Syllabus of Mathematics Courses

in

B. E. Programme

Title of the course : **ENGINEERING MATHEMATICS**
Subject Code : **AMT – 411/AMT-421**
Weekly load : 4 Hrs. LTP 3-1-0
Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Differential Calculus	Tracing of Standard Cartesian. Parametric and Polar Curves; Curvature of Cartesian, Parametric and Polar curves.	9
	2. Integral Calculus	Rectification of Standard curves; Areas bounded by standard curves; Volumes and surfaces of revolution of curves; Applications of integral calculus to find centre of gravity and moment of inertia	9
	3. Differential equation	Exact differential equations, Equations reducible to exact form by integrating factors; Solution of linear differential equation of first order- Leibnitz's linear and Bernoulli's equation. Higher order linear differential equation with constant coefficients, complementary function and particular integral. Method of variation of parameters. Cauchy's and Legendre's equations.	12
Unit-2	4.Matrices	Elementary transformations. Row reduced Echelon forms. Rank of a matrix. Normal form. Linearly dependent and independent vectors. System of linear equations. Linear transformations. Eigenvalues and eigenvectors. Properties of eigenvalues. Verification of Cayley-Hamilton Theorem and its use for finding inverse of a matrix.	10
	5. Infinite series	Convergence and divergence of positive term series, tests of convergence (without proofs), Comparison test, integral test, Ratio test, Cauchy's root test. Absolute and conditional convergence of alternating series- Leibnitz's test, Weirestrass M- test for series with general terms.	8
	6. Functions of complex variables	Limit of a complex function. Differentiation. Analyticity. Cauchy-Riemann equations. Harmonic functions. Conformal mapping. Some special transformations- translation, inversion and rotation.	12

Total = 60

Course Outcomes(COs):

Upon completion of this course, the student will be able to:

CO1: Form a differential equation and solve various types of differential equations.

CO2: Understand the concept of convergence of infinite series and discuss the convergence/divergence of a series using different tests.

CO3: Find eigenvalues and eigenvectors of a matrix.
CO4: Understand the concept of linearly independent and dependant vectors.
CO5: Understand the concepts of complex function theory.

CO/PO Mapping (S/M/W indicates strength of correlation) S – Strong, M – Medium, W – Weak												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S											
CO3	S											
CO4	S											
CO5	S											

Recommended Books:

1. Danial A Murray, Elementary Course in Differential Equations, Longman (1902).
2. E. Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited (2010).
3. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill (2006).
4. Peter V.O'Neil, Advanced Engineering Mathematics, CENGAGE Learning (2011) .
5. Gorakh Prasad, Differential Calculus, Pothishala (1968).
6. Gorakh Prasad, Integral Calculus, Pothishala (1961).

Title of the course : **HIGHER ENGINEERING MATHEMATICS**
Subject Code : **AMT – 511/AMT-521**
Weekly load : 4 Hrs. LTP 4-0-0
Credit : 4 (Lecture 4; Tutorial 0; Practical 0)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Laplace Transforms	Laplace transforms of elementary functions. Properties of Laplace transform. Transform of derivatives and integrals. Evaluation of integrals by Laplace transforms. Inverse Laplace transforms. Convolution theorem. Solution of ordinary differential equations. Unit step function and unit impulse function. Engineering applications.	10
	2. Fourier Series	Fourier series. Change of interval. Even and odd functions. Half-range series. Applications to typical waveforms including saw-tooth, triangular, sine-wave etc. Parseval's theorem on Fourier constants.	8
	3. Partial Derivatives	Functions of two or more variables. Partial derivatives. Homogenous functions. Euler's Theorem. Total derivative. Derivative of an implicit function. Tangent and normal to a surface. Change of variables. Jacobian. Taylor's and Maclaurin's series expansions for a function of two variables, maxima and minima. Lagrange's method of undetermined multipliers. Differentiation under integral sign.	12
Unit-2	4. Multiple Integrals	Double integral. Change of order of integration. Triple integral. Change of variables. Applications to area and volume. Beta function. Gamma function. Their properties.	10
	5. Vector Differentiation	Scalar and vector fields, differentiation of vectors, velocity and acceleration, vector differential operators: Del, Gradient, Divergence and Curl, their physical interpretations. Formulae involving Del applied to point function and their products, Directional derivative.	10
	6. Vector Integration	Line, surface and volume integrals. Theorems of Green (in plane), Gauss and Stoke (without proof) - their verification and applications.	10

