph Isomorphism-connectivity- Euler and Hamiltonian paths.

Unit II: Graph Coloring and Tree

Planar graphs – Graph Coloring– Chromatic number –Introduction to Trees – application of Trees- Tree traversal.

Unit III: Spanning Tree

Spanning trees – Rooted trees -Shortest path algorithm Minimal spanning tree-– Kruskal and Prim's algorithms – DFS and BFS algorithms.

Unit IV: Probability

Addition Law – Multiplication law – Conditional Probability. Distributions: Binomial, Poisson and Normal distributions.

Unit V: Sampling distributions

Tests based on large samples, Student's t, F and chi-square test for Goodness of fit, Independence of attributes.

Reference Books:

1. Gupta S.C and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2008.

2. Kenneth Rosen H, "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, Seventh Edition, Reprint 2012.
3. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India, 2011.
4. Bondy A and Moorthy U, "Graph Theory and Applications", McMillan, London, Reprint 2013
5. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
6. T.Veerarajan, Probability, Statistics and Random Processes, TataMcGraw Hill, second edition, 2009.
7. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
models, 10th Edition, Academic Press, 2009.

17MA3013 GRAPH THEORY AND PROBABILITY

Credits: 3:0:0

Objective:

- Understand Graphs and their properties in depth.
- Understand different types of graphs and their limitations.
- Learn graph algorithms for construction and application.
- Learn axioms of probability and distribution functions.
- Knowledge on sampling theory.Their need and areas of application.
- Learn the nuances of fitting the distributions appropriately to get the best estimate.

Outcome:

- Convert real life problems into appropriate graphs to find suitable solutions.
- Students can identify the graph structures applied in the existing fields and improve the efficiency of their application.
- Students can create new algorithms or improve the existing ones to get better efficiency.
- Apply probability concepts in day to day activities since most of the things are probabilistic.
- Apply the right distribution to the problems and give best solutions.
- Use Sampling Distributions for modeling their projects for getting best fit of the statistical averages.

Unit I: Graph Theory

Graph terminology – Representing Graphs and Graph Isomorphism-connectivity- Euler and Hamiltonian paths.

Unit II: Graph Coloring and Tree

Planar graphs – Graph Coloring– Chromatic number – Introduction to Trees – application of Trees- Tree traversal.

Unit III: Spanning Tree

Spanning trees – Rooted trees - Shortest path algorithm Minimal spanning tree-– Kruskal and Prim's algorithms – DFS and BFS algorithms.

Unit IV: Probability
Addition Law – Multiplication law – Conditional Probability. Distributions: Binomial, Poisson and Normal distributions.

Unit V: Sampling distributions
Tests based on large samples, Student's t, F and chi-square test for Goodness of fit, Independence of attributes.

Reference Books:

1. Gupta S.C and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2008.
2. Kenneth Rosen H, "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, Seventh Edition, Reprint 2012.
3. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India, 2011.
4. Bondy A and Moorthy U, "Graph Theory and Applications", McMillan, London, Reprint 2013
5. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
6. T.Veerarajan, Probability, Statistics and Random Processes, TataMcGraw Hill, second edition, 2009.
7. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
   models, 10th Edition, Academic Press, 2009.

17MA3014 FUNDAMENTALS OF STATISTICS

Credits: 3:0:0

Course Objective:
- To provide the students with the basic concepts of statistics
- To develop the skills of the students in the area of Probability.
- To develop the skills of the students in the area of Conditional Probability
- To provide the students the concepts in Probability Distributions.
- To provide the students the concepts in Testing of Hypothesis.
- To understand the basic concepts in ANOVA

Course Outcome:
- Students will be able to make logical conclusions using statistical concepts
- Students will be able to gain knowledge in Probability.
- Students will be able to gain knowledge in Probability Distributions

- To analyses samples for Testing of Hypothesis
- Students are able to use ANOVA to their engineering problem
- Understanding the application of Baye's theorem in engineering fields

Unit I: Basic statistics
Measures of central tendency, Measures of Dispersion -Correlation and regression.

Unit II: Probability and Random Variables
Axioms of probability– Independent events - Bayes' Theorem–Discrete and Continuous random variable.

Unit III: Probability Distributions
Theoretical Distributions - Binomial, Poisson and Normal distributions.

Unit IV: Testing of hypothesis
Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Unit V: Design of experiments
Analysis of Variance– One factor classification – completely randomized design- - two wayclassification – Randomized block design - Latin square design – analysis of design for three factor of classification.

Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and sons., New Delhi, 2009
2. T. Veerarajan, Probability, Statistics and Random Processes, Tata McGraw Hill, Second edition, 2009.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd, 2007.
4. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
5. Gupta S.C., Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
6. Veerarjan T., "Theory of Probability and Random Process", Tata McGraw Hill Publishing Company Science, PHI, 2005.

17MA3015 OPERATIONS RESEARCH TECHNIQUES

Credits: 3:0:0

Course Objective:
- To provide the students with the understanding of basic concepts in Operations Research.
- To learn transportation and assignment problems.
- To develop the skills of students in Queuing models.
- To develop the skills of students in network analysis.
- To develop the skills of students in sequencing.

- To learn the applications of simulation models.

Course Outcome:
Students will be able to
- Relate their subject knowledge with the engineering subjects.
- Apply sequencing problems for modeling.
- Understand queuing model techniques.
- Understand transportation and assignment problems.
- Understand network analysis.
- Understand simulation models.

UNIT I: Linear Programming Problem
Formulation of Linear Programming problem, Graphical Method solution to L.P.P, Simplex Method, Artificial variable technique and two-phase simplex method.

UNIT II: Duality and Sequencing
Duality, Dual and simplex method, Dual Simplex Method, Job sequencing, n jobs through two machines, n jobs through m machines and two jobs through m machines.

UNIT III: Transportation Model
Initial basic feasible solutions, moving towards optimality, Degeneracy, Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

UNIT IV: Queuing model
Introduction to Queuing theory, Problems involving (M\M\1): (∞\FIFO), (M\M\c): (∞\FIFO) Models.

UNIT IV: Network analysis and Simulation models
PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis. Elements of simulation model-Monte Carlo technique – applications.

Reference Books:

1. Handy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
2. Natarajan A.M., Balasubramani P., Tamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
3. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
4. Winston, "Operations Research, Applications and Algorithms" , Cengage Learning, 4th Edition, 2004.
5. Sharma J.K., "Operations Research: Theory and Applications" (3rd Edition) Macmillan Company of India Ltd., 2008.
6. Goel.B.S. Mittal.S.K, "Operations Research" (19th Edition), Pragati Prakashass, 2002.
7. Panneerselvam.R.,"Operations Research", (2nd Edition), Phi Learning Pvt., Ltd., 2010.

17MA3016 STATISTICS AND NUMERICAL MATHEMATICS

Credits: 3:0:0

Course Objective:

- Have the knowledge of basic concepts in Statistics.
- Understand the basic probability theory.
- Provides complete familiarity of probability distributions.
- Describes the solution of Numerical Algebraic and Transcendental Equations
- Have the knowledge of Numerical differentiation and Numerical Integration.
- Develops the technique of Numerical Solution of ordinary differential equations.

Course Outcome:

Students will be able to

- Apply the concepts in Statistics and Numerical methods.
- Define and recognize frequency distributions.
- Analyze the importance of probability distributions.
- Ability to apply correlation and regression analysis for decision-making.
- Have the skill of solving algebraic and transcendental equations.
- Apply numerical techniques for modeling.

Unit I: Statistical Methods

Frequency distributions - Graphs of frequency Distribution – Measures of central Value: Mean, Median and Mode –Measures of Dispersion: Range, Quartile Deviation, Mean deviation and Standard Deviation.

Unit II: Correlation and Regression

Correlation-Scatter diagram- Karl Pearson's coefficient of correlation - Spearman's rank correlation- Regression lines - Regression equations.

Unit III: Probability and Distributions

Probability – Independent events - Conditional probability - Baye's theorem - Expectations - Distributions: Binomial, Poisson and Normal.

Unit IV: Numerical Solution of Equations

The Solution of Numerical Algebraic and Transcendental Equations- Simultaneous linear algebraic equations – Direct methods of solution – Iterative methods of solution.

Unit V: Numerical Solution of Differentiation and Integration

Numerical differentiation - Numerical integration – Numerical Solution of ordinary differential equations – Taylor series method – Euler's method – Fourth order Runge-kutta method.

Reference Books:

1. Gupta S.P., "Statistical Methods", 33rd edition, Sultan Chand & Co., 2004.
2. Venkataraman M.K., "Numerical Methods in Science and Engineering", Revised edition, The National Publishing Company, 2005.
3. Kandasamy P., Thilagavathy K., Gunavathy K., "Numerical Methods", S. Chand & Co. Ltd. Reprint 2009.

4. Veerarajan T., Ramachandran T., "Numerical Methods with Programs in C", Tata McGraw Hill Publishing Company Ltd, Second edition, 2006.
5. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, XI edition, New Delhi, 2002.
6. Veerarajan T., "Probability Statistics and Random Variables", Tata McGraw-Hill, New Delhi, 2004.
7. Thangaraj. P, "Computer Oriented Numerical Methods", Prentice hall of India pvt. Ltd, New Delhi, 2008.