Total=60

Course Outcomes(COs):

Upon completion of this course, the student will be able to:
CO1: Understand the concept of Laplace transform and apply it to solve differential equations.
CO2: Study scalar and vector fields and obtain directional derivative.
CO3: Find the area and volume using multiple integral.

CO4: Learn to obtain Fourier series expansion of a function.

CO/PO Mapping (S/M/W indicates strength of correlation) S – Strong, M – Medium, W – Weak												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S											
CO3	S											
CO4	S											

Recommended Books:

1. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007).
2. G.B. Thomas and R.L. Finney, Calculus: Analytical Geometry, Addison Wesley (2006).
3. E. Kreyszig, Advanced Engineering Mathematics, Wiley Eastern (2010).
4. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill (2006).
5. Peter V.O’Neil, Advanced Engineering Mathematics, CENGAGE Learning (2011).

Title of the course : **NUMERICAL ANALYSIS**
Subject Code : **AMT – 611/AMT -621**
Weekly load : 4 Hrs. LTP 3-1-0
Credit : 4 (Lecture 3; Tutorial 1; Practical 0)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Errors	Errors in arithmetic operations and functions. Round-off error, truncation error. Absolute error. Relative error. Percentage error. Principles of equal effect. Significant digits.	6
	2. Roots of equations	Intermediate value property. Bisection method. Method of false position. Secant Method. Newton-Raphson method. Iteration method. Convergence of these methods.	8
	3. Solution of linear equations And eigen value problems	Gauss Elimination method (with and without partial pivoting). Jacobi, Gauss-Seidel methods. Triangularization method. Rayleigh's power method for finding dominant eigenvalue.	8
Unit-2	6. Finite differences and Interpolation	Finite differences-forward, backward and central differences. Shift and averaging operators. Newton's forward, backward and divided difference interpolation formulae. Lagrange's formula. Gauss forward and backward difference interpolation formulae, cubic Spline interpolation.	8
	7. Numerical differentiation and integration	Numerical differentiation using Newton's forward and backward difference formulae. Numerical integration – Trapezoidal rule, Simpson's one third and three-eighth rules. Romberg's integration. Error in integration.	7
	8. Numerical solution of ODEs	Taylor series method. Picard's method. Euler method. Modified Euler's method. Runge-Kutta methods (up to fourth order) for solution of ODE of first order.	8

Total = 45

Course Outcomes(COs):

Upon completion of this course, the student will be able to:
CO1: Understand the concept of errors in numerical methods.
CO2: Find the roots of equations using different methods and discuss the convergence of the solution.
CO3: Understand the concept of different operators and their applications in solving numerical differentiation and integration.
CO4: Solve numerically ordinary differential equations of first order.

CO/PO Mapping (S/M/W indicates strength of correlation) S – Strong, M – Medium, W – Weak												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S											
CO3	S											
CO4	S											

Recommended Books:

1. S.S. Sastry, Introductory Method of Numerical Analysis, PHI (2005).
2. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Addison-Wesley (2004).
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations, New Age International (2007).
4. J.H. Mathew, Numerical Methods for Mathematics, Science and Engineering, PHI (1966).