17MA3017 DISCRETE MATHEMATICS

Credits: 3:0:0

Course Objective:

- To develop logical thinking in discrete mathematics
- To have computing skills
- To use knowledge of grammars in compiler design
- To understand the networking concepts
- To apply the concepts of graph in circuits
- To create programs for various computer applications

Course Outcome:

Students will be able to

- To understand various proof methods
- Analyze the truth value of statements
- Compute optimal solution using graphs
- Determine the languages constructed by grammars
- Create new accepting devices
- Determine the languages accepted by machines

Unit I: Logic

Propositional Equivalences - Predicates and Quantifiers – Tautology- Methods of Proof – Mathematical induction - Set operations – special functions- floor and roof functions.

Unit II: Boolean Functions

Logic Gates- Minimization of circuits-Karnaugh map- Quine McCluskey method–Structural Induction-Relations and their Properties-Equivalence relation.

Unit III: Graph Theory

Graph Terminology –Connectivity – Euler path and circuits- Hamiltonian Paths and circuit – Shortest Path Problems, Planar graphs, coloring graphs.

Unit IV: Trees

Tree Traversal – Tree searching – undirected trees-Spanning Trees – Minimum Spanning Trees-Kruskals algorithm- Prims algorithm.

Unit V: Finite Automata

Languages and Grammars –Chomsky hierarchy– Finite-State Machines with Output –Finite State Machines with No Output- Finite state automata.

Reference Books:

1. Kenneth Rosen H., "Discrete Mathematics and its Applications", , Tata McGraw-Hill, Edition 2012.
2. Edgar Goodaire G., Michael Parmeter M., "Discrete Mathematics with Graph Theory", Third Edition, 2003.
3. Lipschultz, "Discrete Mathematics", Schaum's Series, 2002.
4. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.
5. Iyengar N.Ch.S.N., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., "Discrete mathematics", Vikas Publishing, 2003.
6. Swapan Kumar Sarkar, "A textbook of Discrete Mathematics", S. Chand & Company, 2004.
7. LIU C.L; Mohapatra D.P, "Elements of discrete mathematics: A computer oriented approach", TATA McGRAW-HILL publishing company limited, Third edition, 2009.
8. Girish Sharma, Manoj Singhal, "A text book of discrete mathematics", A.K. publications, First edition 2010.

17MA3018 OPTIMIZATION TECHNIQUES

Credit: 3:0:0

Course objective:

To provide the student with the concept and an understanding of basic concepts in

- Linear programming problem,
- Non-linear Programming Models,
- Dynamic Programming,
- Integer programming
- Network techniques
- Application of everything learnt in real life

Course outcome:

- Explain the basic concepts of optimization and to formulate and solve linear programming problems
- Apply the concepts of Dynamic Programming
- Participate in the class room discussion on Non-linear Programming and application
- Explain and apply the concepts of Integer programming
- Explain and Demonstrate the basic concepts of PERT- CPM and their application
- Reproduce the network model

Unit I: Linear Programming

Engineering applications of optimization – classification of optimization problems- **Linear programming**: Formulation of LPP, Solution to LPP by simplex method,

Unit II: Integer programming
Cutting plane algorithm, Branch and bound technique,

Unit III: Dynamic Programming
Air Cargo model, Capital budgeting problem,

Unit IV: Non linear Programming
Lagrangian method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Geometric programming

Unit V: Network Techniques
Shortest Path Model – Minimal Spanning Tree Problem – Maximal flow problem –Introduction to Genetic algorithm.

Reference Books:

1. S. S. Rao, "Engineering Optimization – Theory and Practice", NAI publishers, 2013.
2. R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, NewDelhi, 2005
3. Kalymanoy Deb, "Optimization for Engineering Design", Prentice Hall of India Private Ltd., New Delhi, 2003
4. P.K.Gupta and D.S.Hira, "Practical Problems in Operations Research" – Sultan Chand & Sons, New Delhi, 2008.
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, New Delhi, 2000.
6. J.K.Sharma, "Operations Research – Theory and Applications", Macmillan India Ltd., 2007.
7. Hamdy A.Taha, "Operations Research – An Introduction", Prentice Hall of India, 2012.

17MA3019 ALGEBRA

Credits: 3:1:0

Course Objectives:

- To create the knowledge in basic concept of Algebra
- To impart the knowledge of number theory and congruence.
- To provide the students with the concept and the understanding in group structure and elementary theorems of group
- To develop the knowledge in Fundamental Theorem on Finite Abelian Groups
- To equip the students with the knowledge of ring theory
- To learn about Unique Factorization Theorem.

Course Outcomes:

- Students will be able to apply knowledge of real numbers, their operations and basic properties.
- Developing the skills in solving systems of linear equations and find the greatest common divisor.
- Students are able to apply class equation and Sylow's theorems to solve different problems.
- Understand and be able to apply the fundamental theorem of finite abelian groups.
- The student will be able to define and work with the concepts of homomorphism and isomorphism.
- Students are able to get the knowledge of Euclidean domains, unique factorization domains.

Unit I: Divisibility theory of integers
Divisibility in Integers, Division Algorithm, Euclidean Algorithm, Primes, Fundamental Theorem of Arithmetic,

Unit II: The theory of Congruence's
Basic Properties of Congruence's, Linear Congruence's, Chinese Remainder Theorem, Fermat's Theorem, Wilson's Theorem, Euler's Phi Function, Primitive Roots.

Unit III: Sylow's theorem
Sylow's Theorem for Abelian Groups, Cayley's Theorem, Permutation Groups, Class Equations, Sylow's Theorem.

Unit IV: Direct products
Direct Products, Fundamental Theorem on Finite Abelian Groups.

Unit V: Ring Theory
Ideals and Quotient Rings, Euclidean Ring, Principal Ideal Ring, Unique Factorization Theorem, Ring of Gaussian Integers, Introduction to Fields.

Reference Books:

1. HersteinI.N, "Topics in Algebra", Second Edition, Wiley India (P) Ltd., 2009.
2. John B.Fraleigh, "A First Course in Abstract Algebra", 7th Edition, Pearl Books, 2008.
3. David M.Burton, "Elementary Number theory", 7th Edition, McGraw-Hill Education(India) PVT.LTD., 2013
4. Alan Baker, "A Comprehensive course in Number theory", Cambridge University Press, 2013.
5. M K Sen, Shamik Ghosh, Parthasarathi Mukhopadhyay, "Topics in Abstract Algebra", University Press, 2006.
6. Ivan Niven , Herbert S. Zuckerman , Hugh L Montgomery , "An Introduction To The Theory Of Numbers", 5th Edition, Wiley India Pvt Ltd, 2008.

17MA3020 ORDINARY DIFFERENTIAL EQUATIONS

Credits: 3:1:0

Course Objectives:

- To read about Linear Differential Equations
- To understand the concept of Nonlinear Differential Equations
- To explain the method of fixed point technique
- To analyze the method of Monotone Iterative Technique
- To determine the existence of nonlinear differential equations
- To develop the applications of Boundary Value Problems.

Course Outcomes:

- Students are able to describe the method of successive approximations
- Students are able to classify the method of fixed point technique
- Understand and be able to apply the method of Monotone Iterative Technique
- Developing the skills in analyze the Picard's Theorem
- Understand and be able to evaluate the Gronwall's inequality
- Students will be able to construct the applications of Sturm-Liouville Problem

Unit I: Systems of Linear Differential Equations

Existence and Uniqueness Theorem, Fundamental Matrix.

Unit II: Non homogeneous Linear Systems

Successive Approximations, Picard's Theorem, Examples, Fixed Point Method.

Unit III: Analysis and Methods of Nonlinear Differential Equations

Existence Theorem, Extremal Solutions, Upper and Lower Solutions, Monotone Iterative Method and Method of Quasi linearization, Gronwall's Inequality, Bihari's Inequality, Variation of Parameters(Nonlinear Version).

Unit IV: Boundary Value Problems

Sturm-Liouville Problem, Green's Functions.

Unit V: Applications of BVP

Picard's Theorem, Stum's Comparision Theorem.

Reference Books:

1. Deo S.G, Lakshimikantham V and Raghavendra V, "Textbook of Ordinary Differential Equations", 2nd Edition, Tata McGraw-Hill Ltd., 2009.
2. Coddington E.A, "An introduction to Ordinary Differential Equations", Prentice Hall of India Ltd., New Delhi, 2009.
3. Jordan D.W and Smith P, "Nonlinear Ordinary Differential Equations: An introduction for Scientists and Engineers", 4th Edition, Oxford University press, 2009.
4. Ravi P, Agarwal and Donal O'regan, "An Introduction to Ordinary Differential Equations", Springer, 2012.
5. Henry Ricardo, " A Modern Introduction to Differential Equations", Houghton Miffince, 2002.
6. George F. Simmons, "Differential Equations with Applications and Historical notes", TMH, 1991.

17MA3021 CLASSICAL MECHANICS

Credits: 3:1:0

Course Objectives:

- To provide the students with the understanding of particle dynamics.
- To equip the students with the concept of Lagrangian and Hamiltonian formulations.
- To learn about the method of small oscillations.
- To develop the skills with the variation techniques.
- To understand the various methods of dynamics of rigid body.
- To understand the various applications of rigid body motions.

Course Outcomes:

- Students will be able to apply particle dynamics in practical problems.
- Updating the knowledge with Lagrangian and Hamiltonian models.
- Developing the skills in solving small oscillational problems.
- Students will be able to understand the variation techniques involved in real life problems.
- Students will be able to apply the concept of rigid body motions in modeling and analysis.
- Students will be able to demonstrate the mathematical model with experimental data.