Title of the course : **NUMERICAL ANALYSIS LAB**
Subject Code : **AMP – 611/AMP -621**
Weekly load : 2 Hrs. LTP 0-0-2
Credit : 1 (Lecture 0; Tutorial 0; Practical 1)

List of Programmes

1. Finding roots of the equation $f(x) = 0$ using
   i) Bisection Method ii) Secant Method iii) Method of false position

2. Finding roots of the equation $f(x) = 0$ using
   i) Iterative Method ii) Newton - Raphson's Method

3. To check consistency and finding Solution of a system of linear algebraic equations using
   i) Gauss elimination Method ii) Gauss - Seidal Method iii) Jacobi Method

4. Solution of a system of linear equations by triangularization method.

5. Finding dominating Eigen value and Eigen vector using Rayleigh's power Method.

6. Interpolation using
   i) Newton's forward difference formula ii) Newton's backward difference formula

7. Interpolation using
   i) Newton's divided difference formula ii) Lagrange's interpolation formula

8. Interpolation using
   i) Gauss's forward formula ii) Gauss's backward difference formula

9. Interpolation using Splines
   i) Linear ii) Quadratic iii) Cubic

10. Numerical differentiation using
   i) Newton's forward interpolation formula ii) Newton's backward interpolation formula

11. Numerical Integration using
   i) Trapezoidal rule ii) Simpson's 1/3rd rule
   iii) Simpson's 3/8th rule iv) Romberg's rule

12. Solution of Ist order ordinary differential equations using
   i) Taylor's series method ii) Picard's method
   iii) Euler's method iv) Euler's modified method

13. Solution of Ist order ordinary differential equations using
   i) Runge-Kutta method of IIIrd order ii) Runge-Kutta method of IVth order

Course Outcome: After the completion of this course, the student will be able to write a program in C/C++ and :

CO1: Solve nonlinear equations and system of linear equations.

CO2: Find largest eigen value of a square matrix.
CO3: Use various interpolation formulae.
CO4: Find numerical differentiation and integration.
CO5: Solve numerically by using various techniques.

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	0	0	0	0	0	1	0	2
CO2	3	3	2	1	0	0	0	0	0	1	0	2
CO3	3	3	2	1	0	0	0	0	0	1	0	2
CO4	3	3	2	1	0	0	0	0	0	1	0	2
CO5	3	3	2	1	0	0	0	0	0	1	0	2

Title of the course : **ADVANCED MATHEMATICS**
Subject Code : **AMO –** 621
Weekly load : 3 Hrs. LTP 3-0-0
Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Complex Integration	Review of analytic function and its properties, Line integral, Cauchy's theorem (proof using Green's Theorem) Cauchy's integral formula. Morera's theorem, Cauchy's inequality, Poisson's integral formulae.	8
	2. Theory of Residues	Power series. Taylor's and Laurent's series, Singularities. Zeros. Residues. Cauchy's residue theorem.	6
	3.Application to Real Integrals	Integration around unit circle. Integration over semi-circular contours (with and without real poles). Integration over rectangular contours.	8
Unit-2	4. Fourier Transforms	Integral transforms. Fourier integral theorem. Fourier sine and cosine integrals. Fourier transforms. Properties of Fourier transforms. Convolution theorem for Fourier transforms.	8
	5. Z-Transforms	Z transforms and its properties. Z transform of polynomial functions, trigonometric functions and hyperbolic functions. Convolution theorem. Inverse Z-transform.	7
	6.Applications	Applications of Fourier transforms in solving partial differential equations (Laplace, Heat and Wave equations). Formation of difference equations and solution of first and second order difference equations with constant coefficients using Z-transform.	8

Total=45

Course Outcomes(COs):

Upon completion of this course, the student will be able to:

CO1: Evaluate complex contour integrals and apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.
CO2: Expand complex function in Laurent series.
CO3: Apply the residue theory for the evaluation of real integrals.
CO4: Learn Fourier transforms and their application to solution of partial differential equations.
CO5: Have a thorough knowledge of Z-transform.

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	0	0	0	0	0	1	0	2
CO2	3	3	2	1	0	0	0	0	0	1	0	2
CO3	3	3	2	1	0	0	0	0	0	1	0	2
CO4	3	3	2	1	0	0	0	0	0	1	0	2
CO5	3	3	2	1	0	0	0	0	0	1	0	2

Recommended Books:

1. R.K. Jain and S.R.K. lyengar, Advanced Engg. Mathematics, Narosa Publishing House (2007).
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill (2006).
3. R.V. Churchill and I.W. Brown, Complex Variables and applications, Tata McGraw Hill (2008).
4. Michael D Greenberg, Advanced Engg. Mathematics, Pearson (1998).