Unit - I: Particle Dynamics

Basic Concepts, Constraints, Generalized Coordinates, Virtual Displacement, Virtual Work, D'Alembert's Principle.

Unit-II: Lagrangian and Hamiltonian Formulations

Lagrange's Equations, Rayleigh Function, Galilean Transformation, Legendre Transformation, Hamilton's Equations, Ignorable Coordinates, Conservation Laws.

Unit - III: Small Oscillations

Stable and Unstable Equilibrium, Formulation of the Problem, The Orthogonality of Eigen Vectors, Normal Coordinates.

Unit – IV: Variation Techniques

Hamilton's Principle, Principle of Least Action.

Unit-V: Dynamics of a Rigid Body

The Inertia Tensor, Angular Momentum, The Eulerian Angles, Euler's Dynamical Equations for the Motion of a Rigid Body, Motion of a Symmetrical Top.

Reference Books:

1. Herbert Goldstein, Charles P.Poole, John Safko, "Classical Mechanics",Pearson Education, 2012.
2. Vimal Kumar Jain, "Classical Mechanics", Ane Books Pvt. Ltd., 2009.
3. GuptaS.L, Kumar V, SharmaH.V, " Classical Mechanics", PragatiPrakashan,

2008.
4. Sankara Rao K, "Classical Mechanics", PHI, 2005.
5. GreenwoodD.T, "Classical Dynamics", PHI, New Delhi, 1997.

17MA3022 REAL ANALYSIS

Credits: 3:1:0

Course Objectives:

- Students have the knowledge of basic properties of the field of real numbers.
- To create the knowledge in Archimedean property and Cauchy – Schwarz inequality.
- To generate the knowledge of basic concepts in Set theory.
- To create the knowledge in Bolzano - Weierstrass theorem.
- To equip the students with the knowledge of continuity and differentiability of real functions
- To create the knowledge in Sequence and Series of functions.

Course Outcomes:

Student will be able to

- Understand the axiomatic foundation of real number system, in particular the idea of completeness and some of its consequences.
- Define and recognize the Archimedean property and Cauchy – Schwarz inequality.
- Describe the fundamental types of point sets, such as open sets, closed sets, compact sets and more generally, sets in higher dimensional spaces.
- Define and recognize the Bolzano – Weierstrass theorem and ability to apply the theorem in a correct mathematical way.
- Know how completeness, continuity and other notions are generalized from the real line to metric spaces.
- Student will be able to demonstrate how the sequences of functions lead to the methods of convergence, especially uniform convergence.

Unit I: Real Number system

Axioms – Unique factorization theorem - Least Upper Bound andGreatest Lower Bound - Archimedean property – Absolute values and the triangle inequality - Cauchy-Schwarz inequality.

Unit II: Some Basic Notions of Set Theory

Cartesian product of two sets - Relations and functions – Composite functions – Finite and infinite sets - Countable and uncountable sets.

Unit III: Euclidean Space R^n

Open balls and open sets in R^n – Closed sets – Adherent and accumulation points - Bolzona-Weierstrass Theorem - Cantor Intersection Theorem - Heine-Borelcovering Theorem.

Unit IV: Limits and Continuity

Convergent sequences in a metric space – Limit of a function - Continuous functions - Continuity of composite functions - Uniform Continuity – Fixed point theorem for contractions – Derivatives and continuity - Rolle's theorem - Mean value theorem for derivatives.

Unit V: Sequence and series of functions
Pointwise convergence of sequences of functions - Uniform convergence – Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions - Uniform convergence and differentiation – Sufficient condition for uniform convergence of a series.

.**Reference Books:**

1. Apostol T. M, "Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. Malik S.C, Savita Arora, "Mathematical Analysis", Third Edition, New Age International Ltd., 2008.
3. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
4. Walter Rudin," Principles of Mathematical Analysis", Tata McGraw Hill, 2013.
5. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.

17MA3023 COMPLEX ANALYSIS

Credits: 3:1:0

Course Objectives:

- To read the concept of analytic functions
- To express trigonometric complex functions
- To explain the concept of contour integration
- To develop the concept of singularities
- To determine the applications of Mappings
- To develop the application of Residue Theorem

Course Outcomes:
Student will be able to

- Identify the applications of the analytic functions in other branches of mathematics
- Demonstrate the uses of the complex trigonometric functions in other branches
- Apply the concept of contour integration to engineering fields.
- Illustrate the uses of singularities in other branches
- Demonstrate the uses of mappings in physics.
- Get the knowledge of applications of Residue theorem in engineering fields.

Unit I: Analytic functions
Derivatives of Complex Valued Functions-R Equations, Differentiability and Uniqueness of Power Series.

Unit II: Elementary Functions
The Exponential Function, Trigonometric Function, Complex Hyperbolic Functions.

Unit III: Complex Integration
Contour Integration, Cauchy's Integral formula, Uniqueness Theorem, Maximum Modulus Theorem, Simply Connected Region, Singularities, Laurent's Series Expansion,

Unit IV: The calculus of Residues
Evaluation of Residues, Application of Residue theorem, Evaluation of Definite Integrals, Summation of Series,

Unit V: Mappings
Conformal Mappings, Schwarz–Christoffel Transformation, Special Transformations, Bilinear Transformations.

Reference Books:

1. Anuradha Gupta, "Complex Analysis", Ane Books Pvt. Ltd, New Delhi, 2011.
2. James Ward Brown, Ruel V. Churchill, "Complex Variables and Applications", McGraw Hill pvt.Ltd., 2009.
3. Lars Ahlfors V, "Introduction to the Theory of functions of a Complex Variable", (3rd edition) 2nd Reprint, McGraw Hill Co., New York, 2013.
4. Tang K.T, "Mathematical Methods for Engineers and Scientists: Complex Analysis, Determinants and Matrices", Springer, 2007.
5. Dube K.K, "Fundamentals of Complex Analysis, Theory and Applications", International publishing house pvt.ltd, 2009.

17MA3024 LINEAR ALGEBRA

Pre-Requisite: 17MA3019 Algebra
Credits: 3:1:0

Course Objectives:
- To provide the student with the understanding of basic concepts of Bases and Dimension.
- To learn various properties of Linear Transformations.
- To learn various conditions for characteristics roots.
- To learn various properties of different canonical forms of matrix.
- To equip the students with the knowledge of matrix algebra.
- To understand the concepts of rank and signature of the matrices.

Course Outcomes:
Students will be able to strengthen their knowledge in
- Bases and Dimension
- Linear Transformations and its matrix forms.
- Minimal polynomials
- Different canonical forms of matrix
- Classification of quadratic forms
- Rank and signature.

Unit I: Vector Spaces
Basic Concepts, Linear Independence, Bases and Dimension.

Unit II: Linear Transformations
Algebra of Linear Transformations, Matrix Representation of Linear Transformations.

Unit III: Diagonalization
Characteristic Roots, Characteristic Vectors, Minimal Polynomials.

Unit IV: Canonical forms
Triangular Forms, Nilpotent Transformations, Jordan Forms, Rational Canonical Forms.

Unit V: Algebra of Matrices
Trace and Transpose Determinants, Real Quadratic Forms, Classification of Quadratic Forms, Reduction, Sylvester's Law, Rank and Signature**.**

Reference Books:

1. Herstein I.N, "Topics in Algebra", Second Edition, Wiley India (P) LTD., 2009.
2. Kenneth Hoffman and Ray Kunze, "Linear Algebra", Second Edition, Prentice Hall of India Private Limited, 2005.
3. Jimmie Gilbert, "Linear Algebra and Matrix Theory", First Edition, Academic Press, 2005.
4. Jin Ho Kwak and Sungpyo Hong, "Linear Algebra", Second Edition, Birkhauser Publication, 2005.
5. Klaus Janich, "Linear Algebra", First Indian Reprint, Springer Publication, 2004.
6. Seymour Lipschutz and Marc Lars Lipson, "Theory and Problems of Linear Algebra", Third Edition, Tata McGraw – Hill Publishing Company Ltd, 2006.
7. A.R. Vasishtha, " Matrices", Twentieth Edition, Krishna Prakashan Mandir, 1993.

17MA3025 TOPOLOGY

Credits: 3:1:0

Course Objectives:

- Toacquire knowledge about topological space, metric space, continuity, connectedness, compactness, separation axioms and algebraic topology.
- To understand the concepts of topological spaces.
- To apply the basic concepts of topological spaces and define metric topology, continuity, connectedness, compactness and algebraic topology.
- To analyze the problems of connectedness and compactness and apply the basic concepts topology in it.
- To synthesis the basic ideas of topology and define separation axioms, algebraic topology.
- To evaluate some new characterizations of topology.

Course Outcomes:

- Students will get the knowledge of topology and algebraic topology
- Student will be able apply the basic concepts of topology and define metric topology, continuity, connectedness, compactness.
- Student will be able to construct the ideas of separation axioms.
- Students will get knowledge of characterizing new ideas in continuity, connectedness and compactness using the basic concepts of topology
- Student will be able to demonstrate the relationship among all the separation axioms
- Understand and be able to understand the basic concepts of fixed-point theorem.