Title of the course : **STATISTICAL TECHNIQUES**
Subject Code : **AMO –** 711
Weekly load : 3 Hrs. LTP 3-0-0
Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	**Correlation and Regression**	Karl-Pearson coefficient of correlation and rank correlation. Partial and multiple correlation (three variables case only). Regression Analysis using two variables.	8
	Probability	Axiomatic definition of probability. Baye's theorem, Random variables. Probability mass function and probability density function. Probability distribution function. Mathematical Expectation.	7
	Probability distributions	Probability distributions - Binomial, Poisson and Normal distributions and their applications.	8
Unit-2	**Sampling**	Simple random sampling, stratified sampling, systematic sampling and Probability proportional to size sampling.	8
	Sampling Distribution	Standard errors. Chi-square distribution, Student's t distribution and F distribution.	6
	Testing of Hypothesis	Sampling distributions. Small and large sample tests (Z test, t test and F test). Chi-square test for independence and goodness of fit	8

Total=45

Course Outcomes(COs):

Upon completion of this course, the student will be able to:

CO1: Understand concept of correlation and regression.
CO2: Compute the probability of events.
CO3: Understand the random variable, expectation and distributions.
CO4: Understand the concept of sampling and sampling distribution.
CO5: Understand testing of hypothesis based on small and large samples.

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	0	0	0	0	0	1	0	2
CO2	3	3	2	1	0	0	0	0	0	1	0	2
CO3	3	3	2	1	0	0	0	0	0	1	0	2
CO4	3	3	2	1	0	0	0	0	0	1	0	2
CO5	3	3	2	1	0	0	0	0	0	1	0	2

Recommended Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand & Co. (2009).
2. A. M. Goon, M. K. Gupta and B. Dasgupta, An Outline of Statistical Theory, Vol. I , World Press Pvt. Ltd (2013).
3. S.C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Co. (2014).

Note: The students who have the contents of this course in their curriculum, are not allowed to opt for this course.

Title of the course : **OPERATIONS RESEARCH**
Subject Code : **AMO - 721**
Weekly load : 3 Hrs. LTP 3-0-0
Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

Theory

Unit		Course outlines	**Lecture(s)**
Unit-1	**Linear Programming Problem(LPP)**	Basic concepts and notations of LPP. Mathematical formulation of LPP, Graphical solution. Spanning set, basis, replacing a vector in a basis, Basic solution and Basic Feasible Solutions (BFS) of system of linear equations, BFS by using Gauss-Jordan elimination process. Hyperplane, hypersurfaces, convex sets and their properties, convex functions. Extreme points, Standard form of an LPP	8
	Simplex Method	Fundamental theorem. Reduction of Feasible Solution to BFS. Standard format of Simplex method. Two phase method. Big M method. Degeneracy. Nature of the solution of LPP through simplex method	8
	Duality theory in LPP	Primal and Dual problem. Duality theory, Complimentary Slackness Conditions (CSC), Solution of primal and Dual and vice versa. Dual Simplex	7
Unit-2	**Post-optimality analysis**	Post-optimality analysis, changes in cost vector, changes in right hand side vector, introducing an additional variable, introducing an additional inequality constraint or equality constraint. Parametric analysis of objective function and right hand side vector. Sensitivity analysis of objective function and right hand side vector	8
	Transportation Problem	Basic concepts and notations of transportation problem, Balanced and unbalanced transportation problems. Initial BFS of TP using north-west corner rule, Matrix Minima method and Vogel's approximation method. Optimal solutions	7
	Assignment problem	Assignment problem. Balanced and unbalanced Assignment problems. Hungarian method to solve assignment problem. Post optimality analysis of Transportation and Assignment problem	7

Total=45

Course Outcomes (COs):

Upon completion of this course, the student will be able to:

CO1: Formulate some real life problems into LPP.

CO2: Use the simplex method to find an optimal BFS for the standard LPP and the corresponding Dual problem.

CO3: Use duality theory and CSC to prove the optimality of a given feasible solution.

CO4: Formulate an optimal solution of transportation problem.
CO5: Formulate solution of an assignment problem.

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	0	0	0	0	0	1	0	2
CO2	3	3	2	1	0	0	0	0	0	1	0	2
CO3	3	3	2	1	0	0	0	0	0	1	0	2
CO4	3	3	2	1	0	0	0	0	0	1	0	2
CO5	3	3	2	1	0	0	0	0	0	1	0	2

Recommended Books:

1. J. G. Chakravorty and P. R. Ghosh, Linear Programming and game Theory, Moulik Library (1991).
2. S. K. Gupta, Linear Programming & Network Models, Affiliated East-West Private Ltd. (1985).
3. H.A. Taha, Operations Research, PHI (2007).
4. A. Ravindran, D. T. Phillips and J. J. Solberg, Operation Research: Principles & Practice, John Wiley & Sons (1987).
5. S.S. Rao, Operations Research, Wiley (1978).
6. M. S. Bazaarra, J. J. Jarvis and H. D. Shirali, Nonlinear Programming, John Wiley & Sons (1990).
7. H. S. Kasana and K. D. Kumar, Introductory Operations Research, Springer Verlag (2005).

Note: The students, who have the contents of this course in their curriculum, are not allowed to opt for this course.

Title of the course	: **DISRETE MATHEMATICS**		
Subject Code	: **AMO – 722**		
Weekly load	: 3 Hrs.	LTP	3-0-0
Credit	: 3 (Lecture 3; Tutorial 0; Practical 0)		

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Logic	Mathematical Logic: Statement and notations, proposition and logic operations, connectives (conjunction, disjunction, negation), Tautology and contradiction, equivalence of formulae and implication laws of logic.	8
	2. Theory of Inference	Mathematical systems, propositions over a universe, Validity using truth table, rules od inference, consistency of premises and indirect method of proof, principal of mathematical induction, variables, quantifiers, Inference of predicate calculus.	8
	3. Relations and functions	Relation and Function: Binary relations, Properties of binary relation in a set, Equivalence relations, Composition of binary relations. Function and Pigeon hole Principle..	7
Unit-2	4. Recurrence relations	Recurrence relations, common recurrence relations, generating functions and their solutions.	5
	5. Boolean algebra	Boolean algebra, Boolean functions and Boolean expressions, simplifications of Boolean expressions, Basic circuits and theorems, Logical gates and relations of Boolean functions.	6
	6.Graph Theory	Basic terminology of graph theory, Paths, Circuits, Graph connectivity, Eulerian paths, Multigraphs, Weighted graphs. Hamiltonian graphs. Shortest path problem and planar graphs.	11

Total=45

Course Outcomes(COs):

Upon completion of this course, the student will be able to:
CO1: Construct mathematical arguments using logical connectives and quantifiers.
CO2: Validate the correctness of an argument using statement and predicate calculus.
CO3: Understand how lattices and Boolean algebra are used as tools and mathematical models in the study of networks.
CO4: Learn how to work with some of the discrete structures which include sets, relations, functions, graphs and recurrence relations.
CO5: Have a knowledge of Graph theory and its applications in various real life problems.

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	0	0	0	0	0	1	0	2
CO2	3	3	2	1	0	0	0	0	0	1	0	2
CO3	3	3	2	1	0	0	0	0	0	1	0	2
CO4	3	3	2	1	0	0	0	0	0	1	0	2
CO5	3	3	2	1	0	0	0	0	0	1	0	2

Recommended Books:

1. J. P. Trembley and R. Manohar, A First Course in Discrete Structure with applications to Computer Science, Tata McGraw-Hill (1999).
2. M. K. Das, Discrete Mathematical Structures, Narosa Publishing House (2007).
3. Babu Ram, Discrete Mathematics, Vinayak Publications (2004).
4. C. L. Liu, Elements of Discrete Mathematics, Tata McGraw-Hill (1978).