Unit I: Introduction

The Nature and Origin of Topology**,** Review of the Concepts in Sets: operations on sets, Cartesian products, Functions and equivalence relations. **Metric Spaces**: Review of the Basic Concepts**,** Continuous Functions, Complete Metric Spaces.

Unit II: Topological Spaces

Basic concepts: Interior, closure and boundary – Examples and properties - Basis and Subbasis - Continuity and topological Equivalence - Subspaces: The Zariski topology – Properties of subspace topology.

Unit III: Connectedness

Connected and disconnected spaces, Connected subsets of the real line – Compactness: Compact spaces and subspaces, compactness and continuity, Properties related to compactness

Unit IV: Product Spaces

Finite and arbitrary products, Comparison of Topologies - Quotient Spaces.Separation axioms: T_0, T1, T2- Spaces, Regular Spaces, Normal spaces: Properties and theorems - Separation by Continuous Functions.

Unit V: Algebraic Topology

The nature of algebraic topology, the Fundamental Group, Examples – the fundamental group of S^1 - the Brouwer Fixed Point Theorem and related results, Categories and Factors.

Reference Books

1. Fred H.Croom, “Principles of Topology”, Cengage Learning, 2009.
2. Paul L.Shick, “Topology: Point set and Geometric”, Wiley Inter Science, 2013.
3. James R.Munkres,”Topology”, Second edition, Pearson Prentice Hall, 2008.
4. Murdeshwar M.G,“General Topology”, New Age International Publisher, 2008.
5. Malik A.K, and Singh S.R, “Topology”, International Publishing House Pvt.Ltd. 2012.
6. Stephen Willard, “General Topology”, Dover Publications Inc., 2004.

17MA3026 PARTIAL DIFFERENTIAL EQUATIONS

Pre-Requisite: 17MA3020 Ordinary Differential Equations

Credits: 3:1:0

Course Objectives:

- To read first order linear partial differential equations
- To discuss about first order nonlinear partial differential equations
- To classify the second order partial differential equations
- To analyze about boundary value problems
- To determine uses of one dimensional diffusion equation
- To explain about one-dimensional and two-dimensional wave equations.

Course Outcomes:

- Students get the knowledge of Lagrange's method
- Students will get the knowledge of Cauchy method of characteristics
- Student will be able examine about Charpit's method
- To analyze about Dirichlet problem
- Students will get knowledge about separation of variables method
- Understand and be able to develop the uses of method of Eigen functions.

Unit I: First Order PDEs

Lagrange's Method, Cauchy Problem for First Order Partial Differential Equations, First Order Nonlinear Equations, Cauchy Method of Characteristics, Compatible Systems, Charpit's Method.

Unit II: Second Order PDEs

Classifications, Canonical Forms, Derivation of Laplace, BVP, Separation of Variables, Dirichlet Problem.

Unit III: Laplace equation

Solution of Laplace Equation in Cylindrical and Spherical Coordinates.

Unit IV:Diffusion Equation

Diffusion Equation, Dirac-Delta Function, Separation of Variables Method,
Solution of Diffusion Equation in Cylindrical and Spherical Coordinates.

Unit V: Wave equation

One-Dimensional Wave Equation, Vibrating String, Variable Separable Solution, Two Dimensional Wave Equation, Method of Eigen Functions.

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Reference Books:

1. Sankara Rao K, "Introduction to Partial Differential Equations", 3rd Edition, PHI Learning .Ltd., 2011.
2. Hillen T, Leonard I.E and Van Roessel H, "Partial Differential Equations", Wiley, 2012.
3. Jianhong WU, "Theory and Applications of Partial Differential Equations", Springer, 2005.

4. Victor Henner, Tatyana Bolozerova and Mikhail Khenner, "Ordinary and Partial Differential Equations", A K Peters/CRC Press, 2013.
5. Robert C.Mcowen, "Partial Differential Equations: Methods and Applications", Pearson Education Asia, 2004.
6. Ian Naismith Sneddon, "Elements of Partial Differential Equations", Dover Publications, 2006.

17MA3027 FIELD THEORY

Pre-Requisite: 17MA3019 Algebra.
Credits: 3:1:0

Course Objectives:

- To provide the student with the understanding of basic concepts of different kind of fields
- To understand various properties of division rings.
- To create knowledge in various properties of primitive polynomials.
- To apply knowledge in various extension of field theory.
- To equip the students with the knowledge of roots of polynomials and splitting field.
- To understand principles of Galois Theory and normal extension.

Course Outcomes:

Students will be able to understand the proof techniques in

- Wedderburn Theorem on Finite Division Ring,
- Different kind of rings
- Eisenstein Irreducible Criterion,
- Extension of fields.
- Solvability by radicals.
- Galois Theory and Normal Extension.

Unit I: Finite and infinite Field

Axioms of the fields, Infinite Fields and Finite Fields , Wedderburn'sTheorem on Finite Division

Unit II: Polynomial Rings

Rings, Polynomial Rings, The Division Algorithm, Polynomial Rings over the Rational Field, PrimitivePolynomials, Gauss Lemma, Eisenstien Irreducible Criterion,

Unit III: Field Extension

Extension of Fields, Algebraic Extension, Finite Extension, Minimal Polynomial,

Unit IV: Splitting field

Roots of Polynomials, Splitting Field, Construction with Straight Edge and Compass, SimpleExtension

Unit V: Galois Theory

Galois Group,Fixed Field, Normal Extension, Solvability by Radicals, Galois Group over Rationals.

Reference Books:

1. HersteinI.N, "Topics in Algebra", Second Edition, Wiley India (P) LTD., 2009.
2. Joseph A.Galilean, "Contemporary Abstract Algebra", Cengage learning, 2014.
3. Joseph Rotman, "Galois Theory", Second Edition, Springer, 2005.
4. Bhattacharya P.B, Jain S.K, Nagpaul S.R, " Basic Abstract Algebra", Second Edition, Cambridge University Press, 2012.
5. John M.Howie, "Fields and Galois Theory", Springer, 2008.

17MA3028 ADVANCED CALCULUS

Pre-Requisite: 17MA3022 Real Analysis.
Credits: 3:1:0

Course Objectives:

- To provide the student with the understanding of basic concepts of Functions of Bounded Variation
- To compose various properties of Riemann-Stieltjes Integral.
- To formulate various conditions for Existence of Riemann Integrals.
- To learn various properties of Measurable set and Measurable Functions.
- To equip the students with the knowledge Directional Derivative, Continuity and the Total Derivative
- To understand the principles of Inverse and Implicit function theorems.

Course Outcomes:

Students will be able to strengthen their knowledge in

- Functions of Bounded Variation
- Riemann-Stieltjes Integral
- Lebesgue Integral
- Measurable Sets on the Real Line
- Convergence Theorems
- Inverse & Implicit Function Theorems.

Unit I: Function of Bounded Variation

Functions of Bounded Variation – Total variation – Additive property of total variation - Function of bounded variation expressed as the difference of increasing functions - Rectifiable Curves

Unit II: Riemann-Stieltjes Integral

Reduction to a Riemann Integral – Riemann's condition - Differentiation under the Integral Sign, Conditions for Existence of Riemann Integrals

Unit III: Uniform Convergence and Integration

Uniform Convergence with example - Lebesgue Integral – Levi Convergence Theorems – Lebesgue dominated convergence theorem. Improper Riemann Integrals

Unit IV: The Directional Derivative

Measurable Functions - Measurable Sets on the Real Line - Riesz-Fischer Theorem - The Directional Derivative and Continuity - The Total Derivative - The Total Derivatives Expressed in Terms of Partial Derivatives,

Unit V: Implicit function and extremum problems
Function with non-zero Jacobian determinant - Inverse Function Theorem, Implicit Function Theorem.

Reference Books:

1. Apostol T.M, "Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. Malik S.C, Savita Arora, " Mathematical Analysis", Third Edition, New Age international Ltd., 2008.
3. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
4. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.
5. Walter Rudin, "Principles of Mathematical Analysis", Third Edition, McGraw-Hill, New York, 2013

17MA3029 NUMERICAL ANALYSIS

Pre-Requisite: 17MA3020 Ordinary Differential Equations,
17MA3026 Partial Differential Equations,
17MA3024 Linear Algebra.

Credits: 3:1:0

Course Objectives:

- To have the knowledge of numerical methods for solving algebraic and transcendental equations
- To develop skills to use numerical methods to solve a linear system of equations
- To use various numerical methods in a modern computer language
- To have a overview of different numerical methods of solving equations
- To apply numerical methods in solving engineering problems
- To analyze data using numerical methods

Course Outcomes:
Students will be able to

- Remember various numerical methods of solving problems
- Select a approximate a function using an appropriate numerical method
- Do error analysis for a given numerical method
- Compute a definite integral using an appropriate numerical method.
- Student will be able calculate the roots of an equation using numerical methods
- Solve ordinary differential equations using numerical methods

Course Contents:
Unit I: Numerical Solutions of Algebraic and Transcendental Equations

Method of Iteration and Newton-Raphson Method, Bisection method-Rate of Convergence.

Unit II: Solutions of Systems of Linear Algebraic Equations
Gauss Elimination, LU Decomposition and Gauss –Jordan method-Gauss-Seidel Methods-Gauss Jacobi method.

Unit III: Interpolation
Finite Differences, Lagrange Interpolation Formulae, Hermite Interpolation Formulae, Spline Interpolations, Linear Splines, Quadratic Splines and Cubic Splines.

Unit IV: Numerical Calculus
Numerical Differentiation, Errors, Cubical Spline Method, Numerical Integration, Trapezoidal Rule, Simpson's one-third Rule, Simpson's Three-Eighth Rule, Boole's and Weddle's Rule, Use of Cubic Splines

Unit V: Numerical Solutions of ODE:
Numerical Solutions of ODE using Picard method, Euler method, Modified Euler method, Runge Kutta Methods, Predictor – Corrector Method.

Reference Books:

1. Sastry S.S, "Introductory Methods of Numerical Analysis", PHI, 2005.
2. Richard L.Burden, Douglas Faires J, "Numerical Analysis", 9th edition, Cengage Learning India Private Limited, 2012.
3. Samuel D.Conte, Carl De Boor, "Elementary Numerical Analysis: An Algorithmic Approach", Third Edition, TMG, 2009.
4. Madhumangal Pal, "Numerical Analysis for Scientists and Engineers: Theory and C Programs", Narosa Publishing House, 2011.
5. Rama B.Bhat, Chakraverty S, Numerical Analysis in Engineering, Narosa Publishing House, 2004

17MA3030 FUNCTIONAL ANALYSIS

Pre-Requisite: 17MA3022 Real Analysis, 17MA3025 Topology,
17MA3024 Linear Algebra.

Credits: 3:1:0

Objectives

- To discover the knowledge of the students with the understanding of basic concepts of Banach spaces
- Reconstructing the methods in Operators &Functional
- Recalling the application of Hilbert spaces
- Identifying the usage of Closed and open mapping theorems
- Summarizing the Various operators
- Classifying the application of normed linear spaces.

Outcomes

Students will be able to have Knowledge in applications of

- Justifying the method and application of Hahn-Banach Theorem,
- Relating the Open Mapping Theorem with other mathematical concepts.
- Synthesizing the Banach Fixed Point Theorem,
- Relating Orthonormal Basis with Hilbert space
- Justifying the Linear and Unitary Operators
- Indicating the Relation between Banach Spaces and Hilbert Spaces.

Unit I: Normed linear spaces

Basic Concepts, Properties, Examples of a normed linear spaces, Banach Spaces, Linear Operators, Bounded and Continuous Linear Operators,

Unit II: Linear Functionals

Hahn-Banach Theorem, Uniform boundedness Principle, Open Mapping Theorem, Closed Graph Theorem, Banach Fixed Point Theorem, Applications.

Unit III: Hilbert Spaces

Inner Product Spaces, Hilbert Space, complex Hilbert space, real banach space, real Hilbert spaces, incomplete normed linear spaces, simple theorems.

Unit IV: Relation between Banach Spaces and Hilbert Spaces

Orthonormal Basis, introduction and definitions, Representation of a Functional on a Hilbert Space, simple theorems.

Unit V: Operator

Introduction, Definitions, standard results , self –adjoint, Normal and Unitary Operators, Hilbert –schmidt operators ,simple problems and theorems.

Reference Books:

1. Simmons G.F., "Introduction to Topology and Modern Analysis", Tata McGraw Hill Publishing Company, 2009.
2. Thambar Nair M. "Functional Analysis: First Course", PHI, 2002.
3. Peter D. Lax, "Functional Analysis", Wiley Publishing Inc. 2014.
4. Francis Hirsch, Gilles Lacombe "Elements of Functional Analysis", Springer, 2010.
5. Kreyszig E., "Introductory Functional Analysis with Applications", John Wiley & Sons, New York, 2001.

17MA3031 CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Pre-Requisite: 17MA3020 Ordinary Differential Equations,
17MA3021 Classical Mechanics,
17MA3026 Partial Differential Equations, **17MA3024** Linear Algebra.

Credits: 3:1:0

Course Objectives:

- Imparts ideas and techniques of calculus of variations and integral equations.
- Understand variational methods for boundary value problems in ordinary and partial differential equations.
- Describes solution to different types of Integral equations.
- Have complete familiarity with Fredholm Type Integral equations
- Have the knowledge of Volterra Type Integral equations
- Provides thorough knowledge of characteristic numbers and Eigen functions.

Course Outcomes:

- Students will be able to explore the methods for finding maximum or minimum of a functional over a class of functions.
- Students will be able to identify the applications of calculus and variations to engineering and science.
- Students will have the skills to solve the IVP & BVP using the techniques of Linear Integral equations.
- Ability to solve differential equations using the techniques of integral equations.
- Know how to solve Fredholm and Volterra integral equations
- Students will be able to define and recognize the characteristic numbers and eigen functions.

Unit I: Variational problems with fixed boundaries

The Concepts of Variation and its properties Euler–Lagrange's equation - Necessary and sufficient conditions for extrema – Functionals on higher order derivatives – functions of several independent variables- variational problems in parametric form.

Unit II: Direct methods in Variational problems

Variational methods for Boundary Value Problems in Ordinary and Partial Differential equations, Simple problems and simple applications.

Unit III: Integral Equations

Introduction - Linear and Non-linear Integral equations – Fredholm integral equation, Volterra Integral equation of the first and second kind.

Unit IV: Conversion of Differential equations into integral equations

Method of converting an initial value problem into a Volterra integral equation – Alternative method of converting an initial value problem into a Volterra integral equation- Method of converting a boundary value problem into a Fredholm integral equation.

Unit V: Integral equations with Special kinds of kernels

Solutions with Separable Kernels, Symmetric kernels and Resolvent Kernel - Characteristic numbers and Eigen functions.

Reference Books:

1. Gupta. A.S, "Calculus of Variations with Applications", PHI , 2014.
2. Van Brunt, Bruce, "The Calculus of Variations", Springer Publications, 2004.

3. Dr. Ajay Pratap, "Special Functions in Mathematics (Linear integral equations)", University Science Press, New Delhi, 2011.
4. Andrei D. Polyanin, Alexander V. Manzhirov, "Handbook of Integral equations", Chapman & Hall/CRC, 2008.
5. KanwalR.P, "Linear Integral Equations: Theory & Technique", Springer, 2013.
6. Dr. Shanthi Swarup, "Integral equations", 19th Edition, Krishna Prakashan Media Pvt Ltd, 2010.
7. Dr. Goyal, Linear Integral Equations, 19th Edition, Jaipur Publishing house, 2010.
8. Elgolts L, "Differential Equations & Calculus of Variation", Mir Publisher, 1977.

17MA3032 - TENSOR ALGEBRA AND TENSOR CALCULUS

Pre-requisite:17MA3024 Linear Algebra, **17MA3034** Differential geometry
Credits: 3:1:0

Course objective:

- To provide the knowledge about the generalization of vectors to tensors.
- To equip the students with the concept of tensor algebra.
- To learn about the fundamentals of tensor algebraic structures.
- To develop the skills with the tensor calculus.
- To understand the various idea of tensor with transformation coordinates.
- To understand the various applications of tensor calculus.

Course outcome:

- Students will be able to apply vectors and tensors in practical problems.
- Updating the knowledge with tensor algebra models.
- Developing the skills in solving tensor algebraic structures problems.
- Students will be able to understand the tensor calculus involved in real life problems.
- Students will be able to apply the concept of tensor with transformation coordinates in analysis.
- Students will be able to demonstrate the physical law in to tensor calculus.

Unit I: Tensor Algebra
Systems of Different orders – Kronecker Symbols – Transformation of coordinates in Sn – Invariants – Covariant and Contra variant vectors.

Unit II : **Classification of Tensor**
Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors.

Unit III: Multiplication
Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor of Tensor – Relative Tensor – Cross Product of Vectors.

Unit IV: Tensor Calculus

Riemannian Space – Christoffel Symbols and their properties

Unit V: Tensor Calculus (contd)
Covariant Differentiation of Tensors – Riemann-Christoffel Curvature Tensor – Intrinsic Differentiation-Geodesics.

Reference Books:

1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, *Tensor Calculus*, Narosa PublishingHouse, New Delhi, 2012.
2. Landsberg J.M, "Tensor: Geometry and Applications", American Mathematical Society, 2012.
3. Charle Harper, Introduction to Mathematical Physics", PHI Learning private limited, NewDelhi, 2012.
4. David C.Kay, "Schaum's Outline of Tensor Calculus", Schaum's Outline, Revised Edition, 2011.
5. Springer C.E, "Tensor and Vector Analysis with Applications to Differential Geometry", Dover Publications. Inc., New York, 2012.

17MA3033 CONTROL THEORY

Pre-Requisite: **17MA3020** Ordinary Differential Equations,
17MA3021 Classical Mechanics, **17MA3026** Partial Differential Equations,
17MA3024 Linear Algebra.
Credits: 3:1:0

Course Objectives:
- To acquire basic knowledge about Control Theory
- To distinguish linear & nonlinear systems
- To motivate the uses & concepts of Controllability
- To provide the students about the knowledge in Stabilizability
- To motivate the students to know about the Optimal Control
- To express optimal control in Matrix equation

Course Outcomes:
- Students comprehend the advanced concept in Control Theory
- Students use linear & nonlinear systems appropriately
- Students apply Controllability concept in their subjects
- Students imbibe knowledge about stability in linear & nonlinear systems
- Students estimate stabilizability for various methods
- Students compute & conclude optimal control for linear & nonlinear systems

Unit I: OBSERVABILITY
Linear Systems, Observability Grammian, Constant Coefficient Systems, Reconstruction Kernel, Nonlinear Systems.

Unit II: CONTROLLABILITY
Linear Systems, Controllability Grammian, Adjoint Systems. Constant Coefficient Systems, Steering Function Nonlinear Systems.

Unit III: STABILITY
Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear Time Varying Systems – Perturbed Linear Systems – Nonlinear Systems.

Unit IV: STABILIZABILITY
Stabilization via Linear Feedback Control – Bass Method – Controllable Subspace – Stabilization with Restricted Feedback.

Unit V: OPTIMAL CONTROL
Linear Time Varying Systems with Quadratic Performance Criteria – Matrix Riccati Equation – Linear Time Invariant Systems – Nonlinear Systems.

Reference Books:

1. K. Balachandran and DauerJ.P, "Elements of Control Theory", Oxford: Alpha Science International, 2012.
2. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall, 2009.
3. ZdzislawBubnicki, "Modern Control Theory", Springer, First Indian Reprint, 2007.
4. Donald E. Kirk, "Optimal Control Theory: An introduction", Dover publication inc, Dover Edition first, 2004.
5. Thomas A. Hughes, "Measurement and Control Basics", 4th Edition, International Society of Automation, 2006.

17MA3034 DIFFERENTIAL GEOMETRY

Pre-Requisite: 17MA3020 Ordinary Differential Equations
Credits: 3:1:0

Course Objectives:
- To understand classical concepts in the local theory of curves and surfaces.
- To provide the students with the basic knowledge on Local Intrinsic Properties of Surface
- To acquire the knowledge of Geodesic on a Surface.
- Students will be able to understand the property of Geodesics and Existence Theorems, Geodesic Parallels, and Gauss Bonnet Theorems.
- To classify the distinction between intrinsic and extrinsic aspects of surface geometry
- To provide the students with basic tools and competences regarding the analysis and applications of curves and surfaces in 3D.

Course Outcomes:
Students will be able to

- Analyze and solve complex problems using appropriate techniques from differential geometry.
- Apply problem solving with differential geometry to diverse situations in physics, engineering or other mathematical contexts.
- Apply differential geometry techniques to specific research problems in mathematics or other fields
- Apply the concepts of Geodesic on a Surface
- Students will be able understand the concept on Geodesic Parallels and Gauss Bonnet.
- Apply the knowledge on curves and surfaces in 3D.

UNIT I: Theory of Space Curves
Introduction, Definitions, Arc-length, Tangent, Normal and Binormal, The Curvature and Torsion of a curve given as the intersection of two surfaces.

UNIT II: Theory of Surfaces in Three Dimensional Euclidean Space
Contact between curves and surfaces, Tangent surface, involutes and evolutes, Intrinsic equations, fundamental existence theorem for space curves, Helices.

UNIT III: Metric
Definition of a surface, Curves on a surface, Surfaces of revolution, Helicoids, Metric, Direction coefficients, Families of curves, Isometric correspondence.

UNIT IV: Geodesics
Intrinsicproperties, Geodesics, Canonical geodesic equations, Normal property of geodesics, Existence theorems, Geodesic parallels.

UNIT V: Local Intrinsic Properties of a Surface
Geodesic curvature, Gauss-Bonnet theorem, Gaussian curvature, Surfaces of constant curvature.

Reference books

1. Willmore T.J., "An Introduction to Differential Geometry", Oxford University Press,(17thImpression) New Delhi 2002. (Indian Print).
2. Andrew Pressley, "Elementary Differential Geometry", Springer 2004.
3. Thomas F. Banchoff and Stephen T., "Differential Geometry of Curves and Surfaces", A K Peters/CRC Press, 2010.
4. Thorpe J.A., "Elementary topics in Differential Geometry", under - graduate Texts in Mathematics, Springer - Verlag ,2004
5. Kumaresan S, "A Course in Differential Geometry and Lie Groups", Hindustan Book Agency, 2002.

17MA3035 MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Credits: 3:0:0

Course Objectives:
- To create the knowledge in solving problems on numerical aptitude.
- To train the students for solving problems on Arithmetic and Mensuration.

- To motivate the students to give importance for numerical problems in Competitive Examinations.
- To develop the students with Short Cut Methods to solve the problems on Arithmetical Reasoning.
- To equip the students with the basic concepts Trigonometry, Data Analysis and Mathematical Operations
- To equip the students to gain knowledge of Permutation, Combination, Probability, Ratio & Proportion, Percentage, Average and Age Problems.

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Course Outcomes:

- Students will be able to apply shortcut methods to solve the problems on numerical aptitude.
- Students will be to get self-training on solving problems in Elementary Algebra, Numbers, Data Analysis and Reasoning.
- Students will be able to solve problems on ratio & proportion, average and age problems.
- Students will get knowledge on solving problems on profit& loss, square& square root, cube& cube root, series and Sequences.
- Students will be able to solve problems on permutations, combinations and probability.
- Students will get to know the short cut methods to solve the arithmetical reasoning problems.

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UNIT I: Arithmetic

Ratio & Proportion, Percentage, Average, Profit & Loss, Time & Distance, Time &Work, Simple & Compound Interests, Elementary Mensuration, Allegation, Age Problems.

UNIT II: Algebra

Elementary Algebra, Partnership, Permutation & Combination, Series, Sequences, Fractions.

UNIT III: Number System

Problems on HCF, LCM, Square & Square Root, Cube & Cube Root, Mathematical Operations, Divisibility.

UNIT IV: Numerical Problems

Work & Wages, Pipes & Cistern, Train Problems, Boats & Streams, Clocks & Calendar, Height & Distance, Basic Trigonometry, Probability, Simple & Compound Interests

UNIT V: Data Interpolation

Data Analysis, Arithmetical Reasoning**.**

References:

1. Praveen R.V, "Quantity Aptitude and Reasoning", PHI, 2012.
2. Aggarwal R.S., "Quantitative Aptitude", 1st Edition, S. Chand & Company Ltd., (New), 2010.
3. Edgar Thorpe, "Course in Mental Ability and Quantitative Aptitude: For Competitive Examinations", 2nd Edition, Tata Mcgraw-Hill Publishing Company Limited, 2000.

4. Arun Sharma, "How To Prepare For Quantitative Aptitude For The CAT", 1st Edition, Tata Mcgraw-Hill Publishing Company Limited, 2003.
5. Mittal P.K, "Numerical Ability And Quantitative Aptitude: For Competitive Examinations", Galgotia Publishers Pvt.Ltd, 2004.

17MA3036 PROBABILITY AND DISTRIBUTIONS

Credits: 3:1:0

Course Objectives:

- To acquire knowledge about Multivariate, limiting and some special probability distributions.
- To understand the concepts of multivariate, limiting and special probability distributions.
- To apply the concepts of probability distributions in solving problems.
- To analyse the functions of random variables.
- To construct and to define limiting probability distributions
- To evaluate the problems of probability distributions.

Course Outcomes:

Student will be able to

- Define multivariate, limiting and special probability distributions.
- Get the knowledge of multivariate and special probability distributions.
- Demonstrate the steps involved in applying probability distributions.
- Understand the relationship between the statistics and probability distributions.
- Apply the probability distributions in decision-making.
- Construct real time problems using special probability distribution and limiting distributions.

Unit I: Probability

Probability Set Function, Conditional Probability, Discrete and Continuous Random Variables, Expectation of a Random Variable, Chebyshev's Inequality.

Unit II: Multivariate Distributions

Distributions of Two Random Variables, Conditional Distributions, Correlation and Regression, Independent Random Variables.

Unit III: Some Special Distributions

Binomial, Poisson, Normal, Gamma, and Chi-Square Distributions**.**

Unit IV: Functions of Random Variable

SamplingTheory, Transformations of Variables of the Discrete and Continuous type, Beta,t and F Distributions, Moment-Generating-Function Technique, The Distributions of $\overline{X}$ and nS^2/σ^2

Unit V: Limiting Distributions

Convergence in Probability, Limiting Moment Generating function, The Central Limit Theorem, Some Theorems on Limiting Distributions.

Reference Books

1. Robert V.Hogg and Allen T.Craig, "Introduction to Mathematical Statistics", PearsonEducation, Asia,5thEdition,2005.
2. John A.Rice, "Mathematical Statistics and Data Analysis", Thomson Brooks/Cole, Third Edition,2007.
3. RamachandranK.M, Chris P.Tsokos, "Mathematical Statistics with Applications",Academic Press,2009.
4. Ajay Goal,Alka Goal, "Mathematics and Statistics",Taxmann Allied Services Pvt. Ltd,2006.
5. Richard. J. Larsen, Monis L. Marx, "Introduction to Mathematical Statistics & its Applications", 5th Edition, Pearson Education, 2011.

17MA3037 STOCHASTIC PROCESSES

Pre-requisite: 17MA3036 Probability and Distributions
Credits: 3:1:0

Course Objectives:

- Learn stochastic process and its large variety from introduction to an intermediate level of application knowledge.
- Learn Markov process in depth.
- Understand the concepts and applications of time series and power spectrum in the field of signal processing.
- Learn the stochastic processes in queues and understand different queue models.
- Learn reliability theory and its application in industry.
- Understand stochastic processes on depth and find avenues for further research.

Course Outcomes:

- Apply the concepts of stationarity and statistical averages in real time.
- Apply Markovian model stochastic processes and obtain solutions especially in the field of engineering
- Use power spectral density in signal processing and research
- Derive new queue models to provide better solutions.
- Find solutions for the untoward happening using the knowledge on reliability theory.
- Indulge in strong research to get solutions in all walks of life since everything is probabilistic.

Unit I: Introduction

Specification of Stochastic Processes, Stationery Processes, Martingales.

Unit II: Markov Chains

Definition and Examples, Bernoulli Trials, Classification of States and Chains, Non-homogeneous Chains.

Unit III: Markov Processes

Poison Process, Birth and Death process, Randomization, Erlang Process, Brownian Motion, Wiener process. Renewal Process, Renewal Theorems, Markov Renewal Equation.

Unit IV: Time Series
Introduction, Models of Time Series, Power Spectrum, Statistical Analysis of Time Series.

Unit V: Stochastic Processes in Queuing & Reliability
Queuing Models**,** Birth and Death processes in Queuing Theory, Markovian Queuing Models, Non-Markovian Queuing Models, Reliability.

Reference Books

1. Samuel Karlin, Howard M.Taylor, " A First Course in Stochastic Processes", Second Edition, Academic Press, 2011.
2. P.W.Jones, P.Smith, "Stochastic Processes An Introduction", Arnold and copublished by Oxford University Press Inc. Newyork, 2009.
3. Erhan Cinlar, "Introduction to Stochastic Processes", Dover Publications, 2013.
4. Roy D.Yates, David J.Goodman, Probability and Stochastic Processes, Second Edition, Wiley India Pvt. Ltd., 2011.
5. J.Medhi, "Stochastic Processes", New Age Science, 3rd Revised edition, 2009**.**
6. Sheldon M. Ross, Introduction to Probability models, 10th Edition, Academic Press, 2009.

17MA3038 FORMAL LANGUAGES AND AUTOMATA THEORY

Credits: 3:1:0

Course Objectives:

- Provides students with an understanding of basic concepts in the theory of computation.
- Understand basic properties of deterministic and nondeterministic finite automata.
- Imparts the relation between types of languages and types of finite automata
- Understanding Context free languages, grammars, and Normalising CFG.
- Develops the knowledge of Pushdown automata and its application.
- Have the knowledge of basic properties of Turing machines and computing with Turing machines.

Course Outcomes:
Students will be able to

- Apply the knowledge of machines and languages in relation to Computer Science.
- Apply their mathematical knowledge in computer applications and have the ability to solve computational problems.
- Design finite automata with outputs and prove their equivalence.
- Analyze the importance of regular sets and expressions.
- Define and recognize a PDA for a given CFL.
- Define and design a Turing machine for a given computation.

Unit I: Theory of Computation
Basic concepts – Functions – Relations - Graphs and Trees, Languages – Grammars - Automata.

Unit II: Finite Automata
Deterministic Accepters and Transition Graph - Languages and DFA- Non - deterministic accepters - Equivalence of NDFA and DFA.

Unit III: Regular Languages
Regular Expressions -Regular Grammars - Pumping Lemma - Context-free Languages - Context-free Grammars - Chomsky Normal Form - Greibach Normal Form.

Unit IV: Push down Automata
PDA for CFL - CFG for PDA - Pumping Lemma for CFL's – Closure properties for CFL's - Decision Algorithms for CFLs.

Unit V: Turing Machines
TM as language accepters – TM as transducers – recursively enumerable languages – Context sensitive grammars and languages – relation between recursive and CSL.

Reference Books:

1. Peter Linz, "Introduction to Formal Languages and Automata", Fourth edition, Narosa Publishing House, 2010.
2. Kamala K, Rama R, "Introduction to Formal Languages, Automata Theory and Computation", Pearsorn Education India, 2009.
3. John E. Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1987.
4. John.C.Martin, "Introduction to the Languages and the Theory of Computation", Third Edition, Tata McGrawHill, 2003.
5. Sipser M; "Introduction to the Theory of Computation", Singapore: Brooks/Cole, Thomson Learning, 1997.

17MA3039 FUZZY SET THEORY AND ITS APPLICATIONS

Credits: 3:1:0

Course Objectives:
- To acquire the knowledge about fuzzy sets, fuzzy numbers and fuzzy systems.
- To understand the concepts of fuzzy sets, fuzzy numbers and fuzzy systems.
- To apply the concepts of fuzzy sets, fuzzy numbers and fuzzy systems in fuzzy decision making.
- To analyse the fuzzy sets, fuzzy system and fuzzy decision-making.
- To synthesis the ideas of fuzzy sets and fuzzy systems in reconstructing fuzzy decision making.
- To evaluate the fuzzy decision making, fuzzy neural networks problems by fuzzy sets and fuzzy systems.

Course Outcomes:
Student will be able to

- Understand the basic concepts of fuzzy sets, fuzzy numbers and fuzzy systems.
- Recognize the basic concepts of fuzzy sets, fuzzy numbers and fuzzy systems.
- Use the concepts of fuzzy sets, fuzzy numbers, fuzzy systems in fuzzy decision making.
- Employ the concepts of fuzzy sets and fuzzy numbers in defining fuzzy systems.
- Compare different type of fuzzy decision-making and choose appropriate decision-making system.
- Understand and be able to justify the best fuzzy decision making techniques.

UNIT I: FUZZY SETS

Introduction, Crisp Sets, Fuzzy sets: Basic types, characteristics and significance of the paradigm shift - Alpha Cuts, Properties, Representation of Alpha Cuts and Extension Principle for Fuzzy Sets.

UNIT II: OPERATION ON FUZZY SETS

Types of Operations - Fuzzy Complements: Arbitrary complement function - Fuzzy Intersections: t-norms Fuzzy Unions: t-co-norms - combinations of operations and aggregation operations.

UNIT III: FUZZY ARITHMETIC

Fuzzy Numbers - Linguistic Variables - Arithmetic Operations - Interval Analysis - Arithmetic Operations on Fuzzy Numbers - Operations MIN and MAX - Lattice of Fuzzy Numbers - Fuzzy Equations.

UNIT IV: FUZZY SYSTEMS

General Discussion - Fuzzy Controllers: overview and example - Fuzzy Systems and Neural Networks -Fuzzy Neural Networks - Fuzzy Automata - Fuzzy Dynamical Systems: Example and illustrations.

UNIT V: FUZZY DECISION MAKING

General Discussion, Individual Decision Making, Multi person Decision Making, Multi criteria Decision Making, Multi stage Decision Making, Fuzzy ranking methods and fuzzy linear programming.

Reference Books:

1. George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic Theory and Applications", PHI, New Delhi, 2005.
2. Zimmermann H.J., "Fuzzy Set Theory and its Applications", Kluwer Academic Publishers,2006.
3. WitoldPedrycz and Fernando Gomide, "An Introduction to Fuzzy Sets-Analysis and Design", Prentice-Hall of India Pvt. Ltd, 2005.
4. Hung T.Nguyen, ElbertA.Walker, "A First Course in Fuzzy Logic", Third Edition, Chapman&Hall/CRC, 2009.
5. John Yen Reza Langari, "Fuzzy Logic, Intelligence, Controle and Information", Pearson Education, 2005.
6. M.Ganesh, "Introduction to Fuzzy Sets and Fuzzy Logic", PHI, 2006.

17MA3040 RESEARCH METHODOLOGY

Credits: 3:1:0

Objectives

- To know the basis of research.
- To understand the research problems.
- To know the research methods, techniques and tools.
- To learn different data analysis techniques.
- To learn the process of interpret the data.
- To write and present research reports.

Outcomes

- To recognize the nature and importance of research.
- To learn the basis of research problem and understand the importance of literature review.
- To define research objectives and hypotheses setting.
- To recognize the research methods, techniques and tools.
- To analyse and test the data using statistical techniques and interpret the data.
- To report and present research findings.

Course Description

Unit I: Research

Meaning and philosophy of research, Nature and objectives of research, Importance of research, Paradigm of research, Characteristics of a good researcher.

Unit II: Research problems

Types – basic and applied-formulation of research problem, Literature survey, Critical analysis of literature and review the research problem, Objectives, Hypothesis, types of hypothesis.

Unit III: Research Methodology

Methods of research, designs of research: Experimental design- Research techniques, Sample design: Population, Types of sampling – Data collection: Types, validity, reliability of research tools, data collection methods.

Unit IV: Measurement and scaling techniques

Analysis and Interpretation of data, Statistics for research: measures of central tendency, dispersion, skewness, correlation and regression analysis, source of error in measurement, testing of hypothesis.

Unit V: Research Reports

Manuscript / thesis writing: steps, documentation, tables, diagrams – report presentation, Bibliography and References, Research ethics: Plagiarism, Originality in reporting research findings.

References:

1. Kothari C.R, 'Research Methodology, Methods and Techniques' 2nd edition, New Age International (P) Ltd, publishers, New Delhi (2004)
2. Ranjit Kumar, 'Research Methodology', Sage Publications, London, New Delhi (2006)
3. Panner Selvam R, 'Research Methodology', Prentice Hall of India, New Delhi, 2004
4. Abdhul Rahim F, Thesis writing: Manual for all Researchers, New Age International (2007)
5. Geoffrey R. Marczyk, 'Essentials of Research Design and Methodology', Wiley, (2005)

17MA3041 MATHEMATICAL THEORY OF ELASTICITY
(For Ph.D Course work)

Credits: 3:1:0

Course Objectives:

To teach the students about basic concepts in

- Stress,strain and Hook's law,
- Bending and Torsion,
- Thermal stresses,
- Composite tubes
- Long circular cylinder
- Composite material.

Course Outcomes:

Students will be able to derive the mathematical formulation of

- Bending and torsion of bar
- Stress – strain relations
- Circular and elliptical bars
- Axis symmetric problems,
- Thin circular disk.
- Composite material.

Unit I: Stress and Strain

The state of stress at a point-normal and shear stress-the plane stress-Differential equations of equilibrium. Deformations-rectangular strain-Interpretation of $\gamma_{xy},\gamma_{yz},\gamma_{xz}$,Stress–strain relations for linearly elastic solids- Generalized statement of Hooke's Law- Stress–strain relations for isotropic materials.

Unit II: Bending and Torsion Straight beams and asymmetrical bending-Bending of curved beams(Winkler-Bach Formula)-Torsion of general prismatic bars-Solid sections-Circular and elliptical bars-Rectangular bars-Thin-walled tubes.

Unit III: Axisymmetric problems

Stresses in composite tubes-shrink fits-Stresses due to gravitation- Rotating disks of uniform and variable thickness-Rotating shafts and cylinders.

Unit IV: Thermal stresses
Thermo elastic stress- Strain relations- Equations of equilibrium- Strain-displacement relations-Some general results-Thin circular disk: Temperature symmetrical about centre-Long circular cylinder.

Unit V: Introduction to composite materials
Stress-Strain Relations-Basic cases of elastic symmetry-Laminates-Ply stress and ply strain-Micro mechanics of composites-Pressure vessels-Transverse Stresses.

Reference Books:

1. L.S.Srinath,Advanced mechanics of solids, McGraw Hill Education India Pvt Ltd-18th Edition,2014.
2. Arthur P. Boresi, Ken P. Chong, James D. Lee, Elasticity in Engineering Mechanics, third edition, John Wiley &Sons, Inc., 2011.
3. Irving H.Shames and James, M.Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
4. H Sadd, Elasticity, Theory, Applications & Numerical:Martin Elsevier, 2005.
5. Wang, C.T, Applied Elasticity, McGraw–Hill Co., New York, 1993.
6. Timoshenko, S.P., and Goodier, J.N., Theory of Elasticity, McGraw-Hill, 1970.
7. P. D. S. Verma, Theory of Elasticity, Vikas Publishing House Pvt. Ltd., New Delhi, 1997.

17MA3042 SEMIGROUPS OF LINEAR OPERATORS AND APPLICATIONS
(For Ph.D Course work)

Credits: 3:1:0

Course Objectives:

- To learn the fundamental concepts of semigroups
- To provide the students about the knowledge in abstract Cauchy problem.
- To enable the students to analyze the spectral characteristics of compact operators
- To equip the students with the knowledge of initial value problem
- To provide the student with the concept and the understanding of perturbations and approximations
- To develop the idea of nonlinear evolution equations.

Course Outcomes:
Students will attain knowledge in

- Applications of semigroup Theory to partial differential equations
- Perturbations and approximations
- Applications of semigroup theory to regard a time-dependent PDE as an ODE on a function space.
- Nonlinear evolution equations
- Initial value problems

- Analytic semigroups.

Unit I: Bounded linear operators
Uniformly continuous semigroups of bounded linear operators, Strongly continuous semigroups of bounded linear operators, The Hille-Yosida theorem, The Lumer Philips theorem.

Unit II: Semigroups of compact operators
Semigroups of compact operators, Differentiability, Analytic semigroups, Fractional powers of closed operators.

Unit III: Perturbations and approximations
Perturbations by bounded linear operators, Perturbations of infinitesimal generators of analytic semigroups, perturbations of infinitesimal generators of contraction semigroups.

Unit IV: Abstract Cauchy problem
The homogeneous initial value problem, The inhomogeneous initial value problem, Regularity of mild solutions for analytical semigroups.

Unit V: Nonlinear evolution equations
Lipschitz perturbation of linear evolution equations, Semi linear equations with compact semigroups, Semi linear equations with analytic semigroups.

Reference Books:

1. Reinhard Racke, Lectures on Nonlinear evolution equations: Initial value problems, Springer International publishing, Switzerland, 2015.
2. Hector O. Fattorini, Adalbert Kerber, The Cauchy Problem, Cambridge University Press, 2010.
3. K. Balachandran and J.P. Dauer, Elements of Control Theory, Narosa Publishing, New Delhi, 2012.
4. Klaus-Jochen Engel, Rainer Nagal, One-parameter semigroups for linear evolution equations, Springer-Verlag, New York, 2000.
5. R.F. Curtain and H. Zwart, Introduction to infinite Dimensional Linear Systems Theory, Springer-Verlag, New York, 1995.
6. J.A. Goldstein, Semigroups of Linear Operators and Applications, Oxford University Press, New York, 1985.
7. A. Pazy, Semigroups of Linear Operators and Applications to Partial Differential Equations, Springer-Verlag, New York, 1983.

17MA3043 COMPUTATIONAL METHODS AND APPLICATIONS

Credits 3:0:0

Course Objectives:

- To acquire knowledge of probability distributions.
- To understand the concepts of regression and correlation.
- To apply partial differential equations in problems water management.

- To learn different soft computing techniques.
- To lean different data reduction techniques.
- To apply data reduction techniques in water management.

Course Outcomes:

- To recognize the concepts of probability distributions.
- To model the water management problems using probability distributions.
- To apply regression and correlation in solving water management problems.
- To model and solve water management and water transportation problems using partial derivatives.
- To recognize different soft computing techniques.
- To use data reduction techniques in water management problems.

Course Descriptions:

Unit I: Probability distributions
Discrete and continuous probability distributions, parameter estimation, hypothesis testing, goodness of fit tests, Chi-square test and KS test.

Unit II: Regression and correlation
Simple linear and multiple linear regression, curve fitting, evaluation of regression, confidence limits, histogram; scatter diagram.

Unit III: Partial differential equations
Classification, nature of problems, concepts of finite difference method, finite difference schemes: solution of parabolic equations, pollutant transport, solution of elliptical equations, solution of Laplace equation and Poisson equation, flow through porous media, concepts of finite volume method.

Unit IV: Soft computing techniques
Basics of artificial neural networks, fuzzy logic and their application in environmental and water resources management.

Unit V: Data reduction technique
Factor analysis; application examples in environmental and water resources engineering.

References:

1. Rastogi, A.K., "Numerical Groundwater Hydrology", Penram International Publishing (India), 2006
2. Rao,S.S., "Applied Numerical Methods for Engineers and Scientists", Prentice-Hall, 2002.
3. Hoffman, J.D., , **"**Numerical Methods for Engineers and Scientists**",** CRC Press, Special Indian Edition , 2011.
4. Kotteguda, N.T. and Renzo Resso, "Statistics, Probability and Reliability for Civil and

Environmental Engineers", McGraw Hill Companies Inc., New York, (1998).
5. Schilling, R.J., and S.L. Harris, "Applied Numerical Methods for Engineering", CENGAGE Learning, India Edition, (2007).

17MA3044 APPLIED OPERATIONS RESEARCH

Credits: 3:1:0

Course Objectives:

- To acquire knowledge of linear programming problems.
- To solve LPP using different methods and applying in management decisions.
- To formulate and solve transportation problems
- To solve assignment problems
- To learn different techniques of sequencing and replacement.
- To learn queuing and network models.

Course Outcomes:

- To develop linear programming problems
- To find solutions of LPP and apply in management decisions.
- To recognize solutions of transportation problems.
- To apply Hungarian method in solving assignment problems.
- To apply sequencing and replacement models in management problems.
- To solve queuing and network problems using CPM and PERT techniques.

Course Descriptions:

Unit I: Linear Programming
Mathematical formulation of a LPP, Graphical Method, Simplex method - Two Phases Simplex Method, Artificial Variable Technique, Method Application to management decisions.

Unit II: Transportation Problem
Initial basic feasible solution, NWC method, Least Cost Method, Vogel's Method, MODI, moving towards optimality without degeneracy, Degeneracy problems.

Unit III: Assignment problem
Introduction, Hungarian Method & problems, unbalanced assignment problems, travel sales person problems.

Unit IV: Sequencing and Replacement Model
Sequencing problem, processing of n jobs through 2 machines, 3 machines, - Replacement of items that deteriorate gradually with time, without time that fails completely – Individual & group replacement.

Unit V: Queuing Theory

Introduction, (M | M | 1): (∞ | FIFO). Decision Theory**:** Frame work, pay off tables – decision criteria, Decision trees, Network Models, Network models for project analysis CPM, network construction and time analysis, cost time trade off, PERT, problems - crashing network, problems

References:

1. Paneer Selvam, "Operations Research", PHI learning Indian (P) ltd, 2nd Edition, 2011.
2. S.D.Sharma, "An Introduction – Fundamentals of Operations Research".
3. Kanti Swarup, Gupta and Manmohan, "Operations Research", Sultan Chand and Sons, 15th Edition, 2010.
4. J K Sharma, "Operations Research Theory & Applications", Macmillan, 4th Edition, 2009.
5. Hamdy A Taha, "Operations Research", Pearson, 8th Edition, 2008.